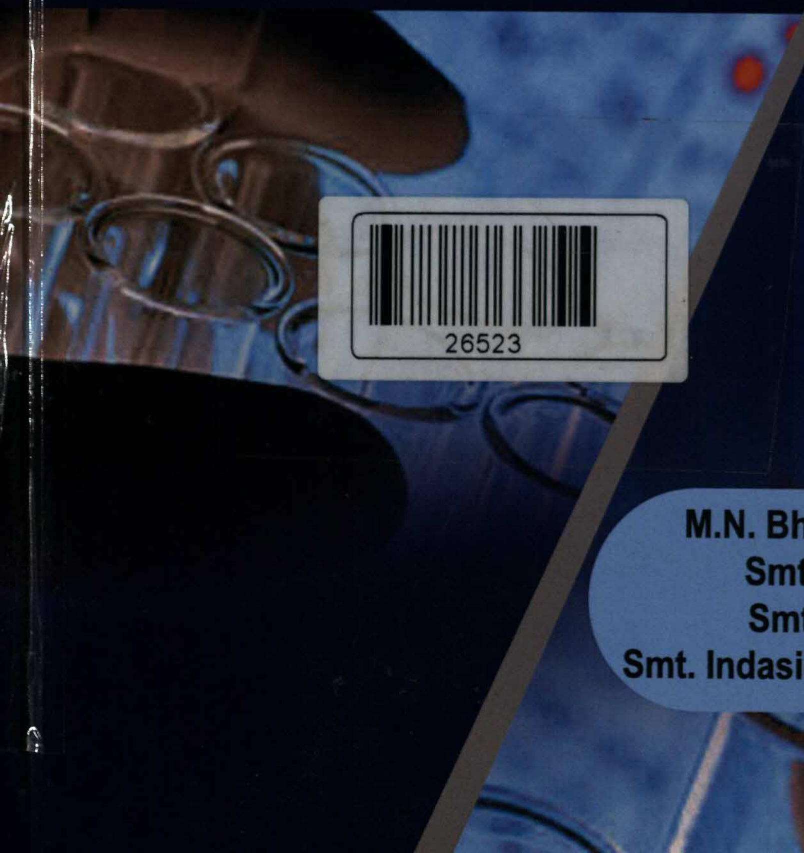
EASTERN

Reasserting Basic Sciences



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Dr. K. D. Ramsiej
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Foreword

It is a great pleasure for me to be associated with this important ISBN publication of the College, entitled **'Reasserting Basic Sciences",** which is the result of tiring efforts of the faculty members of the Science Departments of the College.

This book is mainly the outcome of the proceedings of an International Seminar on "Attracting Best Talents in Basic Sciences", held in the College in 2013 as part of the Golden Jubilee Celebration of Teaching Science in Shillong College. The various articles contained are the contributions of the participants who are academicians, scientists, eminent personalities etc. from across the globe. These articles throw light on various issues with regard to the status of declining trends in taking basic sciences as career by emerging generations of the students, how to overcome this trend and various scopes that studies in basic science can offer to the society.

The initiatives taken by the teachers of the College, particularly by those in different Science Departments of the College, to organise the International Seminar and then compiling the papers to publish the book deserve appreciation as it will certainly contribute to create awareness and arouse more interest in giving appropriate stress to basic science, which is the driving force for developing technology. Inculcating scientific temper and rational attitude is the key to progress of the Society.

I congratulate the faculty of all the Science Departments of the College, particularly the members of the Seminar Committee and the members of the Editorial Board, for their untiring efforts at bringing out this publication. I also thank the Coordinator of IQAC of the College for his keen interest and contribution to the success of the

Seminar and bringing out this volume. I am sure that the contents of the book will serve the purpose, and the efforts of teachers will bear fruit.

Dated, Shillong
17th July, 2015

23/7/15
K. D. Ramsiej

Preface

During the 33rd session of UNESCO's General Conference in 2005, 50 ministers responsible for Science Policy from about 50 countries in their round table discussion on "the Basic Sciences: The Science Lever for Development", underlined the need for Governments around the globe to re-evaluate the priorities to to be given to science education and scientific research, and their impact on overall development policies. The conference agreed that each country should give appropriate stress on the need for education "that inspires students at all levels – pre-primary, primary, secondary and tertiary – as well as in the informal and non-formal environments", to stimulate the creativity of young people and to allow them to appreciate the value of science. It emphasised the need in Member States for capacity building in basic sciences" as the platform for knowledge-based development and to increase efforts to promote the basic sciences and science education. Science leads to technological advances and economic benefits that offer unique opportunities to meet basic human needs, reduce poverty, protect the environment and improve the quality of life

A successful scientist devotes his/her entire life in understanding and explaining key experimental phenomena in their fields of study and hence gets engaged in "basic science". A Physicist tries to explore how matter and forces interact to describe the fundamental laws that govern their interactions. Biologists and medical scientists desire to understand the intricacies of the development of cells to form entire organisms and all other phenomenon exhibited by an organism. The quest to know the basic of human-animal-plant behavior and the forces of nature constitutes our understanding of Nature. This knowledge acquired through analytical approach later enables us to formulate theories and models that provide the driving force behind all technological and medical advances. In other words, "basic science" is really "fundamental science" — it is the science at the heart of human knowledge.

The rational knowledge of basic science would guide one to apply this basic knowledge to real-world problems, such as designing of any electronic gadget or developing new medicine, surgical techniques, treatment for specific diseases or the use of IT based equipments and so on. It is obvious that without an understanding of how something works, it would be rather difficult to fix it when it fails. This applies to every aspect of our lives. It means that we need to keep on trying – it could be a simple 'trial and error' method initially and then graduate to advanced methodology. A detailed knowledge will allow us to understand key matters that would open avenues for solving problems. History has shown that the building blocks of basic science can provide unexpected answers and tools that find important applications in engineering and medicine.

The goals of basic research are to discover new laws and principles, develop original theories, and predict and discover unknown phenomena in an effort to answer questions about the origins of matter, the behavior of the universe, and the phenomenon of life. The results of such research have intrinsic value as shared intellectual assets that contribute to the advancement of human culture. They can also instill hope and pride in a nation's people. Sometimes, new research findings can have a great impact on society by leading to revolutionary changes in technological systems or by creating totally new fields of technology. Moreover, a profound understanding of nature and humanity is a major prerequisite if humanity is to achieve continual progress while maintaining harmony with nature.

In India, we are in a social environment where from the school level, when a child opts for science stream, he/she is destined to struggle for a position in medicine, engineering or information technology; as though these three branches, meant the whole tree of science. Of course, while many have been able to make it into these fields, a majority of science students consider themselves failures. This situation is again a product of neo-liberal economic policies enforced for the last two decades during which consumerism and materialism has become a driving force of life. As such, parents/ guardians/children look for safer and short-cut options for earning a relatively comfortable and decent livelihood, by understating that life-long educational pursuits are beneficial. How can India expect a position in Modern Science when higher education is demoralised, the adverse effects being felt even in the realms of research. It is time for change, changing the mindset of parents and guardians are all the more important as it would percolate to their wards. Efforts should be made to motivate children right from the school level to go deeper into the importance of basic science. Teachers, educators, policy makers, administrators all have equal responsibility to make this happen.

We have to look at the root of the problem, the solution of which starts right from the school level. It is the duty of the teaching faculty and management of schools and colleges to inculcate an awareness and enthusiasm in students about the importance of science and its necessity for the advancement of the nation. From there on, it is a cakewalk to successful ventures of research activities. Schools or colleges can establish contacts with universities in the area to further the cause of research.

Attention of students should be drawn to sciences along with an assurance of a career, so that students opt for the science stream. Apart from this, a change is needed in the policies of the government with regard to sustained grants for universities rather than one-time grants. Most important and essential in this direction is the need for the government to improve funding positions and bring about sustained development of science laboratories with liberal funding.

Schools, colleges, universities and other institutions, having done their part, much remains to be done by the society and the government at large in offering a rewarding career to those having appropriate education in science with suitable earning to lead a decent life. For this to happen, the society must have a scientific outlook, an analytical approach devoid of supernatural beliefs and superstitions with all forms of fundamentalism discarded. Every situation needs to be analysed scientifically and methodologically without prejudice but with facts and an objective analysis. A scientifically inclined society would guarantee a solution to the peoples' agonies and problems, and for this to happen, basic science must get its due importance. This will assure technological advancement that would make life comfortable for one and all.

To raise awareness in this regard, it is therefore important to intensify the conducting of discussions, seminars and other academic exercises. Often it is observed that a large section of society is aware of this situation. Sadly there is power that do not pay heed to this essential component of peoples' requirements, for their own selfish reasons. There is a need therefore, for the enlightened group to become more vociferous and assertive, even to the extent of raising a mass movement. Simple academic discussions may not be sufficient to defeat the self-serving powerful dispensations that are busy in strangling peoples' voices. A consistent and committed effort from the enlightened academia and sustained activism is required to assure equitable distribution of resources, education and development.

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Introduction

Shillong College started with Arts and Commerce Streams in the year 1956 and by 1963, the college took courage to start Science courses. Indeed the college has reached an important milestone in its journey in the year 2013. At this historic juncture, the college management thought it proper to commemorate the Golden Jubilee of the Science Stream by having a detailed programme and organising an International Seminar on '**Attracting Best Talents in Basic Sciences**' on the 24^{th} and 25^{th} July 2013. This Celebration, aims to provide a platform for academicians, educationists, scientists, heads of institutions, teachers, organizations, ending them o pool in ideas and venture into aspects of new scientific knowledge and application, so as to cope up with the changes in the educational system. More than that, at such a time when the trend towards basic science seemed to have faded along the way, not only in the state but elsewhere in the country, and basic science is no more a passion for many, the need of the hour was to revive and to change mindsets and reverse the trend back to the basic science courses.

There is immediate need to address the issues regarding attracting and retaining talents in their career in science. There is a declining rate of students pursuing basic sciences, not only in India, but even in advanced countries. Thus stress must be laid on the basic points to undertake the challenge of overcoming the fear of taking up basic sciences, the need for truthful and accurate information with regards to science studies/research and the need for opportunities to improve knowledge. It may be asserted that the growth in science education got a boost during the post independence period mainly due to the developments of IITs, IISc., etc. Despite the fact that India ranked second in the world in terms of education system, illiteracy rate in the country is still very high. Statistics showed a general trend of decrease in students' enrolment and high dropout rate especially at higher levels of education, which genuinely showed the existence of some problems in our education system. Further, learning basic science now-a-days has failed to attract bright students, they being more inclined to other attractive professional courses. Some of the major problems/concerns that need to be looked into are over centralization, high rate of dropouts, peer and parent pressure, materialistic nature of the society in which we live in, difficulties in job placement and so on. To overcome this we must try encouraging hands-on education while teaching science and increase innovative teaching at the higher levels. General awareness campaigns should be conducted for parents and students to help minimize peer and parent pressure, and that the government needed to do in-depth studies for the cause of the dropouts. The most important point lies in the increase of fund allocation, create job opportunities for students who do not want to go for higher studies and the need to provide training to teachers on how to teach science in a hands-on fashion. Attracting and retaining best talents in basic science has become a major challenge for the nation in general and the state in particular. The Government of India has initiated many schemes to attract and retain young people in basic science. However, only government initiative would not be sufficient. There should be industry participation, public-private partnership and awareness among the general public regarding basic science. The need of the hour is the creation of world class infrastructure, setting up groups of institutions of international standard and to bring back famous Indian scientists working abroad.

Community needs to be involved in this effort and few ways that the community may be involved, besides the usual practices, include:

- Active participation of the community in monitoring water resources both in terms of quantity and quality, which is the first step towards greater awareness of water and environment issues.
- Need for students to realize how basic science is necessary for the day to day management of resources necessary for our lives, irrespective of the area of their specialization.
- Collaborative inquiry and cooperative learning strategies which are important in the teaching of Science in Primary and Secondary Education.

Education is not just for the sake of getting a job, but also for learning and teaching ourselves. It should be multidisciplinary and application oriented. Teachers should make teaching interesting, and that one should invoke structure function relationship as it makes, for example, biology interesting. The decline in the status of Science education is also related to the curriculum adopted and therefore a thoughtful and well-planned curriculum design is a basic necessity which would create an interest among the students. This would also improve the living standards of the people and help deal with economic and environmental challenges. Science and Technology is growing faster than one can ever imagine but its development requires the development of science education facilitated by appropriate curriculum. Science and technology is the pivot of any nation's development; a nation without science and technology is definitely a backward nation. Such a nation will be considered undeveloped. Technology is the primary engine of economic growth and provides the key to unlock any country's potential.

We know very well that today's changing world brings new radical implications. Conventional teaching-learning methodologies need to be upgraded so as to motivate students to think outside the box. Therefore, to upgrade the teaching-learning process, it is pertinent to learn what the new techniques or aids have in offer in order to improve the conventional teaching- learning process. The use of Remote Sensing and GIS as a tool in Science education also needs to be stressed due to the importance, wide applications and job prospects of this technology. Teaching mathematics and developing the art of reasoning is a fundamental prelude to successful science education. The various mathematics soft-wares that can be used for making teaching and learning mathematics more interesting. It is important to highlight the incorporation of technology in the teaching of mathematics in a bid to attract more students to this subject. A joint effort of both students and teachers is also important in order to make a wonderful science class, where lessons could be successfully learnt with pleasure and fun. Innovative and participatory learning needs to be inculcated from the very early stages of education.

Students and young people today swim in a sea of pervasive technology. There is no area of our lives that is untouched by technological changes. As such, teachers need to provide optimum conditions to maximize learning. This therefore led us to the IT-Oriented and Diversified Education to meet job prospects.

It is all too important to also learn that in the pursuit of scientific knowledge and application, certain sets of values are attached and as we all know, values intersect with science in many ways through individual practice or group practitioners, whether consciously or otherwise. These moral values stay side by side in the teaching and practice of science.

Lastly, whether improving teaching-learning process, or enhancing IT Education, diversified Education or even scientific know-how in protecting and conserving human and animal rights in the environment, and in making sense ofknowing science, a pressing need is felt with regards to getting financial aid for enhancing infrastructural facilities, beginning from the Primary and Secondary Science Education to the higher stages.

Whereas science education and attracting careers in Science need a global approach along with local aspirations, one needs to look at what is happening in other countries. As an example, Looking the status of science education in Bangladesh, it is apparent that certain characteristics emerge which contribute positively in this effort, and these are:

- There has been a remarkable development in education in the last 42 years in Bangladesh.
- The country conforms fully to the Education for All (EFA) objectives that began in 1990 in Jomtien and the Millennium Development Goals (MDG).
- The educational system in Bangladesh is three-tiered and highly subsidized.
- Public spending on education in Bangladesh is 12.1 percent (Tk.19,806 crore) of the total budget allocated, which is 2.2 percent of total GDP) in FY 2011-2012.
- The Distance Education and Open Schooling is contributing significantly and this programme promotes gender equality and empowerment of women. The students enrolled are mostly dropouts.

- Designing of Curriculum for Promoting Science Literacy in Bangladesh commensurate with the status of science education at any particular point of time which must include its prospects and challenges in general and finding recommendations in particular.

Dr. (Ms.) D. L. Buam

1

Importance of Science and Technology Education towards National Development

A. Henia

Abstract

Science Education must be as par with the quick growth of scientific approach and technology. Science Education provides good standards for people and leads to cultural development. It is an essential vehicle to provide resource development, modernization and overall development of countries in which science education witt improves the education of future scientists and fosters a greater and more relevant understanding of nature and the findings of science among the population as a whole. Science education gives children an awareness of technology and develops their personal experiences. Practical skills, encouraged in technological activities, help students to acquire resources of knowledge and intellectual and physical skills. Science Education requires financial support, professionals, effecting planning, resources for effective implementation, scientific literacy, development of intellectual skills and sequencing of material. Science and Technology Education are very crucial to the development of a nation. Some countries spend a lot of money on development although there are various problems that affect the development of science education. Recently people have realized the importance of science and technology and there is greater emphasis on science education than before. Radically new technologies of production and access to information are beginning to permeate the developing world. Greater and greater proportions of the labour force are being employed in occupations where scientific literacy is an advantage. Scientific competence and understanding is required for growing numbers of professionals. It is therefore timely and strategically important to undertake a review of such issues. The importance of science and technology in today's world is overwhelming and therefore the education system in the country has to gear itself to provide the required training in scientific skills to meet this growing challenge.

Keywords: *Science & technology, Science Education, ICT, Laboratory, Workshop, Library, Examination.*

Introduction

The importance of science and technology in national development cannot be over-emphasized. It is a known fact that no nation can develop without science and technology. What is science and technology? Science is the study of knowledge which can be made into a system and which depends on seeing and testing facts while technology is the practical application of scientific knowledge. Developed nations of the world like the America, Germany, France etc. boast of several scientific inventions which make them to be rated as the world powers. Science and technology is the pivot of any nation's development. A nation without science and technology is definitely a backward nation. Such nation will be considered undeveloped. Science and technology is associated with modernity and it is an essential tool for rapid development. Modern gadgets in all aspects of human comfort are inventions of science and technology. Electricity, aircraft, telephone, television, computers and other forms of machinery could not have been invented without science and technology.

Science and technology is also very essential in the production of medicine and treatment of diseases. A nation which lacks the necessary science and technology in this area will have to depend on other developed nations for the existence of its people. Such a nation cannot be said to be independent because it has to depend on the whim and caprices of other nations with the necessary science and technology. The development of a nation depends solely on the amount of science and technology at the disposal of such nation. A strong and virile nation is a nation with adequate technology to make its people comfortable. A nation without science and technology cannot feed its people because agriculture requires the application of science and technology.

The importance of science and technology in today's world is overwhelming and therefore the education system throughout the world has to gear itself to provide the required training in scientific skills to meet this growing challenge. Undoubtedly the application of science and technology have transformed the world through dramatic advances in almost all fields including medicine, engineering, electronics, aeronautics etc. and in more recent times dramatic leaps in computer technology have revolutionised in particular the information and communications sector. Modern science permeates every aspect of economic and social life. For this reason education, research and technology is an instrument for accelerating development which should receive special attention in national planning The institutions for scientific education and research oriented' professors, well-equipped laboratories, modern libraries and archives within these institutions, constitute the minimum requirements of a scientific infrastructure any developing country must provide. In order to establish this infrastructure then, the support and funding for universities should be increased.

Technology is the primary engine of economic growth and provides the key to unlocking any country's potential. Hence, developing countries must invest significantly in science and technology. This is achieved by developing the talents, of humans who required to compete in a globally competitive world. To prepare for a smooth transition of; Societal change to an information society it will demand the development of information-related industries centred around micro-electronics, communications, computers, etc. Moreover, reducing the labour component of production systems through automation technology will require re-education of displaced labour.

As the time of the knowledge economy approaches, the world's nations face three major challenges: (1) The globalization of trade has made it harder for nations to use tangible or intangible trade barriers to protect domestic industry, knowledge, and technological innovation. (2) Despite the growing importance of environmental and ecological protection, human activities and population growth are placing an increasing burden on supplies of energy, water, and foodstuffs, while creating more pollution. How to devise sustainable development strategies that will maintain the ecological balance while fostering development has become a national development challenge. (3) The accelerating emergence of an information society and breakthrough in life sciences are having tremendous impact on the activities of businesses and government, and on the way people live, study, and work. In the world of tomorrow, the importance of national boundaries will fade, creating a global village, and a new culture will emerge. Technological development will assuredly play a key role in facing the above challenges. Technology is a critical driving force behind industrial innovation, and success in competition depends upon the sustained growth of R&D spending which allows one to develop and introduce products and technology faster than one's competitors. Since technological knowledge is the basis for rational decision-making, the drafting of public policy in a pluralistic society should be based on scientific information.

Science and technology are growing very quickly but scientific and technological development requires the development of science education. Science Education provides good standards for people and leads to cultural development. It is an essential vehicle to provide human resource development, modernization and overall development of countries in which science education will improve the education of future scientists and fosters a greater and more relevant understanding of nature and the findings of science among the population as a whole. Science education gives children an awareness of technology and develop their personal experiences. Practical skills, encouragment in technological activities, help students to acquire resources of knowledge and intellectual and physical skills. Science Education requires financial support, professionals, effecting planning, resources for effective implementation, scientific literacy, development of intellectual skills and sequencing of material. Science and Technology Education are very crucial to the development of a nation. Some countries spend a lot of money on development although there are various problems that affect the development of science education. Recently people have realized the importance of science and technology and there is greater emphasis on science education than before. Radically new technologies of production and access to information are beginning to permeate the developing world. Greater and greater proportions of the labour force are being employed in occupations where scientific literacy is an advantage. Scientific competence and understanding is required for growing numbers of professionals. The importance of science and technology in today's world is overwhelming and therefore the education system in the country has to gear itself to provide the required training in scientific skills to meet this growing challenge. Hence the importance of Science and Technology education towards national development.

The General Aims of Science Education

- To promote agricultural development. industrial production, scientific research and social development
- To provide pupils with a scientific spirit of curiosity and inquiry
- To understand and change the natural world
- To encourage people to question and search for data
- Science Education improves the education of future scientists and fosters a greater and more relevant understanding of nature and the findings of science among the population as a whole. It gives students an awareness of technology and develops their personal experiences. Practical skills encouraged in technological activities helps students to acquire resources of knowledge and intellectual and physical skills. It also requires financial support, professionals, effective planning, resources for the effective implementation scientific literacy development of intellectual skills and sequencing of material.

Other Objectives of Science Education

- Development of a spirit of inquiry
- Understanding of valid views of the nature of science

- The teaching of problem solving, using scientific techniques such as observation, measurement, formulating or testing hypotheses, experimentation, drawing valid conclusions
- Impartations of science literacy
- Development of manipulative skills and scientific attitudes
- Understanding the interaction between science and the society
- The transformation of the environment
- The production of individuals who are capable of participating in socially useful and productive activities
- The production of citizens who are better consumers of scientific products
- Accelerating the development of potential scientific and technological manpower

Some Problems and Factors which Effect Development of Science Education

- Shortage of funds to purchase equipment
- Poorly equipped laboratories
- Inadequate facilities and basic services
- Lack of well trained laboratory assistants
- Qualified science teacher in short supply
- Poor quality science teaching
- Rapid increase in student population
- The rapidly changing socio-political conditions and attendant contradictory educational policies
- Lack of adequate textbooks, reading difficulty of the textbooks
- Lack of cooperation between school administrators
- Overcrowded laboratory and arranging time table
- Lack of motivations among teachers
- The rapid rate in which teachers are transferred from school to another out profession
- Poor implantation procedures
- Lack of clear cut goals
- The general lack of reinforcing home environment
- Inadequate national policies
- Lack of skilled curriculum developers

- Economic uncertainty
- Rapid technological change
- Enrolment rising faster than national income
- Lack of scientific and qualified staff
- Labour shortages

Problems and Outlook

Looking at the complex scenario of science education in India, three issues stand out unmistakably. First, science education is still far from achieving the goal of equity enshrined in our constitution. Second, science education, even at its best, develops competence but does not encourage inventiveness and creativity. Third, the overpowering examination system is basic to most, if not all.

- First, we must use science curriculum as an instrument of social change to reduce the divide related to economic class, gender, caste, religion and region. We must use the textbook as one of the primary instruments for equity, since for a great majority of school going children and also for their teachers, it is the only accessible and affordable resource for education. We must encourage alternative textbook writing in the country within the broad guidelines of the national curriculum framework. Information and Communication Technology (ICT) is also an important tool for bridging the social divides. ICT should be used in such a way that it becomes an opportunity equalizer, by providing information, communication and computing resources in remote areas.
- Second, we believe that for any qualitative change from the present situation, science education in India must undergo a paradigm shift. Rote learning should be discouraged. Inquiry skills should be supported and strengthened by language, design and quantitative skills. Schools should give much greater emphasis on co-curricular and extracurricular elements aimed at stimulating investigative ability, inventiveness and creativity, even if these elements are not part of the external examination system. Science & technology fair with feeder fairs at cluster/ district/state levels to encourage schools and teachers to implement this paradigm shift.
- Third, examination reform as a National Mission supported by funding and high quality human resources that such a mission demands. The mission should bring scientists, technologists, educationists and teachers on a common platform and launch new ways of testing students which would reduce the high level of examination related stress, curb the maddening multiplicity of entrance examinations, and

research on ways of testing multiple abilities other than formal scholastic competence. Technology is often equated to applied science and its domain is generally thought to include mechanical, electrical, optical and electronic devices and instruments, the household and commercial gadgets, applications of chemical, biological, nuclear sciences and computer and telecommunication technologies.

Aims of Science Education and Organization of Curriculum at Secondary Level

Aims of Science Education The general aims of science education follow directly from the six criteria of validity: cognitive, content, process, historical, environmental and ethical. Science education should enable the learner to

- know the facts and principles of science and its applications, consistent with the stage of cognitive development,
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge,
- develop a historical and developmental perspective of science and to enable her to view science as a social enterprise,
- relate to the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society,
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- nurture the natural curiosity, aesthetic sense and creativity in science and technology,
- imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment, and
- Cultivate 'scientific temper'-objectivity, critical thinking and freedom from fear and prejudice.

At the secondary stage, the beginning made at the earlier stage to introduce science as a discipline is to be further strengthened without emphasis on formal rigour. Concepts, principles and laws of science may now appear in the curriculum appropriately but stress should be on comprehension and not on mere formal definitions. The organization of science content around different themes as being practiced seems appropriate at the secondary stage, but the curricular load needs to be substantially reduced to make room for the additional elements of design and technology, and other co-curricular and extracurricular activities. At the secondary school stage, concepts that are beyond direct experience may come to occupy an important place in the science curriculum. Since not all phenomena are directly observable, science also relies on inference and interpretation. For example, we use inference to establish the existence and properties of atoms, or the mechanism of evolution. By this time, however, students should have developed the critical ability to evaluate the epistemological status of facts that they encounter in science. Experimentation, often involving quantitative measurement, as a tool to discover/verify theoretical principles should be an important part of the curriculum at this stage. The technological modules introduced at this stage should be more advanced than at the upper primary stage. The modules should involve design, implementation using the school workshop, if possible, and testing the efficacy of the modules by qualitative and quantitative parameters. Experiments (and, as far as feasible, the technological modules) should be part of the content of the secondary stage textbook, to avoid their marginalization or neglect. However, this part of the textbook should be subject to internal assessment only. The theoretical test at this stage including that for the Class X external Board examination should have some questions based on the experiments/technological modules included in the textbook. Participation in co-curricular activities must be regarded as equally important at this stage. These may involve taking up projects (in consultation with teachers) that bear on local issues and involve the problem-solving approach using science and technology. The various components of the science curriculum indicated above should be integrated imaginatively. The entire upper primary and secondary school curriculum should have horizontal integration and vertical continuity.

Activity-based Teaching

There is a general feeling that activity based teaching is expensive, takes more time that could be otherwise 'fruitfully' used for 'text based' teaching, does not prepare the child for examinations and competitive tests. The concern about expenditure involved in activities/experiments cannot be dismissed. Most schools cannot afford well-equipped science laboratories. However, it is certainly possible to design low cost activities and experiments as easily available materials. Thus cost should not be allowed to become an excuse for neglecting the very base of learning science. The concern regarding examinations can be addressed by reforms in the examination system that ensure due weightage to activities and experiments. (See 'Examination System'.) Overall, we need to develop textbook approaches, teaching styles and assessment procedures to ensure that meaningful learning does follow from activities.

Content

The most important consideration while developing a science curriculum is to ensure a reduced emphasis on mere information and provide greater exposure to what it means to practice science.

Laboratory, Workshop and Library

A major area of concern is the gradual decline of practical work and experimentation at secondary and senior secondary levels. The oft-repeated recommendation of integrating experimental work and theory teaching has not been realized because of perceived lack of facilities and trained teachers in most of the schools. The degeneration of rigour in practical examinations has also lent weight to the argument to first remove them from the ambit of evaluation and then to trivialize or totally remove them from teaching practice itself. Often practical difficulties are cited as an excuse for this lack of commitment and awareness that experiment is fundamental to doing and learning science.

(i) encourage practical / technological / creative components of the curriculum through non-formal channels,

(ii) Introduce some carefully designed experiment or technology-based questions in the theoretical paper itself. We are aware that this can only be an interim step to prevent the marginalization of experiments in school science curriculum. There is no alternative but to invest heavily improving school laboratories and workshops while reducing the importance of external examinations and promoting experimental culture in our schools. The school should also have computer-interfaced experiments and projects, besides projects utilizing database from the public domain.

ICT in Science Education

Information and Communication Technology (ICT) opened up new opportunities and challenges in the field of education. A beginning for introducing computers in the school system was made through the Computer Literacy and Studies in Schools (CLASS) project in the early 1980s. However, schools faced problems of infrastructure, appropriate software and lack of trained manpower. Today, the scenario has changed: with the increasing use of personal computers in schools, homes and workplaces, and internet connectivity, ICT shows renewed promise as a powerful tool for education, but only if these developments are complimented by making available quality software in different disciplines of science. The Internet opens up vast possibilities; it could provide an e-platform for discussion of topics relevant to school children both curricular and co-curricular where students and teachers could post queries, provide answers, discuss with experts and exchange views.

Examination System

- The activities/experiments/technological modules within the textbook should be assessed internally even for Class X and Class XII Board Examinations.

- The theoretical science paper for examinations including the Class X and Class XII Board examinations should have carefully designed experiment/technology-based questions, questions testing critical understanding and ability to solve problems.

Teacher Empowerment

- Carry out a complete overhaul of the teacher education system in the country including modernization of syllabus and development of appropriate laboratories for teacher education in science.
- Undertake vigorous recruitment of high quality teacher educators who must have actual experience in school teaching.
- Undertake orientation of inspectors and government educational officials and sensitize them to the need for academic autonomy of teachers, without sacrificing academic accountability.
- Provide qualified and trained teachers at all stages.
- Create systems of peer group interaction among teachers. Promote within school and between schools modes of academic exchanges between teachers.
- Institute schemes of incentives/awards to honour the deserving teachers.

Equity

- Use science curriculum as an instrument of social change to reduce the socio-economic divide and to help fight prejudice related to gender, caste, religion and region.
- Emphasise gender sensitisation of teachers both at the pre-service stage and during in-service training to promote gender fair science education.
- Use ICT as a powerful tool for bridging the social divide in education and as an opportunity equaliser.

Science education must be learner centred and teacher assisted, action-oriented, project based and topical, deriving its material nourishment from immediate environment. Methodologies would involve discipline, team teaching, interaction with community and use of media. It would be necessary to **include ideas into pre service and in-service programmes for all science educators through well worked programme.**

- Science education programmes should include total community and integrated scope , encompassing social, economical, political, psychological and cultural aspects
- Science education should provide students self reliance
- Science should contribute to people and to society

- Science education should be practical, relevant and appropriate. It should promote adaptability to change
- Students should acquire a frame of mind associated with inquiry and discovery rather than for them to memorise facts whose value may be transitory
- science should inform the public and foster their interests
- Some technical knowledge should be taken from industrialised countries but it must be suitable to the society and their needs
- An indigenous education system should be provided.

References

1. Ministry of HRD Learning Without Burden: Report of the Advisory Committee appointed by the Ministry of Human Resource Development (MHRD), Department of Education, New Delhi. 1993
2. Ministry of Education Education and National Development: Report of the Education Commission 1964-66. Reprinted in 1971 by NCERT, New Delhi. 1966
3. Menon narayan: The Communication Revolution, National Book Trust, New Delhi. 1976.
4. Ramdas, J.N., Chunawala, S. and Apte, S. Role of Experiments in School Science. Diagnosing Learning in Primary Science - Part 3. Homi Bhabha Centre for Science Education, Mumbai. 1996
5. Rao, V.K., Educational Technology, New Delhi. 2004
6. Sharma,S. Advanced Educational Technology, New Delhi, 2005
7. Siddharthan, N S and Y S Rajan: Global Business, Technology and Knowledge Sharing, Lessons for Developing Country Enterprises New Delhi. 2002
8. Vedanayagam, G: Teaching Technology for College Teachers, Sterling Publishers, New Delhi. 1989.
9. White, R., The revolution in research on science teaching. In Virginia Richardson (Ed.) Handbook of Research on Teaching (4th Edition), American Educational Research Association, Washington, D. C. 2001.

2

Promoting More Learning Activity Till Higher Education Level with Less of Earning Needs Even at Early Stages

S. Aravamudhan

Abstract

An academic pursuit of science subjects can be promoted by, talent search programs apart, a better monitoring of students' activity comprehensively. The monitoring should take into account the inherent aptitude and retention of interest in the subject matter and the simultaneous awareness of the needs to look for means to earn for sustenance even at early stages. If the aptitudes of students are to be reinforced, then an assurance, of possible earning avenues, would enable pursuing the learning activity. Thus the curriculum design should facilitate the natural process of students' learning with an institutional provision of viable career counseling. With such objective in view, in this paper, it is intended to highlight what constitutes learning activity, and how a value addition can be enabled so that career counselling can reinforce the interests of deserving candidates by providing, at appropriate stages, a reassurance of the worth of pursuing on the basis of improvised value addition to the individual academic activity.

Keywords : *Basic science, academics, education, institution, learning, students, curriculum, career, value addition, TQM, NAAC*

Introduction

Mostly, when an individual has the interest, tenacity and perseverance to proceed towards specializing in a subject matter, that is an academic pursuit, then, it is indicative of the aptitude for basic science. It is not necessary that students should opt for mathematics, physics, chemistry or any of the life science subjects to be acclaimed as scientist pursuing basic science. What is more important is that the persons should not be preferentially choosing emolument oriented occupations, but keep aside the earning as a consequence of having to sustain the academic activity. But, the employers have equally a pressing necessity for talented candidates for what they can offer them as job requirements and emoluments. How many people have their living conditions so set to give priority to learning, rather than thinking for a living? In fact, the science and technology activities are precisely meant for improving the living standards. How many people can offer to be thinking of global welfare[1] without having to think about improving one's own living conditions to an acceptable level? These are the issues which require to be addressed to, but sounds too familiar and repetitive and hence relegated to lower the priority levels.

With the above perspectives in view, the question of what constitutes learning and how learning by an individual can be sustained must be addressed. And, would it be possible to address those questions without considering how it is beneficial and who is the beneficiary of the activity? It is these considerations which inadvertently get people into a vicious circle and the greatest disadvantage that results from these is hectic activity and no effective progress even when substantial output is accounted for. It is that *ineffectiveness* which calls for quality assessment and accreditation of educational institution[2], which again has a bifurcated route as to whether, what is required is an internal assessment or an external peer reviewing. It would be emphasized in this paper that it is necessary to take cognizance of the fact when, at the end, one reaches to the same beginning, and then appropriately reinforce the activity with progressive measures.

Learning Science Subjects

Seeking to learn science has the following in-built criteria: *1. Inspiration from events; 2. Intuitive inquiry as to what happened and how it happened; 3. Innovative reasoning and initiating experimentation*. In the early childhood, with the attributes of innocence, the impetuosity necessarily is an admirable quality. These are the inherent abilities (which vary from one individual to the other) by which human beings learn to do things by an exposure to what is available to them in the surroundings (again, a variable factor from an individual's surrounding to the other). An important criterion for not losing out on the inherent abilities one is endowed with is to realize that an intuitive approach is most often a beginner's approach. As people grow, an individual learns how to discriminate what is good and what is bad, and, in that process one should not lose sight of how one got the definitions of what is good and what is bad; and, how it can stand the test of time and how it became a durable guiding principle. This cognizance does not become available as inherent, but the individual's maturity is reflected by how well the individual gets to appreciate and retain the beginner's approach even as a grown up expert. It is often quite true that, those aspects, which bring the person to adapt a beginner's approach, is all that matters between the successful individual and the others who are still in the process for getting to grow. Do our educational structure subscribe to monitoring from this point of view? Is our data tabulation good enough for any talented individual to quickly learn as to what the distinguishing feature is or what is ailing in the methodology? How should the design of curriculum ensure an unfailing recognition of the talented students? This means asking the following question; is our evaluation and grading procedures flawless? Does the current system of evaluation and grading require introduction of *value addition* beyond the marking procedures to indicate the 'talented', which are intended to be searched out by the 'add-on' talent-search methods.

Formal Learning of Science

In the context of the three criteria of learning science enlisted above may be considered to be based upon the a priori definition that early stages of "playing and learning" is learning of science. In fact what we get exposed to by being active through the day is to perceiving properly the stimuli from the surroundings and appropriately negotiating these for the sake of what would be happening and how to handle the events thus encountered. When, it is a question of trying to know what to do in future, the experience at present matters most. If events occurring are not so frequent or do not lend an evident cause or simple reasons, the way is to make this event occur by setting out exclusive conditions extraneously. This is how experimentation is initiated and for which, perception with the usual sense organs may not be adequate; but an aid from instruments may be necessary which can magnify, attenuate or alter the stimuli (signals) to conveniently study the responses. Thus these instruments supplement and reinforce the human sensory organ functions. Trying to find out how to enhance the sensibilities by appropriate external contrivances and devices is part of learning science without which basic science subject study would be stale and naturally interest would dwindle. If they get interested in science instrumentation, it should not be construed as lack of interest in physics, chemistry or mathematics. Engineering subjects require basic science subjects[3] to be studied in their core courses. Even though most of the engineers are employed in technical jobs, if the invention and construction spirit is retained to be for original inventions then genuinely it is basic science. On the other hand if an useful instrument is invented, a prototype well tested, and an industrial viability is established to produce several units on the basis of originally invented prototype, then becoming part of routine production process on the basis of a technical training is not basically a activity to learn science, but could be a means of earning lively hood. Such industrial activity maintained in robust productive capability is a healthy sign in a social set up. For such overt reasons of utility and benefits, the industry may be earning well to pay the employees well and more such units are necessary to prosper and technologically develop. But, the entire edifice is realizable only if there had been an inventor who might not have earned much out of the invention. In general the basic science learning can bring benefit more by the altruistic contribution of the few to the knowledge bank and it provides for many to prosper. Now, is the question of which would a person from a developing stage prefer? The aspiration for learning and contributing can be sustainable only if a beginning is made to find time after providing for the means of sustenance. Any amount of incentives cannot attract even the talented towards basic science for it is not uncommon to find critics among the talent searchers who comment in other quarters that such people are spending time on nothing concrete and worthwhile. It is necessary to find talent searchers who can really provide environment conducive for inquisitiveness beyond the already proven facts which are in abundance and available to study and learn. Thus curriculum designers must provide for such extra-curricular curiosities, and the teachers must be talented enough to know the budding inventor rather than dubbing such aspirants as going astray from the main course. It is this aspect which is critical in bringing the really talented into the path of invention as they learn what is already known. This would strengthen the purpose of education and retain the values for intellectual pursuits which is why basic science stream has to be made more interesting to the learners. The activities for prosperity and technological advancement can get the required replenishment when the basic science activity is sustained by all those few who have the inherent talents and also have the altruistic temperament to involve in such basic aspects rather than becoming a drop in the ocean among those who have the talent and skills tailor-made for taking the human activities along the road to prosperity.

Curriculum Design

As enunciated in the previous section, the "spirit of invention" must underlie as the guiding principle for "learning what is already known". This requires that what is already known must be learnt so thoroughly that the learning process takes the student to the frontier of the topic to know what is yet remaining to know. Concluding that everything is already known would put an end to the necessity to think that there are things yet to discover. If ones inherent abilities do not permit any more inquisitiveness after getting cent percent of the marks for the questions set to answer, that is where such efficient flawless delivery system in teaching-learning has not made investments, but simply bartered materials away under a conserved frame work. This regimented education system can turn out smart and efficient students and useful citizens but cannot produce outstanding original contributors which cannot be many in number. For the sake of rare few the vast majority cannot be exposed to autonomy in learning while shaping them to be useful citizens. Hence innovative methods cannot be part of everyone's endeavor; popularizing "innovation" must be replaced by promoting innovative excursions from the usual practices, carefully not giving rooms for permissiveness of the kind that, once set as precedence, would cause impediments in implementation of any progressive measures when required. To provide for dynamism of the appropriate proportion in the routine regularized activity is the improvisation that would render ever-refreshing curricular contents.

It is said that the exercise that the students go through in the regular study should be such that having solved ***'n'*** number of problems under the teacher's guidance, must be capable of solving the ***'n+1'th*** problem on their own. Which means they should not have been good enough, only to solve any of the n problems on their own and score cent percent; they must have been given a thought development on the subject matter that they can think one their own about the subject matter. This calls for talent generating teaching methods rather than specialized questionnaires for talent search, wherever it exists. As a teacher (even an inexperienced teacher) transfers known textual information in the classroom, it should be possible to know whether such an *n+1th* problem gets generated or not. For instance, a definition to make it clear to the students, would require descriptions in teacher's own words; and if the teacher is inexperienced and could not do a full justice, then there would be questions from the student listeners which is the beginning of the required dynamism which improves the teacher and projects the standard of student listeners as to what their attention in the classroom is about (attendance or audience).

The teacher must be gradually learning how to teach what he knows and the students must think all about what the teacher meant and be convinced about it. When this practice of teaching a specified content reaches a satisfactory level, the content must be further enriched. This calls for the appropriate accreditation to the institution for the progress made compared to what they did earlier and compared to the other institutions. Thus generating an interest at the frontiers of the specified content should be the aim, and also the index for monitoring the quality. This must ensure that all the time first and foremost the specified 'n' number of problem contents must be solvable by one and all and look for students who can become curious at this frontier and articulate to express this curiosity amicably. With proper orientation it is not difficult to design the curriculum and make it interesting even with only a specified content.

It is for the interest at the frontiers of the specified content that students must be given exposure to ICT tools. This requires carefully monitoring what the students want to do when they seek the ICT tools anytime. Thus a councilor must be paying individual attention on such students to know what they get curious about, without interfering with their thinking line. If at all any, a discussion and/ or peripheral conversation can convince them when their preoccupation is unnecessary, and consequently dissuade them away from such tendencies.

At this stage, when they tend to be fissiparous and waste their time appropriate advice about the value of time and the necessity to earn can bring them back to a training that is necessary to be a part of an organization trying contribute one's own portion conscientiously for the welfare of that organization. The personal attention can also bring to light any of the student's need to look for earning, as a responsible member in a social structure and look for appropriate placement.

Such of those students whose personal requirements reveal a need to go in for earning in preference to their natural and inherent talent for intellectual pursuit, must be given adequate assurances for financial assistance and appropriate job openings if they continue to prove original in their approaches in learning and rendering the standard known materials. This would pave the way for opening the potential that a person has to become discoverer. These reassurances and assistances should be having popular support so that it never becomes precedence for anyone to cite for exploiting it for their own ends. To make the exceptional look ordinary and a matter of routine requires careful handling not evoking discontents, disagreements and not invite uncalled for attention.

ICT and Educational Technology

I.C.T stands for Information and Communication Technology. To think of it, basically, teaching is effectively transferring the information content in prescribed books or publications to a group of aspirants who want to know the particular subject matter. Hence it is not unusual to become enthusiastic about the advantages of the ICT tools for classroom teaching[5] and retrieving the information at one's own door steps with the possibility of the variety of resources as data base and their retrieval being made conveniently possible at each and every one's door steps. But it must be borne in mind that conducting exams in a meaningful way would require answering scripts and not producing documents from ICT tools. Handling ICT tools itself is a subject to be mastered and then must be used for studying the specified topics of a given syllabus. Thus unconcerned exposure to ICT tools is not bringing in innovation component.

On the other hand, it is quite common for teachers to use overhead projectors for depicting certain features of the subject. However, these transparency contents can be supplied to the students to enable preparing for answering questions in exams. However, animations do ply a great role in explaining time dependent events concisely and quickly, which by printed materials would require several pages. When such animation tools explain the subject well, the students should be given a summary of the lesson to be learnt in such a way that a question set on those animated features would require only the conventional pen-on-paper description and not require an animated file as answer. This is not usually simple and this cannot be managed by all teachers. Moreover, it is really beyond the scope of teachers to know which part of the subject requires an animated feature for the students to follow, without wondering only about how the animated output could have been made. Besides the novelty in the way of delivery, the attention of the students should be mainly on the subject of study. This once again is not easily achievable by the teachers. Even though it is possible to cite the several youngsters easily getting used to the terms of ICT tools, much less is achieved in substantially accounting for what good this has done in improving their grasp of the subject of study.

In this regard, two research reports of case studies from IGNOU are to be cited here. One is on *l*earner's perception towards ICT (7) and the other is on how non-content related forums influence social presence[8] in the online learning environment. Both are revealing significant aspects related to use of ICT tools and a curriculum design with such ICT component. Such innovation in teaching and learning also can promote the need-based-learning (5) of handling and producing materials with ICT tools. Thus the students can be given specific assignment to produce an explanatory material with ICT, for their own grasp of the subject. A technical assistant *(laboratory assistant)* could help them in producing the material: thus it is required to learn about ICT only to the extent that they have a material to grasp the regular subject matter better. If there are more such instances, the familiarity with ICT would become better. And, it is not necessary to go through extraneously any courses to get a certificate for use of ICT, and such an exercise might after all stand isolated and eventually of no consequence. Other possibility is that such peripheral preoccupation with ICT may be good enough for getting lucrative offers of jobs and people who have inclination to earn would get distracted from the main course of study.

It is hereby emphasized that a reorientation of the way teachers impart education and how the managers accord importance to the provision of earning or learning alternatives to student is what can provide room for improvisation of educational methodology. The aim can be better set to nurture the few inherently talented for intellectual pursuits without creating an atmosphere of discrimination of intellectual pursuits and material earning preferences as different grades of activities[1]. Such a homogenized environment would be the most conducive for advantageously tapping the potentials of individuals for basic science study and a robust industrial activity which would churn out responsible citizens who can stand for the welfare of society and durable prosperity[3] at large.

Thus this can address to most of the issues that come under the Total Quality Management[2].

References

1. http://aravamudhan-s.ucoz.com/saravamudhan44/hrd_resource_ management.html, HUMAN RESOURCE DEVELOPMENT IN THE NORTH EAST FOR THE MANAGEMENT OF THE NATURAL MATERIAL RESOURCES OF MEGHALAYA.

2. http://aravamudhan-s.ucoz.com/saravamudhan44/tqm.html, The Extent of Harmony Between Academic Institutions and Industrial Organizations: "A measure for Total Quality Management".
3. http://www.angelfire.com/art3/saravamudhan/sri_hledu/HUMAN RESOURCE DEVELOPMENT AS THE SOCIAL FACTOR FOR SPECIALIZATION WITH INTERDISCIPLINARY RELEVANCE.
4. http://aravamudhan-s.ucoz.com/technical_education.html;TECHNICAL EDUCATION FOR INDUSTRIAL GROWTH AND PROSPERITY IN NORTH EAST INDIA
5. http://aravamudhan-s.ucoz.com/BDRay_Felicitation_Volume.html In Defence of Regional Economic Development in INDIA: A case for the North East.
6. http://aravamudhan-s.ucoz.com/amudhan_nehu/it_classroom_tools.html

   http://saravamudhan.tripod.com/infotech_tools/.
7. http://aravamudhan-s.ucoz.com/on_resources_NE.html; RECOGNIZING AND UTILIZING RESOURCES.
8. http://www.ugc-inno-nehu.com/IJOP_Vol19_No3_p143-157.pdf.
9. http://www.ugc-inno-nehu.com/IJOP_Vol19_No2_p73-85.pdf

3

Teaching Approaches within a Project based Training Framework – Innovative and Participative Learning

Arindam Ghosh
Navnita Kumari
Ayon Bhattacharjee

Abstract

Education is a light that shows mankind the right path to surge. The idea of education is not just making a student literate but its purpose includes rationale thinking, knowledge-ability and self sufficiency. Education develops creativity and innovation can benefit both students and teachers. Traditional methods as well as multimedia teaching and other useful teaching methods can impart knowledge to the students. Basically teaching includes two major mechanisms - sending and receiving information. Any communication methods that serve the purpose to impart knowledge without destroying the objective could be considered as innovative methods of teaching. The use of training based innovative methods such as feedback, structuring, brainstorming, simulation, group work, conceptual mapping etc., has the potential not only to improve education, but also to empower people and strengthen governance to achieve human development goal for the country.

Introduction

The main path to improve the competitive scenario of a nation is by making science and technical education more effective through high quality research and development. In present days a nation's progress and its competitive edge is measured by the quality and quantity of its scientific and technological manpower. To improve this quality and quantity, a system of exciting and stimulating science education is required that is highly productive, well focussed, flexible and regularly updated. It should be professionally managed well-funded, and young pupils should find interest and get motivated towards higher goals. In the Indian context some major lacunae in this segment are:

i) Lack of flexibility and accountability, excessive centralization with no autonomy.

ii) High rate of dropouts and failures, especially among the rural and girls students.

iii) Low access to education with disparities among gender, region etc.

iv) Lack of relevance.

v) Parental and peer pressure making bright people shy away from science.

These problems may have possible solutions if education is integrated with research as well as technology.

Education

"Education is the manifestation of perfection already in man"

– (Swami Vivekananda)

We should aim at generating interest among the students and motivate them to take up science education. At the same time education should not be a boredom filled burden to the students, rather it should encompass elements of fun, thrill

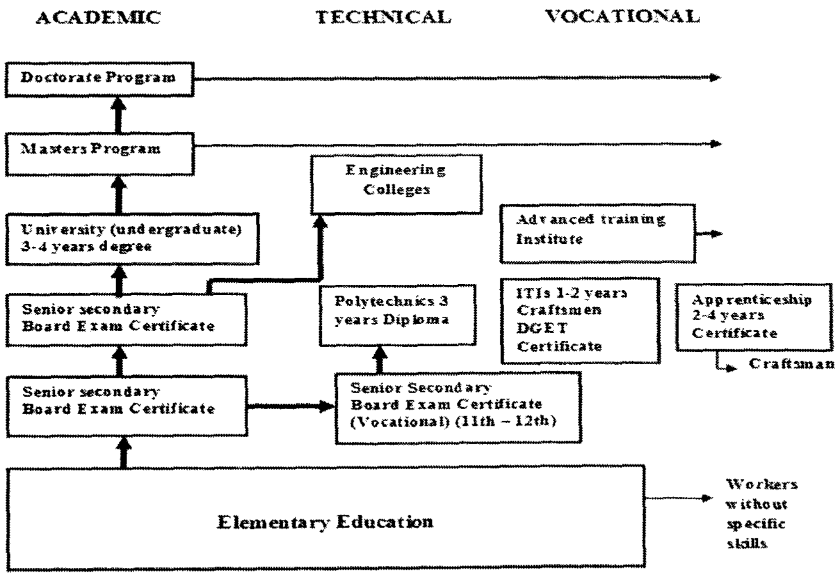

Fig. 3.1 Current System of Education

and achievement. Education plays a vital role in the development of any society and it basically builds the human resources that are responsible for a nation's technological and economic growth. Today in this information age, the concept of education needs to upgrade itself by being the harbingers of change, improve the quality of life by inculcating an atmosphere innovation and research. The structure of current education system can be described in Fig. 3.1.

The importance of creativity and innovation in addressing the economic, environmental and social crises has been recognized in policy discussion in Europe. Recent policies call for the strengthening of Europe's innovative capacity and the development of a creative and knowledge-intensive economy and society through reinforcing the role of education and training in the knowledge triangle and focusing school curricula on creativity, innovation and entrepreneurship. It has been recognized that schools and initial education play a key role in fostering and developing people's creative and innovative capacities for further learning and their working lives. It is argued that creativity, in the educational context, should be conceptualized as a transversal and cross-curricular skill, which everyone can develop. Therefore it can be fostered but also inhibited. The five major areas where effort and improvement is needed to enable more creative learning and innovative teaching: namely, curricula, pedagogies and assessment, teacher training, ICT and digital media, and educational culture and leadership.

Curricula

The study shows that the terms 'creativity', and 'innovation' and their synonyms. Many teachers and education experts however, feel that the curricula in their countries do not, as yet, sufficiently encourage creativity and innovation, mainly because they are not clear how creativity should be defined and how it should be treated in learning and assessment. Furthermore, curricula are often overloaded with content, which reduces the possibilities of creative and innovative learning approaches in practice. The need for the revision of curricula, so as to provide a consistent definition of creativity, and better guidance on how teachers should develop creativity and innovation in practice and encourage development of cross-curricular competences.

Pedagogy and Assessment

In terms of pedagogical practices the importance of creativity and innovation in education is highly appreciated. We should try to encourage learning activities which are likely to allow students to be creative and also aim to foster skills and abilities that enable creativity and innovation. Changes in learning objectives cannot be implemented in practice if assessment for pupils and schools remain the same.

Educational Culture and Leadership

It becomes clear from the study that major changes are needed in the overall educational culture towards more creative learning and innovative teaching.

People outside the classroom, such as school leaders, national policy makers and parents should be involved in this change. Creativity and innovation are often perceived to be present in the school culture; however, they are often not a priority. Therefore, innovative teachers' personal classroom practice is not necessarily aligned with the culture they experience as their working context or appreciated by school leaders. There is a need for a holistic strategy for implementing change towards more creative learning and teaching, taking into account curricula, assessment, teacher training and funding.

Creativity as a Source for Innovation

Creativity is perceived as the prime source for innovation, which in turn is acknowledged as the main driver of sustainable economic development. It is seen as a process of generating ideas, expressions and forms, which can, in essence, amplify knowledge and lead to new ways of using the knowledge.

Creativity as a Strategic Challenge for Education and Training

Enhancing creativity and innovation, including entrepreneurship, at all levels of education and training should be one of the four strategic objectives. We should encourage developing the role of education in a fully-functioning knowledge triangle and training institutions should ensure that curricula and teaching and examination methods at all levels of education incorporate and foster creativity, innovation and entrepreneurship. Education policy makers should consider how to foster greater synergy between knowledge and skills on the one hand and creativity on the other, as well as how to best promote, monitor and assess creativity and innovative capacity, at all levels of education and training.

Traditional Methods

Before the IT era, education involved teachers as the source and students as the receiver of information.

$$\text{SENDER (TEACHER)} \xrightarrow[\text{MEDIUM}]{\text{MESSAGE}} \text{RECIEVER (STUDENT)}$$

This traditional method, the educator delivers a lesson via the "chalk-and-talk" method. The teacher delivers the lecture content and the students listen to the lecture and take notes. The students are passive learners and there is no minimum interaction. The limitations of traditional teaching method are-

- "One way traffic" – Teacher talks, students listen.
- 'Passive students" - Teachers deliver lecture for one hour without much scope for students response and feedback.
- 'Textbook specific" - The lecturer notes are textbook based mostly.

- "Plug and play" - Teaching restricted to textbook, practical aspects not discussed.
- "Non-interactive" - Insufficient interaction with students in classroom.
- "Commit and Vomit" - Learning from memorization and not understanding.
- "Marks oriented" - rather than performance oriented.

Designing your own Action Strategies

The results obtained from any learning-teaching process will largely depend on the success or failure of the application of each individual or combined method. Obviously, there are no easy "recipes" that can be applied mechanically to each and every process. The examples of teaching-learning methods presented in the following sections are intended to serve as no more than a rough guide. Each trainer should design his teaching strategy in accordance with his own style plus the dynamics of his group of students and each of its members.

Feedback

Feedback allows teachers to qualify their own teaching performance by means of evaluations received from their own students. Participants express their opinion about the course's technical contents, its didactic qualities, the level of interactive communication achieved, etc. Course managers can then use the information obtained to reflect on and improve trainer performance. The rules that govern feedback are-

Procedure

In order to obtain effective feedback, teachers must first explain to their students the reasons make feedback necessary and of the way the information obtained can be used. The first step involves students being asked to carry out feedback. Whoever is directing the session should listen to the comments calmly, without trying to justify themselves, in any way, taking notes, asking for clarifications and encouraging students to suggest improvements. At the end of the feedback session, a summary of the obtained results is made, which should lead to a period of analysis and discussion, in which any possible corrective actions are defined. Receiving feedback enables trainers to motivate students to participate in the learning process and promote collective responsibility and clear up any unresolved points.

The teacher should receive input about the effect and acceptance of the course from a didactic content based viewpoint.

Giving Feedback

Giving feedback enables students to:

- Present and submit analysis of their own ideas about the course.
- Consider suggestions about their own performance as course participants.

Evaluation Objectives

- To identify weaknesses detected in different parts of the course.
- To reflect on one's own didactic, methodological and communicative abilities.
- To consider other possible ways of doing things.
- To define ways of making the teaching-learning process more efficient.

Active Structuring

Active structuring attempts to conceptually structure a course area or theme through the application of a variety of social concepts and by diverse types of visualization according to the structure needed.

Procedure

- Explain the exercise and the way it should be carried out.
- Give students pre-prepared cards (30 max.) which should include points related to a theme already covered in class.
- Set up the working structure.
- Each group's structuring proposals should be presented, by one or more spokespersons, in a session involving all class members.
- Any final clarifications should be made, prior discussion of the structuring proposal.
- If necessary, other possible structuring models or evaluations of the trainer or moderator's performance can also be presented.

Application Possibilities

- The structuring of conceptual knowledge.
- The promotion of a focused learning process.
- The forming of more creative didactic methods which remain work and analysis intensive.

Brainstorming

The brainstorming method consists of processing students' spontaneous ideas about a pre-set theme, or problem which has been determined without qualitative comments from the trainer. The most unusual views can be included, in order to provoke diverse and original problem-solving ideas.

Procedure

Precise presentation of the questions or problems raised by the group, including, if necessary, visualisation by means of a whiteboard or flipchart. The following comments deal with the conceptual rules of brainstorming:

- The thoughts expressed should be creative (not self-critical).
- Neither criticisms about the ideas of others nor explications of one's own ideas should be admitted (all ideas should be registered, including repetitions).
- Quantity takes preference over quality – the more ideas expressed the better.
- Each student should be encouraged to express his or her ideas freely and spontaneously.

Students Express their Ideas

Students can express their ideas either in a predetermined order or randomly, but this should be established beforehand (oral brainstorming).The moderator or a nominated student should take note of and resume all the ideas expressed, using a whiteboard or transparencies.

Don't rush to Interrupt the Flow of Ideas

The flow of ideas should not be interrupted even when it begins diminish. To begin with, only conventional ideas are forthcoming; it is later that original ideas emerge.

Analysis of Results

Finally, the results obtained should be analysed (for example, by means of active structuring or a group discussion).

Role Playing – Simulation

This is a game where social conflicts and group interest decision making are simulated. The subject/conflict and the roles/situations are pre-set and the game's outcome is left open. During the role play-simulation games, students have to take decisions based on real or hypothetical model situations, defined by a set of rules that govern their fictitious reality.

Procedure

- Presentation of the content and rules of the role-simulation game.
- Allocation of the roles to be assumed by each group.
- Presentation of the initial situation, written description of the characteristics of the groups participating in the game and, if necessary, the allocation of roles within each group.
- The game commences applying the assigned roles.

Implementation

- The groups discuss with each other a common objective and take the corresponding decisions.
- The decisions taken are put into practice, following the established plan.
- Feedbacks are obtained from the game's director or from the other groups.
- If necessary, the process can be repeated, changing the original conditions or simply continuing until a pre-set result is obtained.

Evaluation

The game's director should ask students' to reflect on the results obtained.

Group Work

Focused as it is on both participants and tasks, group work within a small group framework can be an ideal way of including a social element in learning themes. By means of an orientation session involving all the students, a large group can be divided into several small ones. This is known as the "closed stage" and includes the designing of a general plan, the identification of objectives and sub-themes, as well as the creation of work groups. Once the authentic group work (known as the "open stage") is completed and events data and contextual associations have been analysed, another full session, or "closed stage" can be implemented, in which areas such as group information, comparison, evaluation and summary of partial results are discussed prior to the formulation of a final result.

Procedure

Full session for the preparation of group work (closed stage):

- Group work tasks should be explained, using precise terms backed up by any combination of visual and memorization aids – such as a whiteboard or flipchart or group work hand-outs.
- What is expected in the full group presentation of results session should be discussed.
- The length of the group work process and where it is to be carried out should be indicated.
- Group work (open stage).
- The participants carry out tasks while the moderator ensures that the group does not lose sight of the objective.
- The group work should be considered complete once concrete and certain results have been obtained and when these are ready to be presented in the full session.

Full Session (Closed Stage)

- The order of the presentations should be pre-set.
- Each group should present its problem solving alternatives in the full session.
- Once all the presentations are completed, the different results should be compared and submitted to critical analysis.
- Finally, a summary of all the results should be drawn up.

Meta-Plan Technique

The meta-plan technique is a visualization and systemisation method based on the use of written cards. This technique paves the way for a whole range of possibilities for the continuing analysis and structuring of existing knowledge. The first step is to distinguish between inductive and deductive processes. An inductive process achieves systemization during a course or as the work is being carried out. A deductive process, on the other hand, consists of the working relationship between unstructured prior knowledge and previously established categories.

Procedure

Presentation of a task based on content or suggestions. Each participant should write 3 to 5 words/comments about the proposed or suggested task in a legible script on A4-sized cards split in half horizontally. Meta-plan cards should be of only one colour whilst different colours are used to identify main ideas or to represent systematic units.

Presenting and Organizing Ideas

- Students should present their ideas in a full session in order of participation. The ideas should be displayed on the whiteboard or wall – either directly after the session or during it. Each presenter should try to organize thematically the idea or word written on his card, in accordance with the contents of the cards already displayed.
- Once this process has been completed, all the students should take part in a structured analysis of the "cluster".
- Finally, the moderator should discuss or summarize the obtained results with the participants.

Conceptual Mapping

The centre of the conceptual map is a main idea or concept, suggesting other subordinate ideas. The centre of the conceptual map is a main idea or concept which causes a corollary effect, suggesting other subordinate ideas which in turn may vary, being transformed into other more diverse ramifications. The conceptual map permits the representation of complex association of ideas and content, specific fields of knowledge and thematic areas, and also functions as a memorisation tool.

Procedure

- ➢ The first step is to write a word or words representing a concept, idea or subject in the centre of a sheet of paper or on the whiteboard.
- ➢ Other words, such as nouns, verbs and adjectives should then be added in such a way as to further define the main ideas.
- ➢ Participants should then reflect on whether all these conceptual words have the same level, if some are of a higher level or perhaps subordinate to others.
- ➢ Each branch may continue altering as a result of other .
- ➢ Too many varied ideas can cause the conceptual map to lose transparency

Conclusion

Education policy makers should encourage teachers to develop their roles as learning facilitators and promoters of creativity and help teacher education institutions to respond to the new demands of the teaching profession. Also teachers should acquire the following:

Professional Attitude

- ➢ Respecting students' different views.
- ➢ Well informed of current news and events.
- ➢ Establishing good collaboration relationship with colleagues .

Teaching Strategies and Skills

- ➢ Stimulating students' thinking.
- ➢ Making appropriate requests to students.
- ➢ Providing appropriate learning materials.
- ➢ Devising appropriate learning activities.
- ➢ Shifting from one role to another agilely.

"We must be the change we want to see in the world." - (Mahatma Gandhi)

References

1. "Innovative and participative learning-teaching approaches within a project based training framework" InWEnt – Capacity Building International, Germany.
2. "Innovative Methods of Teaching" Damodharan V. S. and Rengarajan. V.
3. "Creative Learning and Innovative Teaching - Report on the Study on Creativity and Innovation in Education in the EU Member States" Cachia R., Ferrari A., Ala-Mutka K. and Punie Y.
4. "Teachers' Role in Project – Based Learning" Tang A.

4

Financing Infrastructural Facilities in Science Education at The Secondary Level in Meghalaya

C. Nongbri

Abstract

Secondary Education is a crucial stage in the educational hierarchy as it prepares the students for higher education and also for the world of work. The Constitutionally mandated universalisation of elementary education is now driving the State's universalisation of secondary education to reach the goal of ensuring a well-educated population where Science education is also emphasized. There are many science teachers which have been extended science grant. District and State Level Seminar / Exhibition are being conducted for Secondary Schools to inculcate the spirit of scientific engineering and analytical thinking in the minds of the students as well as promotion of science education and generating creative talents to the children of our State. The challenge that the State is facing is to provide infrastructural facilities in Secondary Science Education. This paper will discuss the financing for infrastructural facilities in Science Education at the Secondary level in Meghalaya.

Introduction

We are living now in an age of rapid changes. Science is playing a dominant role in bringing about these changes. It is no exaggeration to say that at present Science influence every field of activities. The technological advances have explored and multiplied the possibilities of affording sustenance and comforts to human beings. Thus from cradle to grave scientific discoveries and inventions have inextricably woven themselves with the fabric of human existence.

Now, it becomes very essential to be in possession of some basic knowledge of science on the part of each individual. One encounters with innumerable events and objects regularly in his/her social and natural environment which regulates daily life. To understand these, a bit of manipulation of the basic knowledge in science is the prerequisite. The water we drink, the air we breathe, the food we take, the shelter we undertake the commodities we transport, the clothing we wear and in all spheres of our life we face a lots of problems. To get solutions to these we are bound to take assistance of knowledge which has got strong basis of science. Considering these aspects, science has been included in the school curriculum even from the elementary stage so as make human being an efficient one. In new pattern of 10+2 Education system science is one of the major subjects to be learnt in schools. Hence, the schools as well as the science teachers have immense responsibility in the changed situation particularly in teaching science.

Over the years, the Indian Parliament has adopted major policy statements S&T development. These developments have been largely guided by the Scientific Policy Resolution of 1958, one of the most comprehensive science policy documents ever approved by any legislative body in the world. The Parliament approved in 1968, the Technology Policy Resolution, which states that research and development together with S&T education and training of a high order will be provided a pride of place. Basic research and building of the centres of excellence will be encouraged. The quality and efficiency of S&T generation and the related delivery system will be continuously monitored and upgraded. The policy statement calls for strengthening linkages between educational institutions, R&D establishments, and industry and government machinery.

The central government has periodically constituted National Commissions on Education to assess the system of education and for recommending ways and means to diversify, improve and update the system, consistent with the changing environment. Some of the commission's reports were translated into National Policies on Education. Thus, the National Commission on Education of 1964 chaired by D.S. Kothari resulted in the preparation of the National Policy of Education in 1968. In 1986, the National Policy was suitably modified, amended and updated. This was further modified in 1992 in the light of Ramamurthy Committee's report covering a whole range of operational, financial and technical issues.

The statements emphasize education to be a unique investment for the present and the future, with emphasis on equal access on requisite merit, mobility of students and faculty and networking of educational institutions, R&D establishments, greater autonomy and accountability, relevance of curricula, excellence in research, and mobilization of resources. Thus the statement first made by the Kothari Commission that *the destiny of this country is shaped in the classrooms and laboratories of schools, colleges and universities* is re-echoed.

India has committed wholeheartedly to science and has provided the necessary policy support for S&T human power development. There is also a systematic planning process in place. The policies and plans have helped India develop a vast infrastructure for higher S&T education, and have provided the second largest manpower in the world, with the best in the system comparable to the best anywhere in the world. After all these all efforts taken by the government it would not reached the goal completely due to unplanned, unprecedented and irregularities of authorities. In the global village we have to maintain the standards in order to fulfil the need of the present student community. However, inadequate infrastructural facilities have been a problem for all the schools in the North east particularly in our State.

It is proper to know the perspectives and problems of science education in our State. The challenge that the State is facing is to provide infrastructural facilities in Secondary Science Education. Hence, this paper attempted to discuss the infrastructural facilities in Science Education and how they are financing at the Secondary level in Meghalaya.

Objectives

To make a survey of the existing provisions and facilities available for organising science Education Programmes in secondary schools in and around Shillong in East Khasi Hills.

Delimitation

The study is delimited to a sample of 20 secondary schools in and around Shillong in East Khasi Hills.

Methodology

The method of study is purely descriptive.

Tools and Techniques

An Interview schedule was developed to find out the facilities that are made available by the Government to the schools regarding the Science Laboratory.

A questionnaire was also developed with great care to elicit information from the Heads of Schools- the infrastructural laboratories facilities available at secondary level and qualifications of science teachers

Data Collection

The investigator interview the Officers and staffs from Science Cell, Directorate of School Education and Literacy regarding the status of financing the Laboratory of the Schools and Questionnaires were given to the Head of institutions to assess the availability of infrastructural facilities in the secondary Schools.

Analysis of the Data

The analysis of the data in this study is based on the Interview schedule questionnaire collected from the sampled secondary schools which have summarised below.

Major Findings of the Study

The major finding of the study is divided into parts. One part is the findings concerning the financing of the facilities provided by the Government to the schools and the second part is the availability of facility of Laboratory in School.

Financing of Infrastructural Facilities in Schools

i. *Infrastructural Facilities*: The financing of infrastructural facilities in schools is done by the State in case of Government Schools but these facilities are not available to the adhoc, permitted and private schools.

(a) One time Grant of 90,000/- was sanctioned by the Government through the Centrally Sponsored Scheme for improvement of Science Laboratory and 18,000/- for the Library assistance.

(b) Adhoc, permitted and private schools: The Adhoc, permitted and private schools do not receive any facilities from the Government. These schools have to furnish the laboratory before applying for the opening permission.

ii. *Science Grant*: There is a huge difference in the sanction of science grant. Government and Deficit Schools got the grants according to the enrolment of the students and as such there are more than two or three teachers who received the Science grant and the amount of the grant is as per the scale of pay of teachers whereas the science grant for science teachers for adhoc and permitted schools are only fixed for Rs 11,000/- only.

iii. *Programmes:* There are many programmes conducted by the government to inculcate a spirit of scientific enquiry and analytical thinking in the minds of young students. Some of these programmes are

(a) Science Seminars: These programmes are funded by the Birla Industrial and Technological Museum every year with the theme spelt out. It is deliberated generally to school, block, district and state level.

(b) Science Exhibitions and Fairs: The National Council of Educational Research and Training (NCERT) New Delhi organizes

Jawaharlal Nehru National Science Exhibition for children (JNNSEC) for popularizing science amongst children, teachers and public in general.

(c) Innovation in Science Pursuit for Inspired Research (INSPIRE) was launched on 2008 with an objective of attracting talents amongst students to study science and pursue career with research. The first component viz. INSPIRE Award Scheme implemented centrally through the States/UTs to two students from each school of Rs 5000/-each for preparing a science project model

Facility of Laboratory in School

1. Availability of a laboratory in school: 80 % said that the schools have Laboratories and only 20% said that they do not have.
2. Separate room for Laboratory: 80% of the schools mentioned they have a separate room for Laboratory and only 20% said that they do not have.
3. Responsibility of the laboratory: Only in 20% of the schools has a teacher has been given the responsibility of the laboratory.
4. Number of Science teachers: It has been found that 3 or four teachers for science and Mathematics subjects in Government and Deficit Schools whereas only one (1) teacher is sanctioned by the government for Adhoc and non permitted schools
5. Specify the number of experimental instrument available in laboratory and evaluate it.

Table 4.1 Evaluation of Laboratory Equipments

Sl. No.	Subject	Types of T.L.M	Sufficient	Appropriate
1	Physics	Charts	20	50
2		Three dimensional models	40	20
3		Experimental instruments	40	60
4		Other instruments	10	50
1	Chemistry	Charts	20	50
2		Three dimensional	40	50
3		Different Chemicals	40	50
4		Other instrument	20	40
1	Biology	Charts	20	60
2		Three dimensional models	20	30
3		Microscope	50	60
4		Other instruments	10	10

The types of TLM specified which are common for all the three subjects are Charts, three dimensional models and other instruments.

Physics

As can be seen from the table above, only 20% of schools mentioned that the charts in Physics, are sufficient and out of these only 50% are appropriate. Three dimensional models 40% said they are sufficient and out of these only 20% are appropriate. Regarding the Experimental instruments only 40 said they are sufficient and out of these only 60% are appropriate. Other instruments only 10 % said they are sufficient, and 50% said they are appropriate.

Chemistry

In Chemistry, only 20% of schools mentioned that the charts in Chemistry are sufficient and out of these only 50% are appropriate 50% said they are not appropriate. Three dimensional models 40% said they are sufficient. Out of these only 20% are appropriate. Regarding the availability of different chemicals available in the laboratory only 40 said they are sufficient and other instruments only 10 % said they are sufficient and 50% said they are appropriate.

Biology

As can be seen from the table above, only 20% of schools mentioned that the charts in Biology are sufficient and out of these only 60% are appropriate. Three dimensional models 20% said they are sufficient and out of these only 20% are appropriate. Regarding the Microscope available in the laboratory only 50 said they are sufficient and out of these only 60% are appropriate. Other instruments only 30 % said they are sufficient and 50% said they are not appropriate.

Applicability of the laboratory

The teachers were also asked to evaluate the applicability of the laboratory on the following indicators:

Ventilation and Sunlight: 60% of the schools said that the laboratory is well ventilated and well lighted

Water and Sink Facility in laboratory: Only 30% of the schools have water and sink facilities in the laboratory

Furniture for laboratory instrument: Only 30% of the furniture is available in the Laboratory and 20% are applicable

Electricity facility in laboratory: 50 % of the schools said that there is electricity facility in the laboratories and 30% are working

Organized arrangement of Experimental instruments: Only in 30% schools that the Experiment al instruments are organized properly.

Overall conditions of school laboratory: Only in 30% schools that the overall conditions are good.

Problems

The schools were also asked to describe briefly about the school laboratory on basis of physical facility. The Schools listed some of the main problems of their schools' laboratories as follows.

1. Insufficient number of seating arrangement and furniture.
2. Not fully furnished due to lack of funds.
3. The laboratory in the schools is an extended room in which some apparatus are kept. The room is mostly used for demonstration purposes.
4. The science lab is in the process of being revamped.
5. The school lab is temporarily built and needs to equip with more materials. The school has three laboratories for the three science subjects. The laboratory is not fully functional. However, improvement can always be made.

Conclusion

Resources available to the students in schools can influence students' achievement. Various indicators such as teacher's salary and educational level, availability of teaching materials can measure these resources. Although certain teaching strategies can be effective for very large classes, students are often unruly in these settings. Moreover, teachers in large classes tend to focus more on rote learning, rather than on problem solving skills

In the present scenario, as can be seen from the study, the financing of Science laboratory in secondary schools is inadequate. It is also identified that many centrally sponsored scheme did not take off in the State due to unplanned, unprecedented and irregularities of authorities. It is therefore suggested that the government should take all necessary steps to improve the condition of the Science laboratories in Schools if we are to inculcate a spirit of scientific enquiry and analytical thinking in the minds of young students.

5

Problems of Secondary level Science Education in Assam – Case study in Rangia Sub-division, Dist. Kamrup, Assam

Gitimoni Deka
Dwijendra Nath Deka

Abstract

Effective science education is the need of the human thirst to acquire more knowledge for better life has been encouraging research on various branches of science. Infrastructure Development of the Secondary & Higher Secondary schools is one of the core area of works for RMSA, Assam - Creation of adequate numbers of classrooms as per teacher–student ratio (TSR) & class-student ratio (CSR) including computer lab, science lab, library, art/craft/culture room, toilet blocks, drinking water facilities is being taken up for imparting quality education. Survey of status of science education in various schools shows that the science education in high school classes are in pathetic condition so far as infrastructure in Govt. high schools are concerned. To meet the national aspiration in line with the present curriculum, it is necessary to construct proper science laboratory with all infrastructural facilities e.g. practical working table with running water, proper placement of apparatus, chemicals, charts etc. The government should recognize education as a fundamental right in the real sense.

Introduction

Secondary education includes the final stage of compulsory education. It is a stage of education following primary school. Secondary education is also characterized by transition from primary education for minors to tertiary. It includes children of 14–18 years of age group covering almost 88.5 million populations according to the Census Report, 2001. However, enrolment figures show that only 31 million of these children were attending schools in 2001–02, which means that two-third of the population remained out of school.

India's education system is divided into different levels such as pre-primary level, primary level, elementary education, secondary education, undergraduate level and postgraduate level. The National Council of Educational Research and Training (NCERT) is the apex body for curriculum related matters for school education in India (India, 2009). The NCERT provides support and technical assistance to a number of schools in India and oversees many aspects of enforcement of education policies (India, 2009).

The Govt. of India launched Rastria Madhyamik Shiksha Abhijan (RMSA) in March, 2009 with the objective to enhance access to secondary education and to improve its quality. The 12th five year plan is guided by the vision of RMSA to provide access to quality secondary education for all. The implementation of the scheme started from 2009-10. It is envisaged to achieve an enrolment rate of 75% from 52.26% in 2005-06 at secondary stage within 5 years of implementation of the scheme by providing a secondary school within a reasonable distance of any habitation. The other objectives include improving quality of education imparted at secondary level though making all secondary schools conform to prescribed norms, removing gender and socio-economic disability barriers, providing universal access to secondary level education by 2017, i.e., by the end of 12th Five Year Plan and achieving universal retention by 2020 (HRD Ministry, 2013). Strengthening of 34300 existing schools have been approved by Govt. of India in which 23807 new science lab, 19641 computer rooms, 25869 libraries, 28969 art/craft/culture rooms, 19801 toilet blocks, 12370 drinking water facilities and 2020 residential quarters have been approved. Out of these 1881 science labs, 1585 computer rooms, 2090 libraries, 1726 art/craft/culture rooms, 2823 toilet blocks, 2611 drinking water facilities and 6 residential quarters have been completed and remaining structures are in different stages of construction (HRD Ministry, 2013).

Effective science education is the need of the human thirst to acquire more knowledge for better life has been encouraging research on various branches of science and the results discoveries and inventions in the twentieth century have been an eye opener to humanity (Mohanty, 2009).

Assam Launches Rastriya Madhyamik Siksha Abhiyan

In a bid to streamline school education system for children in the age group of 14-18 years, Govt. of Assam also launched the Rastriya Madhyamik Siksha

Abhiyan. The government is committed for the development of education sector. At present Assam has 2,060 secondary schools and 586 higher secondary schools.

The mission is to provide a secondary school within a radius of 5 kilometers and a Higher Secondary school within a radius of 7 to 10 kilometers of every habitation, and Gross enrollment ratio (GER) of 75% for class IX to XII (Goswami, 2013) . Another aim of the mission is to ensure universal access to education for children in the age group of 14 to 18 years. Severe shortages of science teachers, inadequate infrastructure and lack of facilities like modern laboratories in schools and colleges have discouraged many students from pursuing science in Assam (The telegraph, 2012).

The Rashtriya Madhyamik Siksha Abhijan, Assam, in association with Unicef and Assam Science Technology and Environment Council, has set up mobile science laboratories on specially designed vehicles to visit government high and higher secondary schools, which do not have laboratories. Again for popularizing science amongst the students of secondary & higher secondary sections, science exhibition programme at district level like "Bigyan Jeuti" will be organized. Infrastructure Development of the Secondary & Higher Secondary schools is one of the core area of works for RMSA, Assam - Creation of adequate numbers of classrooms as per teacher–student ratio (TSR) & class-student ratio (CSR) including computer lab, science lab, library, art/craft/culture room, toilet blocks, drinking water facilities is being taken up for imparting quality education.

Objective of the Study

The present study tries to reflect the condition of the essential infrastructural facilities for teaching general science course available in the Govt. secondary schools in Rangia subdivision area of Kamrup district of Assam.

Plan and Procedure

To collect information from different schools, a self devised questionnaire. It was distributed amongst the Principals/ Head masters and science teachers of the study area.

Sample

The data collection was done on a random sampling basis. Rangia is a Sub-divisional head quarter of Kamrup (Rural) dist. In the subdivision, there are 65 numbers of Govt. high/higher secondary schools from which students appear for High School Leaving Certificate examination every year. To enquire about the infra structural facilities available for teaching basic science course in Class IX & X, the researcher visited fifteen number of school in and around the Rangia town.

General Science Syllabus for Class IX & X

In Assam, from this (2013) academic session, CBSE course has been introduced in secondary classes. For Class IX & X following chapters has been incorporated in their syllabus

Table 5.1 Topics in Science Books of Class IX and X in Assam

Class IX		Class X	
Chapter No	Name of the Chapter	Chapter No	Name of the Chapter
1	Matter in our surroundings	1	Life processes
2	Is matter around us pure	2	Heredity and variation
3	Atoms and molecules	3	Organic evolution
4	Structure of the atom	4	Environment
5	The fundamental unit of life	5	Wave motion
6	Tissues	6	Reflection and refraction of light
7	Diversity in living organisms	7	Electricity
8	Motion	8	Electromagnetism
9	Force and laws of motion	9	Chemical bonding
10	Gravitation	10	Neutralisation and redox reaction
11	Work and energy	11	Organic compound
12	Sound	12	Metal and metallurgy
13	Why do we fall ill	13	Common industrial chemicals and materials
14	Natural resources	14	Renewable and non-renewable sources of energy
15	Improvement in food resources		

The present batch of Class X appearing H.S.L.C exam in 2014 is the last batch pursuing state board syllabus.

Text book

The text book is published in vernacular medium i.e. Assamese, Bodo, Bengali, Hindi etc. by Assam Text Book Production Corporation.

Observations

- None of the school is getting regular funding from Govt. agencies.
- In 2003, some schools received certain scientific instruments, chemicals, apparatus, biological specimens, life cycle charts, geometric instruments etc. from some Gauhati based "Scientific farm" or NGO.
- Some schools were handed over a letter from the supplying agencies that the supplied materials were under Govt. scheme of improvement of "Science Education, 1994-95".
- None of the schools received any cash/cheque amount from government.

- No school received any price list/ warranty card of the supplied materials from supplying agencies.
- No furniture was supplied to keep all these materials by the supplying agencies.
- It was found that the government schools covered under this study kept all these materials in an unsystematic way. That is, the school Headmaster/ Principal/ Science teacher some how "accommodate" these materials in School staff rooms as they do not have any extra space/rooms/store rooms to keep these materials.
- No laboratory facility is available for Class IX & X in any Govt. school in study area.
- There is no formal practical class allotment was found in daily class routine.
- There was no provision of training exclusively for teachers for conducting "Practical experiments" from Govt. or school administration/management side.
- The Board of secondary Education, Assam introduced "Science Practical" in General Science subjects from 2009 for Class IX & for Class X from 2010.
- Students appeared in High School Leaving Certificate Examination, Assam, from 2011 attended "Science Practical" Examination for 20 marks, which was conducted by the school itself internally. The school authority later sends the marks to Board for final "general Science" marksheet preparation. In Board examination, students appeared for 80 marks "general Science "theory examination.
- Students in Class IX sit for practical examination in half yearly & annual examination. In class X, students sit for general science practical examination in half yearly examination only.
- The teachers of general science course conduct only two/three science experiments (e.g. dissection of China rose [Hibiscus rosasinesis} & dhatura [Datura stramonium]; filtration, charts preparation) before the commencement of the examination.
- There is no separate science teacher for teaching biological science part, physical science or chemical science part of the text book.
- Whatever science teaching kits are available in the schools like microscope, charts, models of human body and others are very rarely used.
- None of the schools have the experience of organizing any science exhibition.
- None of the school under study area has any experience of any programme organized under RMSA till June, 2013

Conclusions

- The science education in high school classes are in pathetic condition so far Govt. high school is concerned in rural Kamrup of Assam.
- Every year students come out of from those schools with "Good results" (marks?) but their knowledge of basic science is very poor.
- Science teachers of these schools are reluctant to use or apply the science teaching kits at their disposal for the benefit of the students.

Suggestions

- Proper implementation of RMSA.
- To meet the national aspiration in line with the present curriculum, it is necessary to construct proper science laboratory with all infrastructural facilities e.g. practical working table with running water, proper placement of apparatus, chemicals, charts etc.
- Proper training of Science teachers from time to time as per up gradation of school level science syllabus.
- Govt. should build up laboratory infrastructure for motivating both teachers and the taught.
- The government should recognize education as a fundamental right in the real sense. And as such adequate and equal opportunities should be provided to all children irrespective of caste, creed, gender, region or religious status. But this does not appear to be the reality. The central and state governments' education policies have not been able to reach equally to all sections of the society; rather the privileged class gets the best of it. To change this situation all the stakeholders in the secondary education system – the children, parents, teachers and educationists – assert their views and take united action to have the right to education for all. The right to education is a universal and inviolable right. Let's make this happen.

References

1. Goswami, Dr. Dulumoni, *Secondary Education under 12th plan*, The Assam Tribune, May 29, 2013, pp 6.
2. Human Resource Ministry, GOI, April, 11, 2013.
3. India 2009: A Reference Annual (53rd edition), 233.
4. Mohanty, Gitanjali, *Essential facilities for quality bioscience teaching in secondary schools,* Journal Of All India Association for Educational Research, Vol 21, No. 1, June, 2009.
5. The Telegraph, Wednesday , October 3 , 2012 Guwahati.

6

Capturing and Retaining Talents in Basic Sciences

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Abstract

Changing mind-set and having rational approach to life is pre-condition for developing Scientific Culture. Children can be introduced gradually to basic scientific concepts that will provide a framework for understanding many scientific facts and observations at home or in the community. So to effectively bring the best talents, what requires is to sow a science's seed in the mind of the individual and then polish them through all the above mechanism.

Introduction

Science as an academic discipline focuses on curiosities, explorations, formulation of hypotheses, tests through experimentation and finally document findings. Though serious, a field of study requires dedicated effort, in which learning science can be fun. There are ways to get one interested and engaged in science at a young age and this can be done firstly by removing the fear that science is all about endless reading and writing. Once the fear is removed and is initiated, he or she can gradually be introduced to the academic rigorousness and discipline of serious scientific study. The present paper seeks to explore the few dimensions that possibly can change the mind-set towards basic science and make teaching-learning basic science more effective and interesting.

Five fingers that make a strong fist of Basics Sciences

Developing Scientific Interest\Temper at Home

Children can be introduced gradually to basic scientific concepts that will provide a framework for understanding many scientific facts and observations at home or in the community. Parents can immensely help their children develop and incite an interest in mathematics, science, and technology by exhibiting attitudes and values that support learning such as:

- Listening: One of the most important point that parent can do to arouse and create an interest in science in their children is by Listening to children's ideas and explanations.
- Avoid Negative Statement: Most of the time we parent induces a fear psychosis in the mind of our young children about science or math by our "negative" statements like "I never liked these subjects when I was in school" or I got my worst grades in these subjects", or "These subject are very tough" this would discourage them to take science/ mathematics. Rather we ought to be positive as the thinking capacity of our children is different compare to ours. Thus helping a child to learn by providing him with safe, interesting learning experiences in a supportive and positive atmosphere will definitely encourage them toward science.
- Daily Applications: Help children see the mathematics, science, and technology that exists around them that they encounter in their daily lives. Point out how these subjects are used around their home or in their community. Involve your children in family activities and "everyday" jobs that use mathematics, science, and technology. Activities such as determining how much paint is required to cover a room of 100sq ft (say) when a litre covers 10 square feet.
- Application in Career: Encourage your children to ask questions and to find out how much mathematics, science, and technology are required in "science-related" career / jobs and the amount of education required for them.
- Participating in Informal Learning Activities: Activities that are not mandatory and occur outside the school (i.e., formal learning) is one of the excellent ways to help children develop an interest in mathematics, science, and technology. Museums, science centers, planetariums, aquariums, and zoos are some of the many informal learning opportunities that exist within the community. Parents can also instill scientific temper in the mind of the children by insisting their children to watch science related channels that shows the application

of science in every aspect of life such as the Discovery Channel, National Geographic Channel etc.

- Encourage asking Questions: Help the child to look for changes by asking him to observe, make reasonable predictions, asking questions and to seek answers as science is about question and reasons. This is to make him/her prepare to look at the world in a scientific way such as:
  - a) What happens over time when a plant isn't watered or exposed to proper sunlight?
  - b) What changes can be reversed? Once water is turned into ice cubes, can it be turned back into water?
  - c) If an apple is cut into slices, can the slices be changed back into the whole apple?
  - d) Why does sun always rise in the east every morning?
  - e) Why do we have four seasons?
  - f) Why do we have to eat?
  - g) Why do we use units such as kg, liter, meter etc?
  - h) What is the main composition of toothpaste?
  - i) For instance, low barometric pressure is often followed by storms.
  - j) Why do we see brown layer on iron when keep in the open for months?
  - k) Where do all the sugar disappears when tea is poured?
  - l) Why do we see rainbow after rain?
- Evidence, Models and Explanations : Parents can come up with models and evidence to base their explanations and results of their tests so that children can test their theories such as why baking soda is required to make bread rise and why when added in excess the bread becomes sour.
- News paper Reading: Habituate a child to check out the health, science and technology sections of the news paper as a lot of information on the current developments in the scientific field or sciences related issues are reported.

Educational Institution

Educational institution is the ideal place for creating, igniting the interest and synthesizing the raw unpolished scientific mind to bring the best genius mind and dynamo great scientist. Every Educational institution comprise of three inseparable components such as i) Management ii) Faculty members and iii) Pupils. Hence good co-ordination of these three pillars can really encourage, instil, tap and promote the interest and decisiveness in the professional mind-set of the youngster in basic sciences. Here are some of our suggestions that can be look upon such as:

- Curriculum: Make curriculum interesting to attract talent. Curriculum that inculcate excellence in basic sciences and encourage the aptitude to convert concepts and discoveries in technologies and also by incorporating up-to-date topic in the syllabus with ample opportunities to encourage creativity, innovation and experiential learning. Curriculum be framed by competent teachers keeping in mind with the need of the hour.
- Evaluation system: The system should move from examination based evaluation to more open assessment mechanisms for all year round performance. Memory, comprehension and creativity should be given equal importance in evaluation. Year through continuous assessment on the performance of the students at the school level will reduce dependence on year-end examinations. To enable the modifications in the evaluation process, teachers need to be trained in new methods of evaluation.
- Innovative Practical Class: Allocating separate timing at least once a week to have innovative, simple and practical class to unlock and explore the potential of students in the field of basic sciences and also to make mandatory for science faculties in school to undergo science course training program once a year that impart new ideas so that they can motivate their students and have inspiring lecture for basic science.
- Brain Storming Sessions: Organizing brain storming sessions both intra & inter-school or college like seminars, debates, and lectures on new technological invention or current science issues.
- Local Issues Research: A unique program that motivates children to take-up scientific research on specific local issues of their choice. (eg program that will help to eradicate the superstitious believe through experimental proof).
- Scientific Excursion: Encouraging scientific excursion at school level and college level that will create a chance for interaction with scientist and their working atmosphere.
- Scientific Forum: Creating Scientific Forum at school and college level to exhibit/execute/showcase their creativity and innovativeness and more particularly their ability to solve a societal problem experienced locally using the method-of-science.
- DO-able Projects for Students: 'Do-able' Projects or a real experiment to promote 'methods of science' with ample opportunities to

encourage creativity, novelty and experiential learning (learning by doing) for students with the help of school/college science teachers, coordinators of school/college science clubs or science activists based voluntary organizations, Environmental organization etc to improve science education and to have more knowledge about other science burning issues.

- Incentives to Toppers: Educational institution can very well create a competitive atmosphere in their respective institution by giving incentive or acknowledgement to toppers in basic sciences.
- Personnel Development: Improving personal development of teaching faculties such as providing good, safe, secured and amiable working atmosphere with new applicable technologies, teaching aid and recognition of their contributions in letter and spirit through good pay/ incentives and acknowledgment.

Government Institutions

One of the most important institutions that can attract talented individual to the area of basic science and retain them are the Government institutions. What is required is the vision of those people in the government and more importantly the will to implement various schemes/ packages both in letter and spirit. Here are our few points that can be explored.

- Formulation of Policies: Formulation of policies relating to Basic Science converting to Technology.
- Grants-in-Aid: Support and Grants-in-aid to Scientific Research Institutions, Scientific Associations in university, college as well as schools and individual be awarded to high-level promising research projects in biology, chemistry, mathematics and physics so as to able them to work in bringing the practicable application of knowledge of Basic science to the society and to create facilities to demonstrate technologies.
- Employment: Considering ways and means to employ science graduates in the universities, and research labs run by the Government or any other government agencies or have a Tie-up agreement with industries that will be able to absorb them.
- Go - Village Policies: Formulating rules that mandate all Research students in chemistry, physics or Math to go to village schools and kindle children's interest in science learning.
- State level Basic Science: Promotion of basic Science at the State, District, and Village levels for grass- roots development through State Science and Technology Councils and other mechanisms.

- Basic Sciences Week: Organize a 'basic sciences week' nationwide and holding 'demonstration labs' in crowded shopping mall areas. Demonstrating interesting experiments to kindle youngsters' interest so that they could later do science. A science popularization programme be launched to effectively cover children across India. This programme should bring all popular science activities under one umbrella for rapid implementation and replication of successful initiatives. A large chain of science talent cells should be created and each school should be funded to open a science club and mobile lab. The effectiveness of mobile labs in reaching the rural students and teachers is very high.
- Children's Science Congress: Having State Children's Science Congress in line with the National Children's Science Congress (NCSC).
- Centres of Excellence: Some colleges/university departments be named 'Centres of Excellence' in basic science especially those Rural Institution to attract the best talent both from urban and rural areas.
- Teacher-Student Ratio: Educational institution should be generously funded to upgrade their staff and facilities by making Teacher-Student Ratio in school and colleges proportionate with those of the universities so as to properly assess the performance of the students.
- Business Set Up: Above all, creating a stable platform for intermediate or graduate students so that they can start their business establishment either as individual or groups/companies by using their acquired knowledge or information converting them into industrial products such as making of soaps, making of Jams or small electronic devices or manufacture of organic manure, pesticides etc., through promotion by formulating policies that will include:
  - i) Providing financial help or subsidiaries for their business set- up;
  - ii) Free advertisement of their products;
  - iii) Minimum government taxes on their products;
  - iv) Expert Government inspectors who acts as catalyst in refining their industrial products through suggestions or ideas;
  - v) Pumping more resources in the sick industrial units;
  - vi) Creating a healthy competitive commercial atmosphere;
  - vii) Supporting mini-research facilities in each industrial unit;

Industries Play a Big Role in Promoting Basic Science

As we know that all the information and knowledge that a student obtained after studying for more than a decade right from the start of his or her education is to convert them into industrial product that benefits the society at large. Hence industries play a very important role in attracting best talents in the field of basic science such as:

- Job Placement-Many of the science students from universities are absorbed in the industries as industrial professionals or scientist. If industries create/provide jobs for students after graduation, this will further attract many students to opt for basic science after their higher secondary or degree level as large number of students would prefer to be employed at young age and some students prefers not to study for a long period of time to get better placement. Basic Science colleges should collaborate with research institutes and industry for campus placements.
- Study Tour- industries should permit school or college students to visit their industries for learning purpose providing them a brief demonstration about the various works that they perform especially stressing how they have used knowledge of science for the various products/developments they have obtained during academic learning.
- Funding - Academic institutions should develop groups at each institute which specialize in developing novel funding mechanisms involving industry and explore other possible modes of industry participation. They can also provide funds to students/teachers at various level to carry out projects.
- University-Industries Partnership-Companies and universities when working hand in hand become a powerful engine for innovation and economic growth. The long-running collaborations between these two will give rise to new technologies and transform industries while improving and updating the role of the university to new scientific developments.
- Scholarship - Industries should be encouraged to sponsor Graduate students for Masters and PhDs in science and also internships of longer duration in industry for post graduate students.
- Engagement- Industries engagement with students right from school and early university level by can start a Student- Industrial study as part of the mandatory curriculum comprising of seminar, popular talk or simple project for at least a month for every academic year. This will make Science students exposed to various applications of science in industry through seminars and popular science lectures by industry leaders

NGOs can Promote Basic Science

A major problem today is to find ways and means to attract the most talented youngsters to Basic Science at a young age. NGOs can help a great deal in promoting basic science in our country. Following are our opinions that NGO can contribute in attracting talents in basic science.

- Setting of Organisation: Concerned individuals or associations can set-up or form some kind of organization to encourage students to take up basic science as their profession by providing important information about the wide scope and future of basic science. They can create awareness in the society by delivering lectures in various localities and this way they can reach the majority of students population.
- Parent Science Society: Majority of our parent population are either science illiterate or not educated at all, so it becomes difficult for them to guide their children for they do not have much idea about the scope and career that the basic science can offer. So they tend to force their children to go to other lucrative professional courses where there is sure future not knowing that there is a good and satisfying career that basic science can offer. Hence, creating an NGO consisting of parent such as Parent Science Society/Association that is capable to disseminate information about the career prospects in basic science and other allied courses is going to be most rewarding.
- NGO Scholarship: Not only that NGOs can promote basic science only by providing information about the importance/ scope it offers but can provide Schemes meant exclusively for science students such as giving awards/scholarship/free books or study materials to outstanding science students after the 12th standard, graduate or M.sc level in collaboration with scientific agencies and socio-economic departments similar to the DBT's program.
- Platform: NGOs can also provide a platform for students to showcase their talents like holding up minor science fairs/exhibitions/competitions in collaboration with other government agencies.
- Watchdog or Critics: NGOs are very clear about the fact that their role is not to replace the government, but to act as watchdog or critics to see that the government fulfils its duty and obligation to its utmost capacity in ensuring that the government successfully covers educational requirements, with respect to quality, affordability and equity in mind and also in implementing science scheme both in letter and spirit.
- Scientific Tool: NGOs can encourage individual groups or communities to use scientific knowledge in developing new simple scientific tools that can be used in agriculture, handloom, and small-scale cottage industries.

- Pressurising NGO: NGO can pressurize government in the introduction of some high quality undergraduate science programs at selected institutions in addition to the ongoing programs to attract the talented students to the science streams.

Conclusion

Science originates in the mind which leads to imaginations then postulates into theory, proves by experiment, manufacture in the industries and finally uses by all mankind. So to effectively bring the best talents, what requires is to sow a science's seed in the mind of the individual and then polish them through all the above mechanism.

7

Designing of Curriculum for Promoting Science Literacy in Bangladesh

Khan Ferdousour Rahman
Sabina Yeasmin

Abstract

Developing scientific values in students' mind is an important goal of science teaching. Bangladesh, of late, has adopted various strategies to educate the people and mainly the children. However, there are still many challenges for the country to overcome and to attain an acceptable standard of education, where science education is in fact in a state of crisis. The enrolment for science studies in the country shows a sharp decline over the past few years. This discipline, what once used to be the most sought after subject at secondary, higher secondary and tertiary levels, is losing its appeal in an alarming shift of choice. A thoughtful and well-planned *curriculum design can* create interest among the students. This paper aims to present the current situation of the country in terms of science and technological development in education sector and suggests measures for improvement through properly designed curriculum.

Keywords: *Science, Literacy, Education, Technology, Curriculum.*

Introduction

Background

Science and technology (S&T) has undeniable impact in all sectors of national and international affairs. It has been so nourished through centuries that it has, at last, reached the highest peak of perfection, beauty and brilliance. It is an outcome of human culture that speaks eloquently of man's ceaseless endeavours for higher and higher attainments. In view of its need and importance one can in unequivocal terms conclude that S&T enjoys a global popularity now as it did in the past. But, why? Because, it is a dynamic and forceful discipline as one can easily grasp, learn and use in everyday life. And that is why science now occupies a unique place of dignity and earns the admiration of the world people leading them on, as if, to unveil its deeper mysteries.

Bangladesh, one of the most densely populated countries in the world, extends over an area of 147,570 sq km with a population of around 160 million, half of which are women. The country faces the challenge of becoming a learning society, and ensuring that its citizens are equipped with knowledge of S&T, skills and qualifications they will need in this century; so that with insignificant natural resources and a huge population on a small piece of land, it can be developed through scientific and technological means.

Statement of the Problem

Science education here in Bangladesh presently is in a state of crisis. Though many scientists, born and educated in Bangladesh but now living in western countries, have contributed and are still contributing significantly to the advancement of S&T. Even in colonial days, Bengalis like Jagdish Chandra Bose, Satyen Bose and Meghnad Saha proved commendable science skills. Our society is in increasing need of S&T based professionals to carry the nation into a technologically driven future. As a society, if we are increasingly ignorant about science, and if that continues, it is going to cost us.

Ours is really a critical situation in the matter of learning and teaching science and we cannot force it out. We must not forget that S&T shall stay in Bangladesh, whether we want it or not. It shall not say for its own sake but for the sake of our individual, national and international interests. But of late science started to be neglected. By undermining science thus we painfully noted the fall of a great discipline from a magnificent state. Such deterioration has deterred the progress of science and diminished its enthusiasm in learning and cultivating the technological progress. The result of such position is, by and large, detrimental to the nation.

So far we have failed to address the problem of making science events popular among science students and scientists, at least as popular as entertainment or sports. This has resulted in making it difficult in organize science events due to the absence of sponsorship even from technology-driven companies who would prefer spending their money in areas other than science. The future of Bangladesh lies in the knowledge but our ability to generate new knowledge and use of innivatively depends upon scientifically literate population.

Objective of the Study

The broader objective of this article is to explore the status of science education in Bangladesh including its prospects and challenges in general and finding recommendations for way out in particular.

Approaches to the Problem

Literature Review

Bangladesh faces considerable challenges concerning illiteracy, secondary and tertiary education as well as in the area of science education; as within the current climate in Bangladesh, S&T education receives less priority in policy formulation (Alam and Khalifa, 2009). Again, Siddique (2011) finds there are differences among different groups of citizens on what should be the goals of 'science education' in Bangladesh. Some people call for using science education as a tool for removing superstitions and religious extremism from the society whereas some argued for a religious focus of science education. Ashraf (2008) and Choudhury (2009) see science, what once used to be the most sought after subject at secondary, college and university levels in the country, is losing its appeal in an alarming shift of choice.

Now-a-days, science education throughout the world promotes 'scientific literacy' which has been characterized as consisting of four inter-related aspects: contexts, knowledge of and about science, competencies, and attitudinal aspects of science (Akhter, 2011). Alam (2008a) observes that the number of female students in science at higher education is even less than 20 percent; whereas UNESCO (2007) finds the under representation of women in S&T as a worldwide issue. Kaykobad (2012) opines that the academicians have immasurably failed to play their role in motivating due appreciation of the society for knowledge works. However, Siddiqui (2011) sees that in line with recent global trends, the science curriculum in Bangladesh sets a goal of promoting selected values through teaching science. But Sarkar (2011) finds the classroom science teaching here is textbook oriented and examination based, where students are assessed by the items taken from the textbooks and tests often demand answers to be copied from the textbooks. However, it is encouraging that under such situation the need for science education as well as faster technological development is increasingly felt in the country.

Research Questions

S&T education needs to be developed to confront the challenges of 21st century. It is time to make aware the society and policy makers to seriously consider this issue. Thus in doing so, the paper will take endeavor to answer the following research questions:

i) What is the present status and challenges of science education in Bangladesh?

ii) What are the ways to bring back the days of glory of science education?

iii) How to popularize science education to create a group of scientists who would work devotedly to find solutions to the challenges facing the country?

Methodology of the Study

The study is conducted mainly on the basis of secondary sources of data. In order to collect the secondary data, comprehensive literature reviews of related field have been studied. In doing so books, journals, newspaper clips, published and edited archive records and other existing resources available were explored for gaining access to the updated scholarship on S&T education. Data were analyzed and summarized according to content and context of the study.

Discussion and Findings

Curriculum

In formal education, a curriculum is the planned interaction of pupils with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives. It is a dynamic and ever changing series of planned learning experiences. The term is often used to describe the goals, methods, materials, and assessment. Kerr defines curriculum as, 'All the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school (cited in Kelly, 1999).

Role of Education

A Chinese proverb regarding 'education' goes thus "If you want to think one year ahead, plant rice; if you want to think ten years ahead, plant trees; but if you want to think hundred years ahead give education to people." Education is the key to creating, adapting and spreading knowledge for technological transformation in the network age. It is considered as one of the basic requirements for human resources development and plays a vital role for the development of a nation and many countries made required progress through education. Nevertheless, some of them also failed to retain the development achieved since these countries failed to supply required skilled workforce.

Science and Technology Education

Now-a-days, science education throughout the world promotes 'scientific literacy' which has been characterized as consisting of four inter-related aspects: contexts, knowledge of and about science, competencies, and attitudinal aspects of science (Akhter, 2011). Scientific and technological know-how, not the amount of natural resources, determines the development of a country. Much of the relevancy of science to human being and to society arises by way of technology, which is the bedrock of scientific investigation. Science brings reason and enlightenment, provides ideas for technological innovations, and improves the quality of life; whereas technology, in turn, provides science with new tools and instruments for doing research, for the storage and dissemination of information and for stimulation of further research. However, building scientific capacity is much more than just technology transfer.

Science is no longer confined within the borders of a single nation. Mobility of scientists is now a universal character of science. There is increased cooperation and exchange of information between scientists of different countries — developed and underdeveloped alike. S&T complement each other via complex, two-way interaction. In today's knowledge-based society, S&T, as we are being constantly reminded, have become an integral part of our everyday lives. In case of developed nations, the leading factors responsible for economic development are innovations through scientific knowledge. Since the 1950s, a number of reform movements brought revolutionary changes in the science curriculum of western countries. The countries that achieved sustainable development have given a high priority to S&T education in formulating education policy. The underlying reason for the inequity between the developed and developing nations is due to the widening gap in S&T. UNESCO (2007) finds the under representation of women in S&T as a worldwide issue.

Education in Bangladesh

There has been a remarkable development in education in the last 40 years in Bangladesh though it is yet to achieve the quality in all tiers. The country conforms fully to the Education for All (EFA) objectives that began in 1990 in Jomtien and the Millennium Development Goals (MDG). She is also a signatory to the Dakar Declaration of 2000. Again Article 17 of the Bangladesh Constitution provides that all children between the ages of six and ten years receive a basic education free of charge. The educational system in Bangladesh is three-tiered and highly subsidized. The government of Bangladesh operates many schools in the primary, secondary, and higher secondary levels. However, the education system of the country suffers from very low level of external and internal efficiencies and is mostly non-responsive to the employment market demand (Alam, 2008b).

Although budgetary allocation for education sector has increased over the years in Bangladesh, the share of this budget as percentage of the total budget and the GDP (gross domestic product) is witnessing a declining trend for the last few years. An allocation of Tk 25,114 crore for education sector of the country was set for fiscal year 2013-14, which is the third largest allocation as per as the sector is concerned; but the percentage of the allocation declines to 11.3 percent from 14.3 in the revised budget of 2009-10 fiscal year. Its highest value over the past 40 years was 2.56 percent in 2007, while its lowest value was 0.94 percent in 1980 (World Bank data). The Dakar Declaration of UNESCO sets a 20 percent budget goal and prescribes that at least 6 percent of a country's GDP be allocated to education.

Current Situation of Science Education in Bangladesh

Like many other countries in the developing world, science education in Bangladesh tries to follow the western world in reforming the system. Since the independence of Bangladesh in 1971, this has been reformed several times following western models. The reforms included development of new curricula, training of teachers, and the publication of new government sponsored textbooks. However, stakeholders remained unhappy with the outcome of these reforms. Due to the lack of academic research by science educators, the reasons for the unsatisfactory outcome of the reforms have not been identified.

Science education starts from primary school (Grade III) in Bangladesh. In the beginning, student studies basics on natural sciences, such as life of trees, flowers, etc. From Grade III to Junior high school (Grade VIII) student studies the basic composite science subject (Physics, Chemistry, Biology) and general Mathematics. From Grade IX students are divided into the following groups on the basis of their interest: biological science group, physical science group, arts group, and commerce group. Science subjects are also taught in Madrasha (religious school), but in a limited scale where basic Physics, Chemistry, Biology and Mathematics are taught. There are around 15,298 secondary schools (BANBEIS, 2008) at present in Bangladesh. The number of science students at secondary and higher secondary level in 2010 had plummeted to almost half that of twenty years back. A recent study of BANBEIS (2011) shows that number of science students in decline as more and more opt for business education.

Table 7.1 Decline of Number of Science Students at Secondary & Higher Sec. Level in Last 20 Years (1990-2010)

Decline in 20 Years		
Year	Exams	Science Students of the Total Examinees
1990	SSC	42.18 %
2010	SSC	22.35 %
1990	HSC	28.13 %
2010	HSC	18.34 %

Source: BANBEIS, 2011

For our survival in the 21st century competitive world, the country has no alternative out to use science education as a tool for improving the living standards of the people and for dealing with the economic and environmental challenges it faces.

Findings

- Bangladesh lacks trained personnel necessary for intensive technological development. Only few scientists are engaged in research and development (R&D) in the country.
- In the name of globalization and for neo-liberal economic policy, multi-national companies are penetrating into the country with their products, which has perhaps increased students' interest in business studies and even students with strong skills in physics, chemistry, and mathematics are opting for such discipline.
- Science is related to research, but it lacks in practical application in the country as there are absence of required research institutions in the country. There are fewer science-based jobs in the country and most industries in the country do not have R&D facilities. The savvy state of our industries, including ICT, has resulted in the setback of science enrollment.
- Science education is losing its importance because of the teaching methodology and teachers also cannot inspire the serious and meritorious students to take up science for their studies. Science education is regarded as difficult and only attracts top students in schools and colleges. Even students with strong skills in physics, chemistry, and mathematics are opting for business studies.
- Science education is made more difficult by poor and unattractive teaching and too much unnecessary workload with poor or no laboratory facilities, computing, or Internet facilities.
- The societal changes have profound implications for science education in the country. In the past a science teacher in the country invariably implied a person with strong background in science and mathematics. But unfortunately, today students in Bangladesh can earn a B.Sc. degree without mathematics.
- The present scenario of science education in secondary schools, particularly of rural areas is horrifying. Lack of brilliant teachers and school infrastructure including laboratory facilities and lack of subject oriented job after completing the education have been identified as the major issues for declining science in school level education.
- In many secondary schools there is almost no scientific equipment and no chemicals are available.

- The curricula and syllabi prevailing are not apt to create interest in learning science.
- We have been unable to impress young students with the beauty and joy of science. Science textbooks are not written with the aim of creating inquisitiveness in children, nor for their enjoyment and thus fail to fire a spirit of inquiry. The intermediate level science curriculum is also not consistent with secondary level.
- This trend of decline in science education is noticed also in the universities. In a typical private university, more than half of the students are enrolled in BBA program because it is easier to get good grades and then good jobs. More so most of the private universities in the country offer business program but rarely any basic science subjects (Alam, 2008a; Alam and Khalifha, 2009).
- Some of the problems identified as common in both secondary and higher science education include lack of laboratory space, lack of funding, and inexperienced and fewer qualified teachers with poor salaries and lack of motivation.
- One important way for students to find joy in science is through commonplace scientific experiments. By directly observing cause and effect students internalize knowledge. However, experiments are not emphasized in schools and colleges, partially due to insufficient funds for purchase of scientific instruments and constructing laboratories.
- Weak curriculum and textbooks, weak teaching and assessment methods, lack of properly trained teachers and laboratory facilities, irregular practical classes, poor salaries of the teachers, and students' sliding interest as some of the main reasons for qualitative and quantitative decline of science education. Poor teaching quality and lack of infrastructures are also responsible for the declining number of science students.
- Under the existing system, one needs private coaching to study science in the country, which can be afforded only by the affluent as it is expensive.
- Commerce, on the other hand, is a lot easier to study and to get good marks in. One can get into a BBA program which has a lot of job opportunities. Students are losing interest in science related subjects as science graduates are facing difficulties in job market.

Conclusions and Recommendations

Recommendations

- The country has no alternative to using science education as a tool for improving the living standards of the people and for dealing with the economic and environmental challenges it faces.

- Our education policy is mainly examination-oriented that evidently does not create quality. Mere pass and good results are what the learners aim at. This is not conducive to realizing the objects of education in general. A comprehensive, clear and realistic policy of education with particular emphasis on science is needed.
- There should be a national science policy. Although the present government envisages building a 'Digital Bangladesh', its apparent failure to address the problem has frustrated the scholars, who fear this trend would create a huge dearth of human resources educated in S&T in near future unless urgent steps are taken to attract more students in science education.
- The availability of skilled and capable teachers having appreciable bias in science is a problem. It is no denying the fact that good education is possible in the hands of good teachers.
- Recruiting quality teachers and building capacities of the existing ones through e-learning using ICT based materials, and for regular organizing of science weeks and science fairs can improve the existing situation.
- Salary and other benefits of teachers should be given due consideration and science graduates need to be motivated to become teachers.
- A permanent commission should be formed for recruiting teachers for appointments and to attract science graduates to science teaching, there is a need to formulate a policy that will ensure jobs for them with handsome salaries.
- Appropriate training should be imparted to the teachers to make them capable of teaching the respective subjects of science discipline.
- There is an urgent requirement of building up laboratory and other infrastructures. Required equipments and chemicals need to be supplied to the B and C category secondary schools to have better scientific education.
- Academic supervision is also required to get better result from the teachers. To have better knowledge on science subjects, it is understood that laboratory assistant is necessary in all the schools.
- The interest of learning science is seriously lacking among the students and the want of atmosphere conducive to learning of science is a problem. These are to be adhered to and carefully avoided.

- A learner-centered approach to teaching and learning should seek to ensure that students are regularly engaged in practicing science rather than memorizing without understanding the contexts of the textbooks.
- It is more important to write good science books making it simplified and attractive. Scientific instruments from indigenous materials may be used in order to reduce the investment.
- Competitive events and appropriate campaign should be launched at a regular interval in schools to popularize science education among children.
- Mathematics should be made compulsory for science students. The 'Math Olympiad' model can be replicated to attract students to physics, chemistry and biology.
- Government should provide scholarship to attract more students to science studies. Scholarships should also be provided for young faculty members for higher studies and research.
- The science curriculum should be updated to make it attractive and enjoyable to the learners. It must be need based and students should be encouraged to scientific ways of thinking.
- Science should be made compulsory at the secondary level and the SSC and HSC science curricula to be coordinated, so students are prepared enough to tackle higher level of science when they enter colleges after graduating from high schools. In fact a better coordinated science curriculum is required at every level of the education system.
- The entire process of learning science should have a job oriented aim. Once it is made learner-oriented, it will be most effective as a proper mechanism for job-oriented end in the national and international situations. Steps should be taken to create more jobs for the science graduates and to do so, the country has to be production-oriented and the labor market should be expanded.
- Disparity in urban and rural education facilities should be eliminated and there is an urgent necessity of additional budget allocation in education sector to enhance teachers' capacities and update the curricula.
- A national science convention and similar events at district levels should also immediately be organized.
- A terrestrial television channel may be dedicated to broadcasting educational programs, which will help both teachers and students by reducing the latter's dependence on private coaching centers.
- Last but not the least, commitment of the government to create a S&T-driven economy to face challenges of the 21st century is an utmost priority.

Concluding Remarks

The effort to bring back the glory of science education in the country has been envisaged as the most timely measure to restore the importance of science in our country. One can hardly deny the role science plays in the modern world. It helps the nations making steady progress in all walks of life. To keep pace with the progress and prosperity in the comity of nations, science can help us enormously. But the state of science teaching in schools and colleges in Bangladesh is far from satisfactory. So the urgent need for bringing back science education to the mainstream cannot be over emphasized. We need to redesign the science curriculum to make it intertesting and thereby to attract the students. The reason to make this effort is not simply the loss or gain of human potential, as important as it is, which is also about our collective economic well-being.

References

1. Akhter, Syeda Tahmin 2011, *Curriculum Emphases of Secondary Science Education*, preliminary findings of a Ph.D work, Monash University, Australia.
2. Alam, G. M. 2008a, *Impact of the Private Universities on Bangladeshi Education System: An Investigation on Education Policy*, VDM: Germany.
3. Alam, G. M. 2008b, The Role of Technical and Vocational Education in National Development of Bangladesh, *Asia-Pacific Journal of Cooperative Education*, 9(1): 25-44.
4. Alam, G. M. and Khalifa, M. T. B. 2009, The Impact of Introducing a Business Marketing Approach to Education: A Study on Private HE in Bangladesh, *African Journal of Business Management*, 3(9): 463-474.
5. Ashraf, Shamim 2008, State of Science Education in Bangladesh Current Status and Future Trends, *Star Campus*, Volume 2, Issue 79, July 27.
6. Choudhury, Shamima K. 2009, *Problems and Prospects of Science Education in Bangladesh*, AIP Conference Proceedings (Third IUPAP International Conference on Women in Physics), Volume 1119, pp. 83-84.
7. Kelly, A. V. 1999, *The Curriculum. Theory and Practice*, London: Paul Chapman.
8. Sarkar, Md. Mahbub 2011, *Promoting Scientific Literacy Through Secondary Science Textbooks*, preliminary findings of a Ph.D work, Monash University, Australia.
9. Siddique, Mohammad Nure Alam 2011, *Promoting Scientific Values Through Secondary Science Teaching*, preliminary findings of a Ph.D work, Monash University, Australia.
10. UNESCO 2007, *EFA Global Monitoring Report,* Oxford University Press.

8

Diversified Curriculum for Girls' Education Programme at the Open School of Bangladesh Open University

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Abstract

The Open School is one of core faculties of Bangladesh Open University (BOU) and it runs three school programmes. The curricula of these programmes are considerably more varied than in the past as secondary education at the formal level has been diversified. Historically, in Bangladesh, secondary education was to prepare students for higher studies which is known as 'elitist model' in the education literature; recently this has been transformed as country pursues policies of open access and universal coverage and establish programmes offering broader curricular subjects, greater options and stronger ties to labour market demands. It is worth noting, elitist models of secondary education was dominant in Bangladesh before the issue of national education policy 2010. Accordingly, the Open School also diversified its curriculum and widely incorporated in the Junior School Certificate (JSC) programme (G-6-8) and the present paper contends that the diversification of secondary education, while acknowledged, is not well studied. Apart from measures of overall participation (enrolment ratios), almost all existing data revolves around two simple dimensions: one hierarchical (i.e., lower vs. upper secondary education) and one programmatic (general vs. technical-vocational). The present paper compares the programmatic foci and contents of secondary education systems. It seeks to move beyond existing characterizations of secondary education.

Key Words : *Open School, Curriculum*

Introduction

The Open School develops curriculum for its school programmes at par with the national curriculum where curriculum is a body of knowledge to be transmitted. Curriculum is an attempt to achieve certain ends in students – products. Bobbitt (1918: p. 42) states that the curriculum will show the abilities, attitudes, habits, appreciations and forms of knowledge that people need. These will be the objectives of the curriculum. They will be numerous, definite and particularized. In line with this National Curriculum and Textbooks Board (NCTB) prepares and implements the primary and secondary curriculum – known as national curriculum - as per the theory and the context of the county. NCTB develops curriculum through a long process maintaining all sorts of procedures focusing the needs of the country. Therefore, BOU Open School adopts their curriculum and customizes little bit, if necessary. For instance, the nation has a broad-based education policy entitled National Education Policy 2010; any subsequent action is based on this policy and accordingly the NCTB came out with the new National Curriculum 2012. The principles of education mentioned in the National Education Policy 2010 especially the clauses on secondary education are studied to lay the foundation of the new curriculum. As per the Education Policy, initiatives have been made to integrate all the conventional streams of education (main stream, madrasha, English medium) for a unitary system. In this system, all types of educational institutions will follow identical education activities under the same curriculum from classes 1 to 8 (NCTB, 2012). This curriculum puts emphasis on inclusion of vocational education; initially at the Grade 6 only and we can't say it is a vocationally integrated general curriculum. BOU-OS already piloted a vocationally integrated curriculum for its Junior School Certificate (JSC) programme for the disadvantaged children in association with the NGO network - Campaign for Popular Education (CAMPE). This curriculum was much diversified with compared to the formal curriculum as it combined the general education with particular emphasis on the livelihood for the target group. Rahman (2006) states that JSC curriculum prioritized the needs of the target group and the Open School came out of the 'elitist model' of education and designed a vocationally integrated general education for the disadvantaged children. Again it designed a vocationally integrated curriculum for the JSC programme in association with the Commonwealth of Learning – the international provider of distance education - focusing the target group of the disadvantaged girls' learners who did their grade 5 educations from community, NGO and/or formal schools. The present paper compares the programmatic foci and contents of secondary education systems. It seeks to move beyond existing characterizations of secondary curriculum.

Bangladesh Education System

The Ministry of Education (MoE) has authority over all of Bangladesh's educational structure except the university education as all universities – as per the law – enjoy the autonomy to design and implement the tertiary level. Therefore, formal school education is under ministerial control; and side by side, BOU Open School (BOU-OS) runs school programmes for dropouts through open schooling to support government's short and long run educational policy (MoL, 1992). In spite of the full authority to design and implement the curriculum, the OS adopts and customizes the curriculum of the ministerial control. Recently, the school level conventional curriculum is absolutely different from what is in the immoderate back because it steps to diversify with vocational emphasis. The educational structure: there is universal access to primary and junior secondary school, then, SSC (Gr. 9-10), HSC (Gr. 11-12). Bangladesh faces challenges to provide livelihood education to the at the JSC level. However, educational curricula incorporate prevocational preparation in the junior and senior secondary schools. Another challenge is remained to mainstream the dropouts at the JSC level particularly for the female dropouts. According to the UNDP (2012) although Bangladesh is on track to achieve the Net Enrolment target (Chart 1), the drop-out rates remain to high; Enrolling the last 10% of the children (hard-to-reach population), ensuring quality of education for children who are already enrolled in schools remain as major challenges. Therefore, dropout has always been a problem although MGD 3 is met (see table 8.1); but alternative approach for the disadvantaged is required to mainstream them to contribute to the economic development of the country.

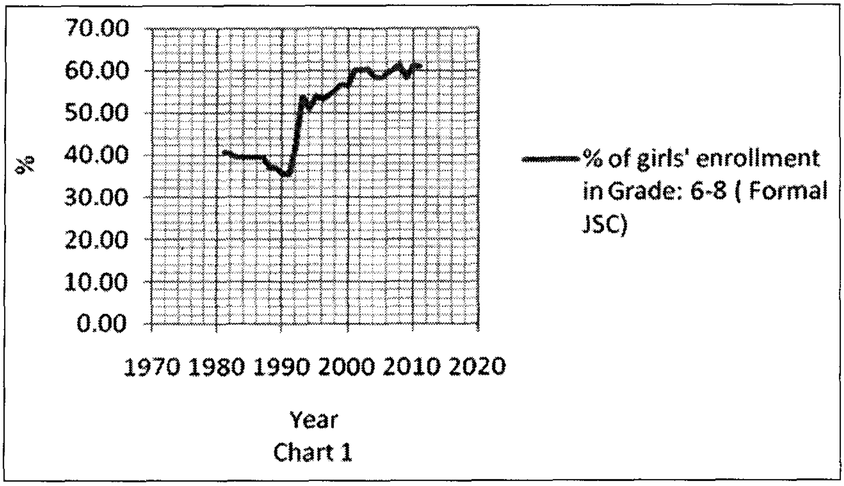
Table 8.1 MGD 3 and Bangladesh

Goal 3: Promote Gender Equality and Empower Women: Goal will probably be met				
Target 3.A : Eliminate gender disparity in primary and secondary education preferably by 2005, and in all levels of education no later than 2015				
3.1a: Ratio of girls to boys in Primary education (Gender Parity Index = Girls/ Boys)	0.83	1.02 (BANBEIS 2010)	1.0	Goal met
3.1b: Ratio of girls to boys in secondary education (Gender Parity Index = Girls/ Boys)	0.52	1.14 (BANBEIS 2010)	1.0	Goal met

Source: UNDP, 2012

In order to address the educational problem of the country and to respond the MGD goal, the country took some steps such as stipend for the female learners, community participation and increased budgetary allocation in education worked as tonic. Finally, it achieved the MGD 3; not only is that percentage of girls' enrolment now above 60% (see chart 1) at the JSC level what was less than 40% in forty years back. At present, the beauty of the formal JSC classrooms of every corner of the country comprised of girls and boys and that is 50-50. But, dropouts' rate still remained high what makes the education system very expensive – it has been a big challenge.

Fig. 8.1 Percentage of Girls' Enrollment in Grade 6-8



Source: Prepared from BANBEIS (2013)

In order to address these challenges Bangladesh's education system includes 5 years of primary education, three years of junior secondary education, and two years of senior secondary education. Each year at the primary level is a Standard, and each secondary level is a Form. This system was implemented in 2010 as a result of a 2011 National Education Commission study. At present, Bangladesh's basic education program comprised of the primary and junior secondary levels (MoE, 2010). Primary education is the most important stage in the educational system, and the government strives to make this level of education accessible to everyone. One central objective of primary education is for children to be literate first in Bangla and then in English. Other goals are for children to become knowledgeable in mathematics and to have a command of science and social studies (NCTB, 2013). From 1991 to 1997, the number of students completing the primary level and entering junior secondary increased from 65.0 percent to 98.5 percent (BANBEIS, 2013)

Bangladesh secondary education was diversified as there are three streams such as: general, vocational and madrasha and now the NCTB is in a process to implement the new Secondary Curriculum 2012 (NCTB, 2012). Completing the Junior Certificate programme may lead to admission to the senior secondary school program. Only those pupils whose grades are high enough on the Junior Certificate Examination are admitted to the senior secondary program. From 1991 to 1994, the number of students admitted to senior secondary schools increased from 28 to 34 percent. Bangladesh is in the process of implementing the unified secondary schools, Form I to Form V, in the remote areas of the country to increase access to a senior secondary education. In addition, the ministry writes all required textbooks. The ministry's emphasis is on training qualified teachers, developing a diversified curriculum, and expanding facilities to meet the national commitment of universal education.

Diversified Secondary Curriculum

The objectives of the new policy are to review the current education system and its relevance and to identify problems and strategies for its further development in the context of Bangladesh's changing and complex economy; to reexamine the structure of the education system to guarantee universal access to primary and junior secondary education, while consolidating and vocationalising the curriculum content at these levels; to advise on ways to ensure the education system is sensitive and responsive to the people's wishes and the country's manpower requirements; to study the various methods of streaming into vocational and academic groups at the senior secondary level; to study how the senior secondary structure relates to the University of Bangladesh degree programs and to determine how the two programs may best be reconciled; to advise on the organization and diversification of the secondary school curricula to prepare students who do not continue with higher education; and to make recommendations to the government on the best and most cost-effective methods of implementing the recommendations proposed by the Ministry of Education. Finally the NCTB approved the following curriculum for the JSC programme as under (see table 8.2)

Table 8.2: Class 6-8 subject frameworks, distribution of marks and contact hour/period

	Compulsory subjects for all streams (general education, madrasha	Marks in exams	Distribution of time (class periods)		
			Weekly	terminal	Annual
1.	Bangla	150	5	87	174
2.	English	150	5	87	174
3.	Mathematics	100	4	70	140
4.	Bangladesh and Global Studies	100	3	53	106
5.	Science	100	4	70	140
6.	Information and Communication Technology	50	2	35	70
	Total	650	23	402	804
7.	Compulsory subjects of neral education stream Religion and moral education: Islam and Moral Education/Hindu Religion and Moral Education/Christian Religion and Moral Education/Buddhist Religion and Moral Education Physical	100	3	53	106

8. 9.	Education and Hygiene Career Education F	50 50 50	2 2 2	35 35 35	70 70 70
		250	9	158	316
10	Compulsory subjects of general stream (only one can be taken) Small ethnic group's language and Culture/Agriculture Education/Home Science/ Arabic/Sanskrit/Pali/Music /Dance/Drama	100	2	35	70
		1000	34	595	1190

(Source: NCTB, 2012)

Note:

- The length of first period is 60 minutes and other periods are 50 minutes.
- There will be 6 periods a day from Saturday to Wednesday. Thursday will have 4 periods.
- Duration of daily assembly is 15 minutes and there will be a mid-day break after 3rd period for 45 minutes.
- Time range will be 5 minutes less in every case provided the school has 2 shifts. In such case the mid day break will be of 25 minutes.

Diversified/comprehensive Curriculum

One of the challenges of the formal school curriculum is to provide minimal provisions for children with disabilities to enter into schooling system. Few disabled children are integrated in regular school classes, and there is a limited special education curriculum. Parents must pay fees to nongovernmental organizations if their children with special need are to be educated. However, the government has committed to intensify efforts to educate these children by paying the nongovernmental organizations' fees. These are multi-purpose institutions that combine under one roof the objectives of an academic course of study and one or more vocational fields. Frequently these schools were originally academic secondary schools to which vocational content was inserted in the curriculum with the objective of making the school more responsive to labour market needs and to serve a more diverse student clientele. Diversified schools typically allow some crossover so that academic students are permitted limited vocational coursework and vocational students are encouraged to continue some academic coursework. Comprehensive schools permit fewer crossovers. In these schools, aptitude and achievement tests and teacher recommendations are used to screen students for academic or vocational tracks. In view of this, the BOU Open School conducted a country-wide need survey through focus group discussions and finding was that inclusive education through integrating the vocational education has been the paramount for the disadvantaged girls in the country (Rahman, et al. 2013). Finally, the School has been diversified and comprehensive as well. This type of curriculum already been piloted before in association of the NGO network organization – Campaign for Popular Education and the Commonwealth of Learning. It is difficult to distinguish 'Diversified schools' from 'Comprehensive schools'; both combine some occupational courses in an otherwise general academic curriculum. Table-2 bellow is the JSC curriculum of the BOU-OS and it attempts to bring some order to the curriculum question at the secondary level by presenting a continuum of academic and vocational content.

Table 8.3 JSC curriculum framework

	Compulsory subjects	Marks in exams	Credits allocation		
			Grade 7	Grade 8	Grade 9
1.	Bangla	150	6	6	6
2.	English	150	6	6	6
3.	Mathematics	100	4	4	4
4.	Bangladesh and Global Studies	100	4	4	4
5.	Science	100	4	4	4
6.	Information and Communication Technology	50	2	2	2
	Total				
7.	Religion and moral education: Islam and Moral Education/Hindu Religion and Moral Education/Christian Religion and Moral Education/Buddhist Religion and Moral Education	100	4	4	4
8.	Physical education and hygiene	50	2	2	2
9.	Career education	50	2	2	2
10.	Fine arts	50	2	2	2
	Total general courses	900			
11	Vocational Education (only one can be taken) Tailoring Beauty Culture Poultry	100	6	6	6
	Total	1000	40	40	40

(Source: BOU Open School)

This curriculum has been at par to the diversified curriculum of the formal curriculum; only difference it has put emphasis on the is the comprehensive approach keeping consideration of the socio-economic condition of the target group. This issue has been widely discussed in the School's curriculum committee – 1st authority of the University – and in initially, three vocational courses, say tailoring, beauty culture, and poultry have been incorporated in the vocational part of the curriculum. This curriculum is going to be implemented through piloting the COL funded project 'Girls' Education Challenges' at the Open School of BOU.

Conclusions

Stated outcomes and long-term social objectives of the different types of secondary schools often overlap. Almost all statements of the goals or objectives of all types of secondary education include items such as preparing students for the world of work and making students smoothly functioning members of society. These statements are included for political as well as educational reasons and they often downplay academic goals. Such objectives may or may not be stated in 'occupational' or 'vocational' terms, but they invariably have, directly or indirectly, occupational implications. Indeed, in Bangladesh, even academic secondary training is justified in vocational terms – that is, as preparation for careers of the learners. In practice, access to institutions or streams offering a narrowly focused academic curriculum is often highly coveted, especially by middle-class. Therefore, the Open School has come out with the diversified and comprehensive curriculum for disadvantaged girls' under the project activity with the Commonwealth of Learning.

References

1. BANBEIS (Bangladesh Bureau of Educational Information and Statistics). (2013). Time series data: Secondary education. Dhaka: BANBEIS. Available at: http://www.banbeis.gov.bd/webnewindex.php?option=com_content&view =article&id=316&Itemid=171 [Last accessed on July 12, 2013].
2. Bobbitt, F. (1918). *The Curriculum*, Boston: Houghton Mifflin. Available at: http://www.ncrel.org/sdrs/areas/issues/envrnmnt/stw/sw100.htm[Last accessed 11 July 2013].
3. BOU-OS (Open School of Bangladesh Open University). (2013). *JSC Curriculum under Girls Education project with the Commonwealth of Learning*. Minutes of the Curriculum Committee. Gazipur: BOU.
4. Donald B. Holsinger and Richard N. Cowell. (2000). *Positioning secondary school education in developing countries.* Paris: International Institute for Educational Planning/UNESCO. Available at: http://unesdoc.unesco.org/images/0012/001224/122425e.pdf [Last accessed 11 July 2013].
5. NCTB. (2012). *National Curriculum 2012*. Dhaka: NCTB.
6. Rahman, M.M.(2006). *Developing Courses of Studies for the Junior School Certificate (JSC) Programme of the Open School of Bangladesh Open University (BOU), a partnership programme with an NGO coalition, Campaign for Popular Education (CAMPE).* Paper presented at the Pan-Commonwealth Forum 4 (pcf4); Jamaica. Available at: http://pcf4.dec.uwi.edu/viewpaper.php?id=377 [Last accessed on 12 July 2013].
7. Rahman, M. M., Yeasmin, S. and Panda, S. (2013). Streamlining Female School

Dropouts through Distance Education in Bangladesh. Paper presented in the International conference on "Education for All: Role of Open Schooling being organized from 13th to 15th March, 2013. Organized by the National Institute of Open Schooling (NIOS), Delhi, India.

8. MoE (Ministry of Education). (2010). *Education Policy 2010*. Dhaka: MoE.
9. MoL (Ministry of Law). (1992). *Bangladesh Open University Act 1992*. Dhaka: Mol.
10. Psacharopoulos G and Antonio Zabalza, A. (1984). The effect of diversified schools on employment status and earnings in Colombia. *Economics of EducationReview.* Volume 3, Issue 4, 1984, Pages 315–331. Available at: http://www.sciencedirect.com/science/article/pii/0272775784900499 [Last accessed on July 12, 2013].
11. UNDP (United Nations Development Programme). (2012). *MDG and Bangladesh.* Available at: http://www.undp.org.bd/mdgs.php. [Last accessed 11 July 2013]

9

Collaborative Inquiry and Cooperative Learning Strategies in the Teaching of Science in Primary and Secondary Education

Nancie M. Sangma

Abstract

Collaborative inquiry and Cooperative learning strategies can help engage all the students in meaningful science learning. Collaboration and Cooperation reflect the way practicing scientist work in their real world investigations. One of the goals of science teaching is to enable students to experience science in the way the actual scientists do. It is often difficult to make this happen in the classroom but using collaborative projects is a simple and exciting way to do it. Cooperative learning techniques in the classroom promote academic achievement in many ways. It provides learning opportunities for students with a variety of learning. Thus students need particular skills in order to engage in scientific investigations and they can gain these skills through collaborative projects and to enhance the ways in which they can work together in the classroom which will create more interest among the students in the learning of science.

Key words: *Collaborative, Cooperation, Projects, Investigations, Science*

Introduction

Teachers in schools across the nation are gathering regularly with colleagues to examine student work and uncover how their young learners are thinking about science ideas. Such groups aim to (1) improve their practice by basing instructional decisions on evidence of student thinking and (2) improve outcomes for students. Achieving positive student learning outcomes, however, requires that teachers use principled ways of designing instruction, selecting student work, analyzing these artifacts, and making evidence-based changes to instruction (Bray, Lee, Smith & Yorks, 2000; NRC, 1996; Wood, 2007).

This paper presents a collaborative inquiry and cooperative learning strategies for teachers who would like to systematically improve their practice through analyses of student work and to make science subjects interesting for science students. Science teaching will become interesting when there is contribution, sharing, valuing others' viewpoints, taking responsibility and listening to teammates-these things happen when students collaborate and cooperate.

Collaborative Inquiry

Collaborative Inquiry refers to a situation in which students in one classroom collaborate with students in another classroom or with scientist at a remote location to explore a science topic or undertake a science investigation. Through collaborative inquiry, teachers integrate new knowledge and understanding of student learning and classroom instruction into their existing knowledge of professional practice. Inquiry constructs understanding of the "classroom encounter" – where instruction, curriculum and student actions intersect (Moore, 2004). Inquiry positions the teacher as an informed practitioner refining planning, instruction and assessment approaches in the continual pursuit of greater precision, personalization and innovation. A focus on student learning drives inquiry. As we know, one of the goals of science teaching is to enable students to experience science in the way the actual scientists do. It is often difficult to make this happen in the classroom, but using collaborative projects is a simple and exciting way to do it. Most science teachers want students to see science as a set of meaningful interrelated concepts. Students should be able to pose questions and solve problems, think positively about science, and work with others on scientific inquiry. A well-developed collaborative inquiry project will enable students to develop these skills. Collaborative projects engage students in meaningful work that requires thought, dedication engage students in meaningful work that requires thought, dedication and commitment. When the project is completed, they have gained new knowledge and have a resulting product of artifact. Students are motivated because they 'own' their work. Unlike the work done in traditional lecture-driven science classrooms, which often aims at developing 'inert' knowledge, collaborative projects allow students to apply the science concepts they learn. Collaborative projects also foster the development of communities of practice among students, because students "do" science in the same manner as scientists. They interact with their classmates, with students across the country or around the world, or with professional scientists.

When engaging in collaborative scientific investigations, students must first ask reasonable questions. Review what you've already learn about framing questions. Be sure that the students formulate questions they are capable of answering. Sometimes, students don't generate testable questions. If this happens, allow them to think about the feasibility of their questions. Have them share questions with one another and challenge one another's ideas.

One method of encouraging students is to have them check out good internet sites. This will give them ideas to consider. We can also show them interesting science demonstration. Have them discuss what they read or observe. After providing opportunities for asking good questions, students can be made to apply these skills by logging on to collaborative-projects and evaluating the questions they find.

Students need particular skills in order to engage in scientific investigations, and they gain these skills through collaborative projects:

- Using the library or the internet to search for background information.
- Deciding on the type of data that should be collected to answer the question.
- Selecting a sample.
- Designing a means of collecting data.
- Analyzing the data and drawing conclusions.
- Writing and reporting the results.

Each skill will be manifested in a different way at different levels. Naturally, early-childhood investigations are far less sophisticated than those accomplished by middle-school students. Adaptations can be made for students with special needs. Because individual students encounter different challenges as they investigate, we will need to scaffold instructions in a number of ways to accommodate the needs of everyone in your class. Some will need help in getting organized; some will be better at using technology than others. Some will be accustomed to working with more structure; more assistance may be needed to provide for those students.

There are many exciting projects available for young children. The Global Schoolhouse site contains an impressive list. In the following activities, Sampling of projects is explored.

For examples: Students collect and observe different kinds of leaves and make comparisons with other types that are of different colors and shapes. Log on to a search engine, such as Yahoo! (http://www.yahoo.com) or Google (http://www.google.com), and search for "Preschool Leaf Collection Project." You will find several sites that contain information on collaborative projects by this title. Explore these sites and consider how you would set up such a project in your own class.

In practice, inquiry engages teachers as learners in critical and creative thinking. It honours openness and flexibility. Through collaborative dialogue, teachers seek emergent possibilities – new questions and solutions to student learning and achievement. Inquiry positions the teacher as an informed practitioner refining planning, instruction and assessment approaches in the continual pursuit of greater precision, personalization and innovation. A focus on student learning drives inquiry. Data generated from student actions and work compels teachers to investigate new, engaging and relevant questions about how and what their students learn. These questions lead to informed actions within the classroom, which in turn serve to refine or initiate new investigations.

Collaborative learning is a method of teaching and learning in which students' team together to explore a significant question or create a meaningful project. A group of students discussing a lecture or students from different schools working together over the Internet on a shared assignment are both examples of collaborative learning.

Seven Characteristics of Teacher Inquiry

Collaborative teacher inquiry is used in professional learning communities, school networks, action research partnerships and a range of other inquiry-based projects. Within the collaborative inquiry approach, the following characteristics play a critical role in generating opportunities for new understandings and actions.

Relevant

Student learning guides inquiry. The primary purpose of all inquiry within the context of instructional practice is to meet the needs of students by engaging them in rich, personally relevant learning. With the learning process positioned at the heart of inquiry, accurately describing student learning becomes an anchor for the process. Consequently, assessment for learning is integral to engaging in professional inquiry. The learning process of students as well as the products of their learning forms the essential material of the inquiry. The ability to analyze the evidence (e.g., transcriptions, anecdotal notes, photographs, videos, oral recordings) with colleagues is a key to the effectiveness of the process. Professional dialogue that focuses on authentic student-centered issues leads to further predictions and/or questions regarding how students might best learn within a specific context. Here, classroom-based description and analysis help generate new knowledge and insights that may have both immediate and longer-term consequences for teaching and learning.

Collaborative

Teacher inquiry is a shared process. Although the mandate to reach every student seems simple, achieving this goal is complex. When educators work together to inquire about their students' learning and engagement, they embrace this complexity as an opportunity for further understanding rather than something to simplify. The vast majority of teaching time is spent alone with students in the classroom. However, the collaborative nature of inquiry is what enables the learning to go deeper. Collaboration provides perspective, diversity and space for teachers to consider questions about student learning that can provide new insight unavailable in inquiry processes that are done individually. Finding common ground for all teachers to engage authentically together requires negotiation. Tools such as "discourse analysis" may help to build a unified focus of study.

Student Learning Guides Inquiry

Reflective

Actions are informed by reflection. Reflection is a critical part of analysis in applied research. Actions taken as a result of ongoing inquiry inform understanding of the kinds of conditions that support further student learning. When teachers make pedagogical decisions, they reflect on students' engagement and learning resulting from their past decisions (Schon, 1983). Setting aside moments for reflection provides opportunities for collective thinking to become intentional and explicit. It allows for multiple perspectives and alternative explanations of student learning to be considered and analyzed. Reflection both aligns and challenges how teachers' and students' actions are related to underlying beliefs and theories of learning. The quality of collaborative analysis makes all the difference. When engaged in collective reflective practice, teachers question, reason and probe ideas in order to push thinking of the group further. Trust, open-mindedness and a high tolerance for ambiguity are necessary characteristics of the collaborative team.

Iterative

Progressive understanding grows from cycles of inquiry. The reflective process discussed above is most powerful when it cycles back, reviews and builds on each successive inquiry. Such iterative reflective work is facilitated by regular and consistent analysis of what and how students are learning. This involves not only the continuous level of analysis of determining next steps for students based on specific learning contexts, but also an analysis of what students and teachers are learning over time. Consistent and regular cycles of inquiry allow for progression in thinking. There are many frameworks that teams have used to identify themes over time. Within collaborative inquiry cycles, teachers identify frequently emerging themes, as well as rare but noteworthy themes which further illuminate the study. Inquiry is not so much a project as a stance to the activity of teaching and learning.

Reasoned

Analysis drives deep learning. Three kinds of reasoning are used in professional conversations as inquiry teams identify common and divergent learning themes:

Inductive Reasoning

Analysis that seeks a general rule or pattern out of many specific instances of learning is inductive. We engage in inductive reasoning when discussing whether or not the particular evidence of a student's thinking and learning (or even multiple demonstrations from that one student) is enough to draw general conclusions about what has been learned. The need for including a wider variety of evidence or considering alternative explanations is an important part of this kind of reasoning. For example, when 30 students are given a choice about the topic of inquiry, we observe that 27 become successfully engaged in learning. Opportunities for student choice may have been a critical factor for increasing student engagement, but we do not know this for certain. It is important to consider a wide range of factors before drawing conclusions.

Deductive Reasoning

Analysis that applies a general rule to specific instances of learning is deductive. We engage in deductive reasoning when we consider how a widely accepted practice can be applied in a specific instance with particular students in a classroom. For example, the research literature has established that providing descriptive feedback is an effective practice; through a process of deductive reasoning, we can work together to clarify how descriptive feedback will look in specific instances of student learning.

Abductive Reasoning

Most often, however, analysis takes the form of abductive reasoning. This type of reasoning can use both inductive reasoning and deductive reasoning. We engage in abductive reasoning when we form and test a hypothesis. For example, a team begins with the supposition that if student interests are incorporated into the program, then student ability to generate robust questions will improve. The team then tests out this hypothesis through classroom actions that incorporate student interests and examines student conversation and actions generated as a result. Further, the team can review other professional resources and research on what has been done to engage students. This type of abductive reasoning is the basic foundation for most scientific reasoning.

Adaptive

Inquiry shapes practice and practice shapes inquiry. Collaborative inquiry requires thinking to be dynamic and creative as teachers seek ways to meet the needs of students. Teachers participating in collaborative inquiry continually adapt and apply knowledge and pedagogical approaches in response to their work in the classroom. This work can often be uncertain and ambiguous. Responsiveness and flexibility are essential. Questions focus efforts on the influence that a specific aspect of practice is having on a specific aspect of student engagement and learning. The data generated from classroom work compels teachers to investigate new, engaging and relevant questions about what and how their students will best learn and be prepared for future learning. As teachers collaboratively engage in inquiry, the questions evolve to become more specific. Often teachers find that they needed to refine their question to reflect what it is they are actually inquiring about. Some questions are discovered to be unanswerable. Continually questioning the focus of the inquiry is a simple way to continue to adapt the inquiry.

Reciprocal

Theory and Practice connect dynamically. An important aspect of inquiry is engaging in what others have discovered about the phenomena under study (Coburn & Stein, 2010). With such wide and varied bodies of knowledge to explore, and limited time to act on the specific needs of students, it is important that the use of expert knowledge is strategic and purposeful. Purposeful use of book studies, literature reviews, and consultation with other professionals are all means to ground the inquiry within the existing bases of knowledge. When informed by existing knowledge bases, local application from an inquiry contributes to the collective knowledge of the profession.

Cooperative Learning

Cooperative learning refers to the use of small groups and teamwork to achieve a variety of academic and social gains in the classroom setting. In the cooperative classroom, improved social relations, accompanied by improved academic achievement, promote students' self esteem. Cooperative learning is an instructional strategy that works well with elementary science. It is a way of organizing the classroom so that the students work together in teams to accomplish a task. The students depend on one another in a positive way, participate equally in the work, and at the same time are accountable for their own individual work. Cooperative groups work face-to-face and learn to work as a team. In small groups, students can share strengths and also develop their weaker skills. They develop their interpersonal skills. They learn to deal with conflict. When cooperative groups are guided by clear objectives, students engage in numerous activities that improve their understanding of subjects explored. In order to create an environment in which cooperative learning can take place, three things are necessary. First, students need to feel safe, but also challenged. Second, groups need to be small enough that everyone can contribute. Third, the task students' work together on must be clearly defined. The cooperative and collaborative learning techniques presented here should help make this possible for teachers.

Cooperative-learning methods generally share six principle characteristics:

- **Group goals**: Group goals are common to most cooperative learning methods. This means that the teacher and the students set goals for each group's performance. Group members' work together to help one another learn so that the group can achieve its goal.
- **Individual accountability**: Individual accountability is achieved by giving each student a unique task and a unique responsibility to carry out during group work. We can also structure individual accountability by making each group member responsible for his or her own performance.
- **Equal opportunity for success and Team competition**: Equal opportunity for success means that each student has an equal opportunity to contribute to the success of the team. Task specialization is accomplished by assigning each team member a unique subtask.
- **Task specialization**: Task specialization is accomplished by assigning each team member a unique subtask.
- **Adaptation to individual needs**: Adaptation to individual needs is accomplished by adapting instruction so that each student's needs are met.

Conclusion

Collaborative inquiry and cooperative learning strategies can help the teachers engage all the students in meaningful science learning. Collaborative inquiry takes place when students join forces in a science exploration with students in another classroom or with scientists at a remote location. Many collaborative projects takes place through the Internet, using emails or websites as means for students to share their data and discuss their findings. In this way, even small children can engage in exciting collaborations. Collaborative inquiry often goes hand in hand with cooperative learning, in which students work in small heterogeneous groups, often with a defined role for each member. Cooperative learning has been shown to improve academic skills, social skills and self-esteem; it helps ensure full participation by all categories of students.

Cooperative and collaborative learning differ from traditional teaching approaches because students work together rather than compete with each other individually. Cooperative and collaborative learning bring positive results such as deeper understanding of content, increased overall achievement in grades, improved self-esteem, and higher motivation to remain on task. Cooperative learning helps students become actively and constructively involved in content, to take ownership of their own learning, and to resolve group conflicts and improve teamwork skills.

References

1. Sherman & Sherman, (2004) "Science and Science Teaching, Method for Integrating Technology in Elementary and Middle Schools," 2nd Edition, Houghton Miffin Company, Boston, New York, p.247-280.
2. Cohen, E. (1994). Restructuring the Classroom: Conditions for constructive small group. *Review of Educational Research,* 64(1), 1-35.
3. Literacy and Numeracy Secretariat (2010) "Capacity Building Series," Secretariat, Special Edition #6, Ontario. www.edu.gov.on.ca/eng/literacynumeracy/inspire21/ 6/2013 6:30p.m

10

Attracting and Retaining of Best Talents in Basic Science – Challenges and Opportunities

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Abstract

Due to increase scope and opportunities young generation are attracted towards professional courses to fulfil their dream. Attracting and retaining of best talent in basic science has become big challenges for the nation. Adequate opportunities with respect to research and development, decent rewarding job and necessary funding are fundamental pre-requisite to set the trend otherwise.

Key Words: *Branded Institutions, Research and Development, Job Opportunity.*

Introduction

"I am concerned by the fact that our best minds are not turning into science, and those who do, do not retain in science. On the other hand we are truly proud of the fact that this year, all the nineteen young boys and girls who represents India in Olympiads, come back with medals. On the other hand our past records show that practically none of such Olympiad medal winners perused science subsequently as a career! We must reverse this trend"

– Prime Minister Dr. Monmohan Singh, 92nd session of Indian science congress, January 3rd 2005, Ahmedabad.

It is evident from the statement that many talented and young people in India do not opt basic science as a career and those who starts with basic science in latter stage shift from science to other stream. In other way we can say that our nation failed to retain the talented young people in science. We have experienced that many of our talented young people who won gold medal in International Science Olympiad did not opt science as their career.

In India around 70% of the total population lives in rural areas and in most of the states our rural students are deprived of choice of education. Plus two level students in rural areas are worst sufferer as the bright and talented students cannot opt for science because most of the junior colleges or higher secondary school in rural areas do not have science stream, or if they have science stream there is shortage of science teachers and lack of infrastructure. In most of the cases parents are not in a position to send their children to the urban areas. So those students have no choice but are compelled to study whatever is available (in their vicinity) to them. For example we can cite the example of Meghalaya, in the year 2013, total candidates appeared for HSSLC were 41,007, out of which 88% were Arts, 7% were Science and 6% in Commerce, which shows the dismal picture of science education in the state. (Shillong Times, July3, 2013). In higher education in science also only 19.30% enrolled for Science, whereas 42% enrolled for Arts in the year 2009-2010 (UGC Annual Report-2009-2010). These examples show the dismal picture of science education in India.

Objectives of the Study

In this article the authors made an attempt to highlight some of the important reasons, why we fail to attract and retain the best talents and to disseminate information and create awareness among the students regarding the opportunities and scope of basic science.

Rational of the Study

The world has witnessed sea changes in the field of research and technology during the last two decades. Due to the innovation of modern technology the scope and opportunities for professional study and job opportunities has increased manifold. Therefore the best talents after plus two stages opt for professional courses like B. Tech., M. Tech., IT, Management etc. and their ultimate goal is to work in multinational company and to go abroad, result of which we fail to retain the best talents in the field of science, research and development.

Challenges

Presently we are facing some challenges to attract and retain the young talented people are towards basic science. These challenges are attributed as follows:-

- Deprived of Vhoice: As it is mentioned that 70% of our total population lives in rural areas and in most of the rural areas do not have proper facilities for science education. Generally at plus two level students get the chance to choose the subjects/ stream in which they are interested. The young talented rural students are deprived of it, because there are very few junior colleges or HSSLC schools having science stream and even if those institutions have the subject, they suffer from various difficulties. Most of the rural people are financially not sound so they fail to send their children to the good institution in urban areas for secondary education. So the meritorious rural students could not opt secondary education.

- Lack of Proper Infrastructure: The condition of infrastructure has a direct correction to the attraction and retention of students in basic science. Most of the institutions having science stream do not have the proper infrastructure. Infrastructure related to education of basic science are:

  (i) Lack of Experimental facilities.

  (ii) Lack of Good library and not having access to internet.

  (iii) Not subscribing good science journal.

  (iv) Non-availability of modern equipment.

  (v) Non–availability of good science books in Indian languages.

  (vi) Non-availability of mathematics laboratory.

  (vii) Lack of proper classroom.

  (viii) Shortage of teacher in basic science.

  (ix) Lack of proper and periodical training to the science teachers

- Lack of Job Opportunities: In basic science job is confined to only teaching and research Moreover to get job in a college or university it takes around 10 years after plus two level (3years UG, 2years PG, and 5 years PhD). Moreover after spending ten years, after plus two stages, decent jobs are not guaranteed in reputed institutions. Where as in professional courses it takes around 5/6 years after plus two stage to get a lucrative job after completing the courses (viz. BE, B. Tech, MBBS, Management etc). Moreover, remunerations in teaching is lesser than the corporate sector. After completing the professional courses, it is easier to go abroad and earn more money and get a social recognition as NRI because of the above mentioned reasons students are moving towards professional courses.

- Shortage of Branded Institutions: Branded institution which has a national & international recognition can attract bright & talented students because by nature, people love to be a part of reputed institutions and moreover they get extra attention, praise and recognition from the society. In India there are very few branded institutions in basic science (viz, St. Xavier's Colleges, Loyola College, Presidency College, Hindu college, St. Stephen College, Hans Raj College, etc.). But it is very difficult to get admission in such reputed colleges. In basic science there is lack of group of branded institutions or a family of branded institution like IIM, IIT, and AIIMS. At present in India we have 13 IIM, 16IIT&7AIIMS. But in basic science these types of institutions are not available. So students prefer to study in these branded groups of institutions.

- Lack of Awareness Students and their parents are not getting the clear picture of the opportunities in basic science. There is a lack of awareness and dissemination of information regarding opportunities in basic science.
- Expenditure on Research and Development: Major portion of the amount spent on Research and Development comes from Government. of India. Industry participation in research and development is very less. 2/3rd of the expenditure is for research and development comes from Government &1/3rd from industry. Whereas in the country like South Korea, 30% of expenditure for research and development comes from Government & 70% from industries. Presently, India is spending around 1% of GDP for research and development and trying to increase it to 2% of GDP by 2015, which is very less compared to the developed countries.
- Lack of Motivation: "Motivation is the process of attempting to influence others to do your will through the possibility of gain reward." Eduir B flippo.

  "Motivation is the act of stimulating someone or oneself to get a desired action." Michael J Jucious.

If the teachers are motivated and satisfied they can give their best to their students. Again if the teachers are satisfied financially (high salary, allowances, perquisites etc)and non financially (recognition, praise etc) they can attract more students to Basic Science. Human needs are unlimited and it is very difficult to satisfy them. Dr. Abraham H. Maslow has classified the various needs of human beings in definite order. These are as follows:-

- Basic physiological needs-(Fooding, clothing, shelter, etc.)

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- Safety and society needs – (Medical reimbursement, Social security, Job security, etc.)

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- Belonging and social needs – (social recognition.)

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- Esteem and status needs – (Self-confidence, independence, knowledge, appropriation, etc.)

↓

- Self-actualization needs – (Desire to become everything that one capable of becoming)

According to this theory once the people fulfil the basic physiological needs, they go for safety & security needs. In teaching profession, in most cases the security & safety needs are not fulfilled because, in some institutions teachers are now appointed on contractual basis, and in college post so there is lack of job security. They do not have social security or pension. So teachers are suffering with insecurity which is a main barrier for motivation. Until and unless people get basic physiological needs and safety and society needs, belonging and social needs cannot be fulfilled. Belonging & social needs are somehow fulfilled to a certain extent as the teachers are respected by the society. Though the teachers are known as nation builder and get some recognition, yet teachers are no match with doctor, engineer and bureaucrats for they are the cream layer of the society. So esteem and status needs are also not satisfied. Therefore, self-actualization needs are also not satisfied. So, there is lack of motivation from the teachers' side and they fail to motivate the students.

Opportunities

Though in India talented young students are not attracting to basic science due to various problems and challenges, still basic science provides some opportunities which are discussed here under-

➢ Research Facilities: Government of India is going to increase the investment in Research & Development from 1% to 2% of the national GDP. Moreover the India's best and brightest scientists who are currently doing research in US and European countries, initiatives have taken to bring them in India and will be provided with world class infrastructure. These initiatives have taken with a view that our young talented people can study basic science and get the opportunity to do the research work and get the international exposure.

➢ Job Opportunities: "The government is going to inject $5 billion into science and technology over the next five years" says Prof. C. N. Rao, the founder of the Jawaharlal Nehru Centre for Advanced Scientific Research and chairman of the science and advisory council to the Prime Minister. Government has initiated this step to create more job opportunities in the field of Basic Science and to improve the quality of science education in India. UGC in the XIIth plan period proposed that at least 800 new colleges under various categories would be set up. Recently Government of India has lunched 5 new institutes of science education and research, 60 new central universities, 10 new national institute of technology, 6 new research and development institution in biotechnology. UGC has advocated increasing the funding during five year plan period from Rs. 46,632 crores to 1, 84,740 crores, which is four times increase from the current funding. Undoubtedly these steps will increase the job opportunities and will attract more and more young talented students.

- Cost Effective Research and Development: - Research and Development is very much cost- effective in India compared to the developed nations. India spends around 0.5% of the total expenditure of the world but produce 2.5 % of global scientific literature. So the talented young people can stay in India and do research work as the expenditure will be lesser than the developed countries.
- Basic Science Courses Started by Some Branded Institutions:-Some of the IITs offers 5 years integrated course in M. Sc degree in some basic science after plus two level and BE in engineering physics after plus two stages which will impart high quality science education and research work. This may attract young talented people towards basic science.

Conclusion

Due to increase scope and opportunities, young generation are attracted towards professional courses to fulfil their dream. Attracting and retaining of best talent in basic science has become a big challenge for the nation. Government of India has initiated lot of schemes to attract and retain young people in basic science but only government initiative is not sufficient. There should be industry participation, public-private partnership and awareness among the general people regarding basic science. Creation of world class infrastructure, set up of group of institution of international standard and to bring back famous Indian scientist who are working abroad is the need of the hour.

References

1. Govt. of India (2005) *"Attracting young people to carriers"*, Office of the principal scientific adviser to the Government of India, Vigyan Bhavan Annex, New Delhi-110011.
2. Science advisory council to Prime Minister (2010) *"India As a Global leader in Science"*.
3. Department of Science and technology, New Delhi—110016.
4. Government of India *"Science, technology and Innovation Policy 2013"*, Ministry of Science and technology. New Delhi.

5. Government of India (2008) *"Attracting Talented students to Maths and Sciences"*, National Knowledge Commission, New Delhi-21.
6. Kapahi C.K. and Ramaswamy B. (2013) *"New UGC 12th Plan Grants, Guidelines and Model Curriculum"*.Anmol publications Pvt. Ltd. New Delhi -110002 (India).
7. Shillong Times, July 3 2013, Shillong.
8. UGC Annual Report 2009-2010.

11

Science Education through Open Schooling at the Bangladesh Open University

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Abstract

The Open School of Bangladesh Open University (BOU-OS) runs three pre-University programmes namely Junior School Certificate (JSC), Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) programme where science education has been the central part of the curriculum and to conduct practical sessions of the programme is the integral role of the School in the programme delivery. This is always a challenging job to conduct science education through distance learning mode; BOU- OS is not exception to this. It is very interesting that the School doesn't invest anything for infrastructure of science lab; and alternatively it uses the equipped lab of the existing formal schools at the local level in a partnership arrangement. This paper discusses the challenges of implementation of the practical part of science education at the BOU Open School.

Key Words: *Open School, National Curriculum, ICT.*

Introduction

The curriculum of the Open School of Bangladesh Open University (BOU-OS) is at par to the National school curriculum which is coupled with some science subjects where the School faces continuous challenges in implementing the practical tutorial sessions. Das (2010) states that laboratory (lab) practicals are an integral part of the science curriculum for which a well-equipped lab is an important requisite; lab-based courses are not easy to provide due to various reasons. As a result, the distance science learners face difficulties in lab support. Several attempts have been made worldwide through innovative methods and the use of Information and Communication Technology (ICT) tools to overcome the challenges of lab based courses. This paper presents the how the BOU Open School carries out the practicals for the distance school programme. This also aims to identify the problem areas of science learners of Open School and their willingness to use ICT solutions in science education. It also provides useful insights for designing innovative solutions for science learners of the distance education system.

Objectives

This study involves analysis of different types of curriculum documents based on their current representation in the science education. Data for this interpretive-qualitative study has been collected from Bangladesh science curriculum documents and textbooks comprising the existing curriculum documents, the existing physics, chemistry, biology, general science, home science, ICT and agriculture textbooks for grades IX-X, and guidelines for authors and publishers to publish textbooks under the curriculum of both formal and the open schooling. The National Curriculum and Textbook Board (NCTB) – the only authority of preparing and implementing formal curriculum – publishes all these documents. An analysis has been done on existing textbooks along with the curriculum documents because textbooks are the de-facto curricula in schools in Bangladesh. Distance learners under the open schooling always do have a modular textbook particularly at BOU-OS students use the self-learning materials (SLMs) as a reading, exam instructions and some administrative guidance. Again, in case of formal schooling, textbooks play a more important role in Bangladesh because teachers and students heavily rely on the lone textbook published by the NCTB for the all streams.

This study explores the followings:

- Explicit statements and/or explanations in the curriculum documents and textbooks;
- Implicit and explicit portrayal of curricular activities especially in the lab work as portrayed in the textbook; and

The above criteria have been used to explore idea of science education through distance learning.

The Curriculum

Bangladesh Open University (BOU) enjoys the autonomy of designing the curriculum of its education programmes ranging from certificate to post-graduate level as is reported in the BOU Act 1992 (MoL, 1992). Being a university BOU has pre-University programmes such as Secondary School Certificate (SSC), Higher Secondary Certificate (HSC) and these are implemented through the Open

Table 11.1 Subject-frame Work, Number and Time Allocation for Classes 9-10 (General Stream)

Type	Subjects	Marks	Time (class period)		
			Weekly	Terminal	Annual
Compulsory	1. Bangla	200	5	80	160
	2. English	200	5	80	160
	3. Mathematics	200	4	64	128
	4. Religion and moral education (Islam & moral Education/ Hinduism & moral Education/ Christian Religion & Moral Education/Buddhist Religion & moral Education)	100	2	32	64
	5. ICT				
	6. Career education				
	7. Phy. Ed., Health Sc. & Sports	50	2	32	64
		50	1	16	32
		100	2	32	64
	Total	800	21	336	672
Group: Science (Compulsory)	8. Physics	100	3	48	96
	9. Chemistry	100	3	48	96
	10. Biology/Higher Mathematics	100	3	48	96
	11. Bangladesh & Global Studies	100	3	48	96
Optional	12. Biology/Higher Maths/Agriculture/Home Science/Geography & Environment/Fine Arts	100	3	48	96
	Grant Total	1300	36	576	1152

Source: NCTB, 2012

Note:

- A student will choose a group from science, humanities or business studies and take compulsory subjects from that group.
- There will be six working days in a week and each day will have 6 periods.
- The length of first period is 60 minutes and other periods are 50 minutes.
- There will be 6 periods a day from Saturday to Wednesday. Thursday will have 4 periods.
- Duration of daily assembly is 15 minutes and there will be a mid-day break after 3rd period for 45 minutes.
- Time range will be 5 minutes less in every case provided the school has 2 shifts. In such case the mid day break will be of 25 minutes.

School – one of the faculties of the University – the constitutionally equal status of any other schools (faculties) of the University. In spite of this autonomy, in order to have the equivalence the School adopts and customizes the National curriculum – known as NCTB curriculum – and implements through the open schooling system which faces difficulties in conducting the practical sessions. Science curriculum and textbooks for science should show this emphasis in the description of the scientific method and in the recipe-like procedures of practical activities (Siddique, 2008, Tapan et al., 2000). The existing general science curriculum portrays this idea about science in a similar way; the textbook emphasizes relying on empirical/experimental data for making decisions in the given examples of the scientific method and procedures of practical activities. The secondary curriculum 2012 also emphasizes relying on experimental/empirical data for making decisions in investigations and, thus, portrays the importance of experiential basis of scientific knowledge. Being adopted the national curriculum the Open School has to face a big challenge to conduct practicals for distance learners. The science curriculum has an objective "to understand the nature of science as a human activity" (NCTB, 2004 a); and for that reason, the curriculum does portray involvement of human inference, imagination and creativity in science by giving learners the freedom regarding hypothesizing, planning and conducting experiments, interpreting data and making decisions in open investigations.

This curriculum has recently been issued and made it available in the Board's website. The Board is implementing for the subsequent years and accordingly developed the course books as de-facto of the curriculum. The existing physics textbook noted that there is no fixed method of doing science, however, scientists' conduct scientific research in an organized and systematic way, and there is one general 'scientific method' of doing science (Tapan et al., 2000). Typical steps of the scientific method and verification type practical works show that the existing science curriculum for science students presents experimental research as the only form of science inquiry; it does not pay any attention to descriptive or correlational research. As a matter of fact, NCTB and BOU-OS has the similar science syllabus. Review of the general science of the OS curriculum of the Secondary School Certificate (SSC) reveals that this has never mentioned that a single experiment may not be sufficient to establish a knowledge claim. The existing general science textbook of the NCTB describes the scientific method with an example of a farmer who conducts an experiment to know whether giving fertilizer increases the yield of the crops (Hoque, et al .2000). However, there are very few practical activities included in the textbook of the both providers –NCTB and BOU; and those that are included are recipe-style procedures; moreover, these practical activities are not to be assessed in the all-important public examination at the end of year 10. Therefore, scientific inquiry has little importance in this curriculum. The NCTB curriculum does not portray different forms of scientific inquiry explicitly. However, the 2012 curriculum promotes diversity in scientific thinking by introducing open investigations. There is no suggested single/fixed procedure given for the investigations. Learners are supposed to recognize problems, identify variables, formulate a hypothesis, plan and conduct an experiment, collect, analyze and interpret data in order to reach conclusions. This kind of activities is not held either in NCTB or BOU SSC curriculum. It is likely that different students will carry out an investigation in different ways. It is also likely that procedures will be given in new textbooks what NCTB developed; in this case, there will certainly be different procedures in different textbooks, because a number of textbooks are published by the NCTB and other private publishers (NCTB, 2004 b). Moreover, different investigations other than the experimental method have been included in the new curriculum; the curriculum, therefore, promotes diversity in doing science.

The way science is portrayed in school science curricula provides significantly in shaping learners' views about science. Therefore, the curriculum should include explicit content on how science works and it should clarify ideas about science. The ideas that 'scientific knowledge is tentative', 'science is socially and culturally embedded', scientific laws and theories, 'science is subjective and theory-laden knowledge', observation and inference, and questioning should be clarified in the curriculum. This curriculum is that scientific inquiry may take place in the forms of descriptive, correlational or experimental research.

It is reported that the Open School's going to adopt the national curriculum; at present, it is implementing the previous one (see table 11.2) until the adopted one is in process. The School's existing curriculum has the science subjects such as: general science, computer studies, agriculture studies and home economics for which School requires the tutorials for theoretical and practicals. The first author is concerned with the practicals for Home Economics subject and tries reflecting her long experience in implementing the science course under open schooling.

The Open School Science Curriculum

The adopted science curriculum structure is of as under:

Table 11.2 Subject-frame work, credits allocation for Grade 9-10

	Compulsory subjects	Marks in exams	Credits allocation	
			Grade 9	Grade 10
1.	Bangla	200	6	6
2.	English	200	6	6
3.	Mathematics	100	6	
4.	General Science	100	6	
5.	Religion Study (any one) : Islamic Studies Hinduism Study Christianity Study Buddhism Study	100	6	
	Total	700	30	12
	Selective Subjects (any three)			
6	History	100		6
	Geography	100		6
	Economics	100		6
	Civics	100		6
	Total	300		18
	Optional Subjects (any one)			
	Computer Studies	100		6
	Agriculture Studies	100		6
	Home Economics	100		6
	Grand Total	1100		6

Source: Open School SSC Student Guide, 2011

Modus-operandi of Practicals

The School develops the SLMs for each science course along with the practical worksheet which are handed to the learners at the time of admission. The learners undertake the self-study at their pace and place – they sit for two face-to-face (F2F) tutorial sessions in a month at the designated tutorial centres (TCs); they have around 20 tutorial sessions and the science students have the opportunity for attending practical classes in the centres at the equipped laboratory under 'Demonstrator'. All theoretical and practical sessions are conducted through the contractual arrangement with the local TCs. The, arrangement that has been the most critical part of this programme is the practical sessions; it is noted that there is no budget for practical and no payment for lab assistance –

as result the learners do not like to come to the practical sessions. In addition, practical activities are not properly monitored. As a result, quality has been the question. Issue arises that includes:

- The School's major weakness in the delivery of practical sessions for science subject;

In order to address this issue, following recommendations are made and it is expected that the School will have to have corrective steps so that the quality of the science students uplift a bit.

Conclusions and Recommendations

The BOU Open School has been in very advantageous situation as it has the contractors – the TCs – to conduct practical sessions for the science students; above discussion reveals that because of managerial issues such as practical not held, learners are less informed about practicals, and no budget allocation for the lab demonstrators need to be solved immediately since quality has been the question. It would get, if development of a practical component involves the followings, perhaps in some combination:

- ➢ The use of course-books or separate printed materials to deliver compulsory, advisory, or optional practical activities.
- ➢ The use of ICT to guide the learner through a systematic procedure.
- ➢ Practical demonstration during tutorial sessions with the tutor as s guide to suggest to follow up activities.
- ➢ Demonstrations within the course's ICT resources (particularly where procedures are costly and/or dangerous, for inaccessible fieldwork, and for lengthy processes).
- ➢ Computer based simulations of even greater complexity but, at the moment, not likely to be accessible to most.
- ➢ Simple, cheap 'home experiment kits', sent out by the BOU on loan (or to be kept for later use at work or otherwise).
- ➢ Work with simple resources each learner has to build from readily available supplies (such as domestic or waste materials).
- ➢ The opportunity to 'drop in' at labs, workshops or group sessions at local centres. Where everything required for practical experiment is available (including perhaps assistance and advice at certain times).
- ➢ Supervised practical work during formal day, weekend or longer sessions (normally compulsory).
- ➢ Mobile van could be used for some vocationally integrated science course such as agriculture.

- Central lab in the campus – where learners would stay for some days as sandwich model could be applied.
- Monitoring from the School is of essential.

References

1. BOU-Open School. (2011). *SSC programme: Student Guide*. Gazipur, Bangladesh: BOU-Open School.
2. *Das, M. (2010). Science Lab Practicals in Distance Education: The Need for Innovative Solutions.* Indian Journal of Open Learning (ISSN: 0971-2690), Vol 19, No 3 *(2010). Available at: http://journal.ignouonline.ac.in/iojp/index.php/IJOL/article/view/124 [Last accessed on 29 June 2013].*
3. Hoque, M. A., Shafiullah, M., Uddin, N. M., Roy, S., & Das, K. M. (2000). *Secondary General Science: Grades Nine and Ten [in Bengali]* (Revised and Refined ed.). Dhaka: National Curriculum and Textbook Board.
4. Mol (Ministry of Law). (1992). *Bangladesh Open University Act 1992*. Dhaka: MoL.
5. National Curriculum and Textbook Board (NCTB). (1996). *Curriculum and Syllabus, Secondary. Level (Grades IX-X) (Report: Part 2)*. Dhaka: Ministry of Education, Government of Bangladesh.
6. NCTB. (2004 a). *General Science Curriculum for Grades IX and X*. Dhaka: Ministry of Education, Government of Bangladesh.
7. NCTB. (2004 b). *Guidelines for Manuscript Writing/Publication: General Science (First Paper) [In Bengali]*. Dhaka: National Curriculum and Textbook Board.
8. NCTB. (2012). *Curriculum and Syllabus, Secondary Level (Grades IX-X).* Dhaka: Ministry of Education, Government of Bangladesh.
9. *Siddique, M. N. A. (2008). Ideas about science portrayed in the existing and proposed science curricula of grades IX-X in Bangladesh.* Asia-Pacific Forum on Science Learning and Teaching, Volume 9, Issue 2, Article 1 *(Dec.,2008). Available at: http://www.ied.edu.hk/apfslt/v9_issue2/mohammad/mohammad5.htm#five [Last accessed on 10 July 2013].*
10. Tapan, S., Hasan, M. A., & Choudhury, R. (2000). *Secondary Physics [in Bengali]* (Revised and Refined ed.). Dhaka: National Curriculum and Textbook Board.
    (a) BOU-Open School. (2011). *General Science: SSC programme*. Gazipur, Bangladesh: BOU-Open School.
    (b) BOU-Open School. (2011). *Home Economics: SSC programme*. Gazipur, Bangladesh: BOU-Open School.
    (c) NCTB. (2012). *Physics, Secondary Level (Grades IX-X).* Dhaka: Ministry of Education, Government of Bangladesh.

12

Developing Biology Curriculum for Undergraduate Students

Sonali Saha

Abstract

Students pursuing science programs should take a Biology 101 class where they are taught the following concepts. These concepts are fundamentals of biology and are used in every field of advanced biology learning. The current approach of this paper is to teach Basic Biology courses to the undergraduates aiming to pursue a career based on scientific research and or premedical students. The course curriculum includes 1) Structure function relationship and chemistry of macromolecules, 2) Structure of cell and cell signaling mechanisms, difference between prokaryotes and eukaryotes, 3) Energy conversion in cells, 4) Cell division and relationship between nucleic acids and proteins, 5) Fundamentals of evolution and ecology. To demonstrate this approach a brief presentation on cell structure and plasma membrane that have been developed as a part of Biology curriculum should be highlighted. In teaching students that have diverse career objectives it is important to develop a teaching plan that meets the goals of learning biology and understanding the basic concepts without it being repetitive, colossal and boring.

Key Words: *Biology Curriculum, Basic Biology, Plant Physiology.*

Introduction

Teaching biology to undergraduate students is an interesting and a challenging task, because not only are the students older and mature when they enter college but they are also thinking hard about their career and future goals.

During the first year of college, large majority of students may not know they want to do after earning a bachelor's degree. Therefore the onus is on the professors and academicians to shape and develop curriculum that will what provide an in-depth and comprehensive window to the biological world, and applications of all what they have learned. This will help students know what the future may possibly hold if they decide to pursue that field. Secondly the challenge is to present the subject in a thorough and interesting way to give the students an exposure that they are on par with competitive schools all over the world. Finally, the subject and its presentation should also bring out the innovative and enterprising side of the students, for an example- if a student is learning about environmental biology, based on what they have learned in biology and chemistry they might come up with ways to reuse and recycle plastic trash generated that seems to engulf our cities, towns and villages.

Biology Courses and Designing Curriculum

This may sound idealistic but it is high time we revised not the syllabi but the approach to undergraduate education. There are some suggestions presented here that highlight the possible changes that can be made in designing science, and specifically biology curriculum.

Introduce Science and Math Classes to all Irrespective of their Majors

Perhaps this is already in practice, but students from all walks of their majors should be exposed to courses in Biology, Calculus, and Conceptual Physics. As a student of Biology Major I was always frustrated when I had to make assumptions while deriving formulas in Physics when I had no background is Math, I could never understand why a magnitude of a physical quantity approaches "0"! In nutshell it is important that upon completion of undergraduate or a Bachelor's degree, students have basic knowledge of fundamental concepts, which can be defined by the experts in the respective fields. To give some examples of what can be considered as fundamental or basic knowledge in Biology, it may be fair to expect that students know shape and structure of protein macromolecule. Here, I will outline what I think should be the part of Biology Curriculum, and will elaborate on topics which must be incorporated in the first course of Basic Biology Course Series I and II. Of course these are some suggestions and will require further brainstorming sessions for concrete results. Basic Biology should be made mandatory to all students who have entered college to pursue no matter what degree! Students pursuing a biology major will have to take many more classes before they get a bachelors degree in Biology.

Basic Biology I

After teaching Biology for last several years to the students pursuing health related degrees such as pre-meds and nursing, and non-health degrees such as

Environmental Sciences, Psychology, Engineering, and being a biology student myself, I strongly feel that the material should focus on illustrating structure-function relationships, and should use hands on labs that will illustrate the application of the structure function relationships in biological systems. I will use specific examples, which must be part of Biology I curriculum to demonstrate the idea.

1. Macromolecules: Students should be well versed with structure of Macromolecules and use physical models to be able to demonstrate three-dimensional tertiary structure of proteins for example. Students should know the charges on amino acids and distribution of charges on proteins, the shape of which is complex and determines its function. For example the secondary and tertiary structure of protein determines its shape, such as proteins that function as ion channels on lipid bilayer of cell membrane. Similarly, the fact that DNA molecules have a negative charge can be demonstrated by conducting electrophoresis lab to demonstrate and visualize the concept. This lab can be used in conjunction with Biology II where students will familiarize themselves with concepts in genetics, such as polymerase chain reactions.

2. Cell structure with emphasis on structure and function of cell membrane and cell wall. Biological membranes are highly important and serve as gateways to hundreds of messengers and play an important role in signal transduction. Understanding of how enzymes work and that enzymes are proteins. The connection between cell structure and function can be very well tied with the structure and function of macromolecules mentioned in #1.

3. Differences between eukaryotic and prokaryotic cells, with an introduction to bacterial cell. Cell organelles play an important role in performing different functions, and the fact that bacterial cells do not have organelles, such as nucleus makes a large difference in the way bacteria reproduce and absence of genetic recombination the way it happens in eukaryotic cells. This topic will provide the opportunity to contrast the role of meiosis where students will be introduced to the basics of cell division and genetic recombination.

4. Biological energetic: Students should understand and internalize the concepts of Cell Respiration and Photosynthesis, with emphasis on electron transport chains, as are both fundamental to energy conversion in biological world. Introduction to ATP as a currency of energy should occur now and as early as Biology I. This would also cover the structure function relation of mitochondria, chloroplasts, and the pigment molecules harbored by chloroplasts.

5. Introduction to Phylogeny, understanding of kingdoms of living organisms and introduction to evolutionary relationships between different groups of living organisms. Labs that include observing diversity of structure function relationship among animal phyla, understanding plant diversity by growing plants. Perhaps there can be a community garden in college campus where students learn to grow different plants and observe different animals that live in conjunction with plants. This lab can be used with Basic Biology II where students learn about genetics and would grow plants to test for Mendel's laws of genetics.
6. Ecology and Conservation. Introduction to food webs and food chain, ecological energetics, use the community garden to start composting, and learn about the detritus and detrital ecosystems. Role of water and conservation of water and natural landscapes.

Specialized courses in Biology and Abolition of Botany and Zoology as Courses

Courses in plant sciences such as plant physiology or plant anatomy, or cell biology, should be offered only if students have taken Biology I and Biology II. The notion of botany and zoology as consolidated courses, encompassing taxonomy, physiology, animal organ systems, should be abolished; instead specific courses in plant physiology, animal physiology, plant breeding systems, cell biology, embryology, and genetics should be offered catering to students needs for students majoring in Biology.

Summary

Here, I lay out a plan to teach biology to college students irrespective of their academic background so that they are well versed with basic concepts of biology, ecology and can incorporate these concepts in their daily lives. It may be proper to provide an example of a consolidated curriculum for Basic Biology I that will generate interest, invoke curiosity and entrepreneurship, and expose students to various aspects of biology at par with students from most competitive colleges globally.

13

Laboratory Method of Teaching Science – Is It Existent in Schools of Shillong?

Yodida Bhutia
Swapnadeep Dey

Abstract

Science if often referred to as an 'organized common sense'. Science education is an important component of school education. It contributes towards finding a solution to problems and helps in developing observation skill, critical thinking and scientific attitude. It's a fact that learning takes place by doing and involving the students in the teaching – learning process. However, it is seen that in the schools of Shillong Science is still taught through the Lecture method. With regards to efficient Science teaching methods, the Laboratory method of teaching of Science lays emphasis on 'learning by doing' and enables students to attain practical experiences which in turn enable the students to obtain adequate concept and proper knowledge of the Science subjects. This in turn helps students to attain the ability to deduce correct conclusions and solve problems. This method is a child-centered, psychologically sound method which may cater to the individual differences of students.

Key words: *Laboratory Method, Scientific Attitude, Lectures Method.*

Introduction

Laboratory is the fundamental and unique part of the science education in schools. One of the unique features of effective science teaching is laboratory work or also called laboratory method of teaching. Laboratory method involves students in the practical work and aims to develop skills such as experimenting, observing, measuring and manipulating equipment. Such skills are seen as an important part of learning about how science proceeds. Through Laboratory work students should be able to "recognise and value scientific knowledge as reliable knowledge, based on observations, reproducible experiments and logic" and "evaluate experiments and arguments and the validity of results" (Australian Education Council, 1984, P. 84). This indicates that knowledge can be established and validated through laboratory method of teaching which may help students in permanent learning. This also helps students to attain the ability to deduce correct conclusions and solve problems. The laboratory method keeps students at the center of learning and caters to the individual differences of students which will promote all round development of students. However the science education in schools of Meghalaya is not growing or expanding as expected. Disinterest among students or fear towards the science subject is a matter of concern. Therefore, investigator made a study on the existence of science laboratory and its uses in the science teaching in the secondary schools of Shillong.

Methodology

The present study is a Survey study where the data is collected from the sample of students from class IX and X. The population of the study includes the secondary level students of Shillong. The purposive sampling is used to select 105 students from ten schools of Shillong. Questionnaire was developed by the investigators after consulting various other questionnaires related to science education, science text book of MBOSE. The questionnaire consisted of both close ended and opened questions. The data is analysed both qualitatively and quantitatively.

Major Findings and Discussions

1. Regarding presence of school laboratory, 90% of the students reported that their schools are having a Science laboratory whereas 10% of the students reported that their schools do not have a Science laboratory. The data obtained shows that while majority of the schools are fulfilling the basic needs for Science teaching, there are still some schools which do not even have a laboratory.

2. In terms of having different laboratories for the different Science subjects, 30% of the students reported that their schools have different laboratories for the science subjects. 50% of the students reported that their schools have only one laboratory for all the Science subjects whereas 20% of the students were not sure whether their schools had different laboratories for the Science subjects. This shows that most schools do not follow the requirement of having separate labs.

3. Students were given a list of common chemicals such as Hydrochloric acid, Sulphuric Acid, Nitric Acid, Acetic Acid, Sodium Chloride, Sodium Hydroxide, Potassium Chloride, Potassium Hydroxide, Ammonium Chloride, Ammonium Hydroxide, Copper Sulphate, Copper Hydroxide, Calcium Chloride, Calcium Carbonate, Safranin Stain, Litmus paper. 55% of the students reported that their Science laboratories are well supplied with chemicals, 25% reported that their school laboratories have less supply of chemicals. They reported that the Science laboratories in their schools had just a few chemicals like Sulphuric acid, Hydrochloric acid, Sodium Chloride, Copper Sulphate and Litmus paper. This indicates that the schools have a meager collection of chemicals which is not sufficient enough to demonstrate and conduct all Science experiments meant for school Science curriculum at Secondary level. This shows that some schools should update their laboratory by having an adequate supply of chemicals in the Science laboratories so that students can use them for experiments whenever needed. 20% of the students were not sure about the availability of chemicals in the school laboratory. Here again, we see that some students have no laboratory exposure and so, they do not have any idea of chemicals available in the Science laboratory.

4. Students were given a list of common instruments such as test tubes, conical flasks, beakers, measuring cylinders, funnels, clamps, burners, wire gauzes, petri plates, Prisms, Lenses(Convex/Concave), Apparatus for performing experiments related to 'Electricity', Apparatus for performing experiments related to 'Magnetism', Microscopes, Magnifying Glasses. 80% reported as to their laboratories having all the Science instruments given in the list. This is a positive sign regarding teaching-learning of science. However, 10% of students reported to their school Science laboratories not having adequate instruments. They reported that their Science laboratories had only some instruments like limited lab-ware such as test-tubes, conical flasks, beakers and measuring cylinders, prisms and apparatus for performing experiment on electricity. This signifies negligence of schools towards setting up of Science laboratories and shows the need for schools to scale up the instrument facility in Science laboratories so that students get ample practical exposure. Similar findings also showed that the most commonly reported problems in the conduct of laboratory work were related to poor conditions, insufficient equipment and long preparation time (Wilkinson an Ward, 1997).

   Furthermore, regarding the functioning of the instruments in the

Science laboratories in their schools, 45% of students reported that the instruments in the Science laboratories function well and 45% reported that the instruments in the Science laboratories are not adequate and do not function well too. 35% of the students stated that the school authorities change defective instruments in the Science laboratory whereas 55% reported that their school authorities do not change the defective instruments in the laboratory. This shows that many schools do not feel the need for checking the proper functioning of the instruments needed for execution of Science practical. A research study found that not only have the laboratories inadequate facilities, but also even the facilities that did exist were not used by the teachers. (Wahyudi and Treagrust, 2004).

5. 30% of the students reported as to their school labs being well equipped with biological specimens such as specimen of insects, frogs, fishes. 60% reported that their Biology laboratories had no collection of specimens and 10% were unsure about the presence of specimens in the laboratory. Availability of specimens is a necessity for effective Biology teaching. It provides a hands-on view of the various life forms that students study about in Biology. It generates an interest towards Science learning and provides students with better knowledge and understanding. It also generates a love for nature which is a necessity in today's times. Silvia Wen-Yu Lee et.. al. in 2011 also found out that the laboratory sessions generated student interest in, and motivated students to learn, vertebrate biology, especially students who were not interested in this subject initially. In addition, the laboratory sessions broadened students' understanding of the nature and reality of field biology.

6. 50% of the students reported as to their school labs being well equipped with Safety measures in the school labs like availability of first-aid box along with other basic amenities for safety like proper ventilation. 45% reported the absence of safety measures and 5% of the students had no laboratory exposure and hence were not sure of the presence of safety measures in the Science laboratory. Presence of safety measures is a necessity for sound laboratory functioning as in the place students are exposed to acids, chemicals and other instruments. Schools should have more awareness in this regard.

7. 55% of the students reported that their Science teachers use demonstrations or experiments while teaching while 45% reported that their Science teachers do not use demonstrations or experiments while teaching Science. Teachers need to make use of such activities while

teaching for effective Science learning amongst students to enhance their understanding, interests and skills.

8. 40% of the students stated that their class routines have separate classes for Science practical whereas 55% stated that they do not have separate classes allotted for Science practical. The maximum periods allotted mostly twice in a week. For effective Science teaching-learning laboratory works need to be given more importance. Similarly in a separate study found that most teachers believed they conducted laboratory work on a regular (once per week) basis, but this view was not shared by the majority of their students. However, teachers reported that the amount of laboratory work performed varies from topic to topic (Wilkinson and Ward, 1997).

9. 85% reported that no classes are held in the laboratory whereas 15% of the students stated that their Physics classes are sometimes held in the school lab. Maximum topics taught using the laboratory were two in number. The results are not favourable for good Physics teaching in terms of practical exposure. If the teacher explains topics with demonstrations, then students will grasp the knowledge better. This if further followed with experiments done by students will generate clearer understanding and interest in students. Incorporation of demonstrations and experiments will ease the understanding problems of students.

10. 35% of the students stated that their Chemistry classes are sometimes held in the school lab. Whereas 65% reported that no classes are held in the laboratory. Maximum topics taught using the laboratory were two in number. The results are not favourable for good Chemistry teaching in terms of practical exposure. Chemistry is a Science subject that can be understood better with the performance of experiments side by side. It provides the students with a visual treat of what they learn in theory and in the process helps them to view the nuances of chemical changes more effectively and promotes better retention of chemical equations and processes.

11. 45% of the students stated that their Biology classes are sometimes held in the school lab. Whereas 55% reported that no classes are held in the laboratory. Maximum topics taught using the laboratory were two in number. The results are not satisfactory for good Biology teaching in terms of practical exposure. Biology is a Science that deals with the study of life forms and Environment. Thus, it is always better to give the students enough laboratory exposure so that they may appreciate the intricacies and beauties of life forms. It not only

generates interest among students but enables them to realize the wonders of creation and fosters in them the feeling of conservation of biodiversity. It also generates a desire to compare and contrast between life activities of various living beings and inculcates desires to research further on life processes.

12. 40% students reported that their Science teacher makes them participate in experiments while teaching Science whereas 60% reported that their Science teachers do not follow any such practices. 45% of the students stated that after they perform experiments, their Science teachers do urge them to make interpretation based on the experiment results while 55% reported that their teachers do not do such things. While some teachers are making an effort which will enable better learning, many teachers need to incorporate such a practice. Schools need to impress teachers to follow the practice for effective Science classes. By making the students perform experiments, a teacher can generate in the students the ability to develop their skills and application abilities. When students perform experiments, they understand the scientific processes better and come up with their own deductions and conclusions which enhance their thinking powers. This practice is completely in accordance with Science learning whereby a student should be able to develop his thinking abilities and aptitudes well.

13. On being asked as to whether the Science teachers discuss the interpretations made by the students while performing experiments so as to finally come to a conclusion after discussion of the experimental work, 30% reported on the affirmative whereas 70% reported that their teachers do not discuss the interpretations made by the students while performing experiments. Here it must be pointed out that teachers should discuss the results of the experimental work done by students in class so as to provide them feedback on the correctness of their performance and along with it the students will also be able to learn better with such discussions. It will also promote interest and cooperation among students.

14. The students were given a list of common experiments such as (i) Experiments on topics related to electricity, light, magnetism, heat, (ii) of reagents for chemistry practical, (iii) Preparation of slides, (iv) Testing acidity or basicity, (v) Training on usage of Microscopes, (vi) Dissection of flowers, (vii) Activities on Environmental awareness, (viii) Preparation of experimental set-ups to demonstrate processes of Respiration, Transpiration, Photosynthesis and (ix) Preparation of Models. Most of the students reported that the experiments were

never done. 15% of students reported about them having performed some experiments on light, electricity, dissection of flowers and with regards to Chemistry, the students stated that they sometimes their teachers demonstrated simple chemical changes but did not encourage the students to try the same. Also the experiments were not chosen equally from all the three Science subjects. Students at all levels should be exposed to some experimental works in all the three Science subjects.

15. 40% of the students were satisfied with the manner in which they got exposure to their school laboratory, 55% were not satisfied and 5% were not sure about what to reply regarding usage of school laboratory as they have never had any laboratory experience in their schools. 70% of the students were of the view that they would learn better if they were given more scope for performing experiments and witnessing demonstrations in Science classes. 20% of the students did not view the need of Laboratory exposure as important for effective Science learning whereas 10% were unsure of the importance of experimentations and demonstration in Science learning.

Suggestions

- Schools should include their academic calendar the types of laboratory activities to be conducted in their science curriculum documents, and teachers and students should be made aware of this.
- Schools and School Managing Committee should take responsibility to keep improving science laboratory with adequate equipments, chemicals, models, specimens etc.
- It is also necessary to have separate science laboratory for different science subjects.
- The topics allotted for practical should be conducted in laboratory.
- During the assessment and evaluation of students in science subjects, scores of practical work should also be included.
- It is important to provide support to science teachers to enhance their performance especially in relation to the effective and regular use of science laboratories. This issue could be addressed by having teachers participate in relevant professional development programs such as different orientation or refresher courses.
- The available human resources may be used such as by inviting exemplary teachers to science teacher professional development programs to share their experiences with other teachers which may motivate both the group of teachers.

Conclusion

The study found that there is laboratory in secondary schools in Shillong however there is minimal use of laboratory method of teaching science in schools of Shillong. In fact the exposure to the practical aspect of Science is an imperative necessity. It not only nourishes the knowledge and understanding of students but also helps to put forward their views on the basis of the concepts that are more clearly attained. In a way, it surely helps students to secure better scores in Science exams as they write with clear confidence and understanding of topics. This also establishes foundation of science knowledge and develops scientific attitude and skills which in turn go a long way to develop efficient scientist and Nobel Laureates in future.

References

1. Abrahams, Ians. (2009). Does Practical Work Really Motivate? A study of the affective value of practical work in secondary school science. *International Journal of Science Education*, 31:17, 2335-2353, DOI: 10.1080/095006908 02342836.
2. Abrahams, I., & Millar, R. (2007). Does practical work really work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education.* DOI: 10.1080/095006907 01749305.
3. Afonso, Ana Sofia and Leite Laurinda. (2002). Prospective physical sciences teachers' use of laboratory activities: an analysis of its evolution due to a science teaching methods course. *Revista Electrónica de Enseñanza de las Ciencias, Vol. 1, No. 3,* Page No. 153-179.
4. Fensham, P. J. (1981). Can the laboratory become the real place of learning? *Lab Talk, 25(1),* 9-10.
5. Jenkins, E. (2007). What is the school science laboratory for?, *Journal of Curriculum Studies*, 39:6, 723-736, DOI: 10.1080/00220270601134425.
6. Lee, S., Wen-Yu, Lai, Yung-C., Yu & Lin. (2012). Impact of biology laboratory courses on students' science performance and views about laboratory courses in general: innovative measurements and analyses. *Journal of Biological Education*, 46:3. 178-179. DOI: 10.1080/00219266.2011.634017.
7. Wahyudi and Treagust, David F. (2004). An Investigation of Science Teaching Practices in Indonesian Rural Secondary Schools. *Research in Science Education* 34. 469-471.

80. Wilkinson, J. and Ward, M. (1997). A Comparative Study of Students' and Their Teacher's Perceptions of Laboratory Work in Secondary Schools. *Research in Science Education, 1997, 27(4).* 608-609.

14

In the Realm of a Natural Classroom – The Field Trip Experience

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Abstract

As per the curriculum assigned by the North Eastern Hill University, the department of Zoology, Shillong College conducted field trips annually for the final year degree students in and outside the state. Interpretive analyses of field reports submitted by the students show how field study enhances their knowledge of the subject. Field trips have helped the students in understanding various aspects involving the adaptation of the animals to their environment, their economic viability and their propagation for continuation of the species. In short, the field trips were educational and innovative in every respect.

Keywords: *Field Trip, Reports, Curriculum, Environment*

Introduction

A Fieldtrip or an excursion is a journey by a group of students to a place for the purpose of observation, learning, and to provide students with experiences outside their routine life. Good field trips provide participants with firsthand experience related to the topic or concept being discussed in the program. According to Krepel and Duvall (1981), a fieldtrip is defined as a trip arranged by the school and undertaken for educational purposes, in which the students go to places where the materials of instruction may be observed and studied directly in their functional setting: for example, a trip to a factory, a city waterworks, a library, a museum etc. Field trips provide unique opportunities for learning that are not available within the four walls of a classroom. The use of educational field trips have long been a major part of the education programming for both the youth and adults.

Sorrentino and Bell (1970) reviewed texts and research articles by science educators, summarising their reasons for taking field trips into five 'attributed values': providing first-hand experience, stimulating interest and motivation in science, giving meaning to learning and interrelationships, enhancing observation and perception skills, and personal (social) development. Quantitative studies of the attitudes of teachers towards field trips were undertaken by Falk and Balling (1979), Fido and Gayford (1982) and Muse, Chiarelott and Davidman (1982). The researchers found that, in the opinion of teachers, the positive benefits derived from field trips were

- Hands-on, real world experiences.
- Quality of education, positive attitudes to science and motivation towards the subject.
- Improvement of the socialisation between students, which would impinge on the classroom, and development of rapport between teachers and students.
- Enabling teachers to utilise other learning strategies such as cooperative learning.

Negative attitudes of teachers revealed by the research related to a number of factors, some of which are interrelated:

- Difficulties with transportation, including cost (Falk and Balling, 1979; Muse et al., 1982; Orion, 1993; Price and Hein, 1991).
- Teachers' skills, the disparity between theory and practice and a perceived teacher inertia (Beasley, Butler and Satterthwait, 1993; Falk and Balling, 1979; Orion, 1993; Tamir and Zoor, 1977).
- Time considerations - preparation, fitting into the school timetable (Beasley et al., 1993; Muse et al., 1982; Orion, 1993; Price and Hein, 1991).
- Lack of support from school administrations for field trips (Falk and Balling, 1979; Muse et al., 1982; Orion, 1993; Price and Hein, 1991).
- Curriculum inflexibility (Falk and Balling, 1979; Orion, 1993; Price and Hein, 1991).
- Poor student behaviour and attitudes (Beasley et al., 1993; Muse et al., 1982; Orion, 1993; Price & Hein, 1991).
- Inadequacy of resources and choice of venue (Beasley et al., 1993; Orion, 1993; Price and Hein, 1991).

As per the curriculum assigned by the North Eastern Hill University, the department of Zoology, Shillong College conducted fieldtrips on an annual basis for final year degree students within and outside the state. Such kinds of field trip were conducted to encourage the students to further pursue their knowledge in connection with the subject as well as to motivate them to develop an interest by observation *in situ*. The aim of this paper was to analyse a qualitative study from the reports of the field trips submitted by the students.

Methodology

Field trip reports of the students were taken and interpretively analysed to evaluate how much knowledge they had gained from their field trips. On an average 50 students were present in every field trip that was organised. Some of the trips that the department had arranged in the past few years were trips to Kaziranga National Park (Assam), Deepor Beel Bird Sanctuary (Assam), Fossil Park (Lawbah-Meghalaya), Indian Council of Agricultural Research (ICAR) complex, Meghalaya, Regional Science and Instrumentation Centre (RSIC) NEHU Meghalaya, Assam State Zoo-Cum Botanical Garden, but the reports that were analysed were of the previous five years only.

Following are the trips taken during the years 2008-2012-

1. Rural resource and training centre (RRTC) Umran, Meghalaya in 2008.
2. Guwahati Zoological Park in 2009.
3. Ialong Park in 2010.
4. Lumsohpetbneng in 2011.
5. Laitmawsiang in 2012.

Analysis

Rural Resource and Training Centre (RRTC) is a land and technology based training centre which believes in learning while doing. In this centre the students were benefited by the guide's demonstration in the field of apiculture, pisciculture, poultry farming, piggery, vermi-compost, biogas formation and information regarding medicinal plants. Applied science is part of the curriculum and hence theory classes were taken relating to the subject, nonetheless the students had learnt much more through the fieldtrip to RRTC in 2008.

In 2009, around 45 students made a trip to Guwahati Zoological Park and reported that it had been worth visiting as they were able to study the various groups of the animal kingdom with proper nomenclature especially those that belong to the phylum Chordata. The following year, a field trip was made to Ialong Park, Jowai, Jaintia Hills District which is known for its sacred grove and for its setting which overlooks the beautiful Pynthorwah Valley. Students were able to collect and study the different fauna including a variety of fish species from Myntdu river as shown in their reports. Students also reported that the quality of water has affected the health condition of the fishes.

Similarly in 2011 and 2012, around 50 students made a trip to Lumsohpetbneng and Laitmawsiang respectively and reports submitted by the students showed the ecological status of the two areas. As per the reports submitted by them, Ecology, a branch subject of biology is best studied through such field trips.

Discussion

Sampath (2006) describes that during the fieldtrips which are undertaken with a specific purpose, students have concrete learning experiences in real situation. The chief purpose of this method is to give the students first hand experiences that cannot be had in the classroom. Interpretive analyses of field reports of science students of Shillong College indicated that many of the objects of investigations were studied best in their natural settings. The positive benefits derived from such fieldtrips were hands on, real-world experiences, quality of education, positive attitudes to science and motivation towards the subject, improvement of socialisation skills between students, which impinged in the classroom and development of rapport between teachers and students, enabling teachers to utilise other learning strategies such as cooperative learning. Findings also indicated that fieldtrips had generated awareness among the students about various environmental issues of the areas that they had visited. Such kind of a realisation could only be brought about in the natural set up. Aggarwal (2008) clearly stated that educational field trips aims at enriching, vitalizing and complementing content areas of the curriculum by means of first hand observation and direct experience outside the classroom. The response in the field reports show that these field trips at higher level are very important for it is not only helpful in effective learning but promotes leadership qualities, discipline and self confidence in the students. With regard to the subject of Zoology, field trips conducted by the department have helped the students in understanding various aspects involving the adaptation of the animals to their environment, their economic viability and their propagation for continuation of the species. In short, the field trips were educational and memorable in every aspect thus, it is necessary that such educational field trips should be arranged and conducted by every department at the higher level.

References

1. Aggarwal, J C (2008). "Principles and methods and techniques of teaching", Vikas publishing house pvt Ltd.
2. Beasley, W, Butler, J and Satterthwait, D (1993). Senior sciences future directions project final report. Board of Senior Secondary School Studies, Queensland (unpublished).

3. Falk, J H and Balling, J D (1979). Setting a neglected variable in science education: investigations in outdoor field trips. Smithsonian Institute, Chesapeake Bay Centre for Environmental Studies (NSF Grant SED 77-18913, unpublished).
4. Fido, H S A and Gayford, C G (1982). Field work and the biology teacher: A survey in secondary schools in England and Wales. Journal of Biological Education, 16(1), 27-34.
5. Krepel, W J and Duvall, C R (1981). Field trips: A guide for planning and conducting educational experiences, Washington, DC: National Education Association.
6. Muse, C, Chiarelott, L, and Davidman, L (1982). Teachers' utilization of field trips: Prospects and problems. Clearing House, 56(3), 122-126.
7. Orion, N (1993). A model for the development and implementation of field trips as an integral part of the science curriculum. School Science and Mathematics, 93(6), 325-331.
8. Price, S, and Hein, G E (1991). More than a field trip: Science programmes for elementary school groups at museums. International Journal of Science Education, 13(5), 505-519.
9. Sorrentino, A V, and Bell, P E (1970). A comparison of attributed values with empirically determined values of secondary school science field trips. Science Education, 54(3), 233-236.
10. Tamir, P, and Zoor, H (1977). The teacher's image as reflected by classroom experiences. Journal of Biological Education, 11(2), 109-112.
11. Sampath, K, Panneerselvam, A, and Santhanam, S (2006). "Introduction to educational technology", Sterling publishers Pvt Ltd.

15

A Wonderful Science Class: A Journey from Planning to Achievement of Learning Outcome

Rihunlang Rymbai

Abstract

A lesson is learnt if there is joint effort of students and teacher. A successful class is a class where students takes pleasure in learning. Learning does not take place appropriately in an atmosphere which is dull, sluggish and lethargic. A classroom which makes learning of science ecstatic is a wonderful class. This will take place without the endeavour from the part of the teacher to create a joyful learning environment which is rich in activities, interaction, discussion and grasping of factual matter. Science is such a discipline which will not do without the practical aspect of it. It is therefore, necessary that the learning of science is not only the focus on theoretical element but also the commitment towards the practical area. The theoretical component must also be taught with enriched practical techniques and approaches so that students gain proper insight and widen the knowledge and understanding of the subject matter, develop interest and have appreciation towards the discipline and the people of science. Keeping the above in mind, the study will focus on a journey that is to be trodden, through a wonderful science class by focussing on planning, execution and evaluation. It will project the framing of learning objectives, arranging needful learning experiences and evaluating the students continuously for attaining the intended learning outcome.

Introduction

Every word that a teacher utters in class cannot be remembered by the students, but memories of how the class was conducted through the creativity of the teacher will be remembered forever. A great class is accompanied by artful teaching, meaningful students' activities, and great classroom interactions. Every science class is an opportunity for a teacher to open up gateways of learning about the wonderful facts, concepts, theories and generalization of science. Science is such a discipline which motivates learning in students because of the practical side of it. There is always a chance that everything learnt can be proved and experimented either by simple activities or by getting oneself involved inside the laboratory. It involves students in learning by doing and in hands on activities.

Science is a dynamic, expanding body of knowledge. It involves observing, exploring, hypothising, verifying, analyzing and interpreting various phenomena occurring around us. It is common, except for few, that a science teacher encourages a student to go beyond the content and concepts given in the textbook. This is making the subject boring and dull. Science can be made lively and interesting by giving students hands on experiences and by encouraging them to ask questions, observe, explore, experiment and investigate. Learning should not remain confined to the classroom alone but it should be intricately woven into the experience of the daily lives of the students (Srijata Das, 2009).

The teacher plays a very important role in triggering the students at the mental level and the emotional level. The teacher is the source of knowledge, positive actions and motivation. The teacher must initiate the students to involve themselves in learning, by guiding them along the way and making them to learn better. With the effort made by the teacher, the students will be able to follow his footsteps and move themselves in the right direction of learning the things that they love and have interest in.

Planning of Lesson

Creativity is one of the higher thinking skills. The teacher can make the class interesting with his creativity. But, creativity must be transferred into an act to make it effective. Creativity can come into play only with proper planning. As planning is needed for every event to become systematic, organized and successful, it is also needed for delivering a great science class. The teacher can therefore plan each day's lesson. "A lesson plan", in the words of Lester B. Stands, "is actually a plan of action. It, therefore, includes the working philosophy, his information about and understanding of his pupils, his compression of the objectives of education, his knowledge of the material to be taught, and his ability to utilize effective methods." One must also understand that a lesson plan is not a blue print that one has to adhere to at all costs. It is, rather, a guide, an index of sequence of classroom activities, a list of important teaching points; suggestions for procedures that may be followed during the period. The teacher should modify the plan or change any part of it whenever necessary.

According to Lee and Takahashi (2011), "Lesson plans contain a vast number of unspoken assumptions about what students should know, what types of resources should be made available, what types of prior experiences students should have and what types of information the teacher should draw on from their students' performance and how. Although lesson plans do not specify and clarify such assumptions, they become communicative resources because the plans offer the conceptual and practical anchors through which teachers estimate the goodness and adequacy of particular teaching practices. A successful lesson implies that what happened was within the parameter of what the lessons prescribed. Even when a lesson goes awry, the lesson plan can be a frame of reference through which teaching practices are made innovative and alternative methods are sought out."

Planning of lesson focuses on the every aspect of making a class an effective one. It arrays from teaching-learning objectives to the learning outcomes of the students and everything that is sandwiched in it. It involves the following:-

Motivation

Motivation is a moving force that keeps the interest on a target. It is needed so that the person perseveres in the goal that one plans for oneself. It endorses a person from one stage to the next and keeps the aspiration and interest of the person going. Motivation stands for the state of an organism which involves the existence of a need that moves or drives him from within towards a goal for the satisfaction of the desired need.

The teacher has a big part in moving the students from the immobile state to a state of enthusiasm, readiness and alertness for attaining new information and learning. There should be a part of teaching where the teacher jolts the students to a state of eagerness to receive new knowledge. The teacher may carry out motivation to the students by asking questions from previous knowledge of the students, by quoting, by telling a short story, by citing examples, by showing an image or by action that will generate interest and readiness of learning in the students. From making the students ready to learn the teacher has excited the students to step up to the next stage of classroom learning. The study made by **Adedeji Tella** (2007) reveals that highly motivated students perform better academically than the lowly motivated students.

Introducing the Topic

The students need to identify the topic of the day's lesson. This will be a starting point of the reception for new learning. The teacher needs to declare the topic of the lesson. The same can be written down on the board. It indicates the beginning of presentation of the lesson. This may be done in order to keep the students on track, if they happen to lose concentration along the delivery of the lesson by the teacher. Therefore, this is an important step before entering into the main presentation of the lesson. A teaching skill was developed on the place and importance of introducing the topic to the class. The Skill of Introducing the Topic was use in the training of student-teachers who can make use of it in the classroom teaching-learning.

Teaching the Content

Teaching content should be based from the syllabus of the science course. In the case of school students, the content for the day's lesson is taken from the science textbook. The approach, technique and methodology of teaching science will depend a lot on the teaching content. The teaching content includes the facts and concept. While the teacher plans the lesson, the teaching content should be analysed appropriately. Only after thorough analysis of the content, the teacher can simultaneously synthesize the methodology and technique of teaching. The preparation for teaching the particular content of science can be carried out by keeping in mind the following dimensions.

Teaching Points

With methodical analysis, the teaching content can be arranged under specific teaching points. The teaching points bring specificity to the facts and concepts to be delivered to the students. It guides the teacher in the path that he should be going. It will indicate if the teacher has side-tracked during the explanation. It will help him from wasting time in taking about irrelevant ideas, which can make the basic idea of the fact or concept become diluted and vague.

Teaching Objectives (Instructional Objectives)

The teaching points can become meaningful, effective and goal-directed only when they are led by the teaching objectives called as instructional objectives. The objectives provide guidelines and direction to the teachers so that they will be able to perform their work, keeping in mind the target that needs to be achieved. The objectives also provide a common understanding for the students about the target that is to be reached. With the process of using the instructional objectives the students are able to learn about the new knowledge and information.

Teachers vary in the degree of precision with which they see the objectives they are pursuing in their teaching work. To make these objectives more explicit and to define them more clearly demands additional work from each teacher, an effort which ought to be rewarded by improved results. However, the teacher cannot hope for satisfactory results if the objectives sought are not related to the other aspects of instruction. To have a precise grasp of the role of learning objectives necessarily implies an insight into the possible relationship between the objectives and the other components of instruction. The roles of objectives are: (1) To improve communication; (2) To be used in choosing learning activities; (3) To facilitate the choice of teaching material ; and (4) To specify the purpose of evaluation.

The teaching objectives can be framed with the use of action verbs. Keeping in mind the **Bloom's Taxonomy** of educational objectives, they are classified under the domains of – **cognitive**, **affective** and **psychomotor**. The cognitive domain includes those objectives which deal with recall and recognition of knowledge and development of abilities and skills. The affective domain includes objectives of interest, attitudes, values and development of appreciation and adjustment. The psychomotor domain includes the objectives like physical movement, coordination, and use of the motor-skill areas.

Teaching Methods

There is countless number of methodologies that a science teacher can make use of inside the classroom. The teacher can teach the students outside the class as well if the situation arises for him to make the students learn better. Planning and designing the teaching method depends on the type of teaching content. It is not always possible for the teacher to use student centred methods of teaching, though it will very much capture the interest of the students. The teacher will also have to balance between the need of the students and the compulsion of completing the course within the time perimeter. Even with the use of teacher centred methods of teaching, the teacher can make the class interesting by the use of participatory type of interaction so that the students can benefit either ways.

The findings of the study by Carpenter (2007) suggest that faculty teaching large classes should attempt to include constructive, active teaching methods in their courses whenever possible. Structured, controlled collaboration (e.g., jigsaw, case study) would probably be most comfortable to students as opposed to uncontrolled, unstructured experiences (i.e., team projects). Results indicate that most students prefer to be active in their learning process. The teacher may choose the method that best suits the teaching content, the need of the students and their capacity and interest. With the use of different methods, the teachers can also plan the techniques that can be integrated for an interesting interaction and display.

Teaching Aids

Teaching aids are the teaching learning materials that aids in classroom teaching. They include the different supplementary materials that the teacher can make use of in captivating the students' attention, concentration and interest in learning. They include the visual, audio and audio-visual aids. They are also classified as the teaching-learning materials that can be projected and non-projected. Teaching aids have a great impact in teaching and learning of science. The findings of the study carried out by Mathew and Alidmat in 2013 reveals that integrating audio-visual resources with the prescribed course content has a positive impact on the teaching-learning process.

The type of teaching aid to be used in the class will again depend on the teaching content, the teaching points and the teaching objectives. The teacher must keep in mind that he himself is the greatest teaching aid. He is, visible, audible, flexible, knowledgeable as well as skilful. He can bring variance in his teaching through his teaching style, his language, his vocabulary, his actions, his approach, etc. With the teacher being enthusiastic about teaching the students will follow the same in learning. After all, the teacher is the greatest motivator.

Teaching Activities

In science teaching, one can always come up with small activities in teaching the various science topics. The Central Board of School Education published an activity book in science teaching in 2009 by the title, "Learning by Doing – Science Activity Book". The activities in science class can make the students come alive with proving and making inferences of the thing they have learnt in theory. The will be able to have faith and conviction in empirical method of learning. With exposure and experience in the hands on activities they will develop a healthy attitude, develop a passion and interest in pursuing science in the later years.

Evaluation

There is a profound relationship between educational objectives and evaluation. Evaluation may be termed as "a systematic process of determining the extent to which educational objectives are achieved by pupils." A child who has achieved the educational objectives can be evaluated easily through his actions and behaviour. The satisfactory learning behaviours are the learning outcomes. In other words, through a student's learning outcome, the achievement of educational objectives can be evaluated.

In order that the teacher can confirm if the students have learnt and understood about the content taught, evaluation is what is needed. With the responses of the students, the teacher can rate his class and recognize the level of understanding of the students. By this, the teacher will therefore be able to analyse the understanding level of the students in the class and get the chance to synthesise and improve his future classes.

Learning Outcome

Frequent classroom interaction between the teacher and the students by questions-answers can help the teacher in measuring the learning outcome. The teacher recapitulates the lesson by asking questions based on the topic taught, and thus, assess the learning outcome of the students. Thus, evaluation is the way of understanding the extent of achievement of educational objectives and acquisition of modifiable behaviour in learning. As the educational objectives can be framed at the three domains of learning, the learning can also be achieved at the three different levels, but it will very much depend on the topic, methodology, and objectives of the lesson.

Learning outcomes are therefore evaluated based on **Bloom's Taxonomy** of educational objectives. The cognitive domain appraise outcome pertaining to knowledge, comprehension, application, analysis, synthesis and evaluation. The affective domain assess outcome that concerns with receiving phenomena, responding to phenomena, valuing, organization and internalizing value. The psychomotor domain evaluates the outcome like imitation, manipulation, precision, articulation and naturalization.

Closure of Lesson

Subsequent to a satisfied affair of evaluating the learning outcome of students, the teacher needs to come out of the topic and arrive at conclusion. This can be done by closing the lesson. The closure can be brought about by summarizing and consolidating the teaching points and refocusing on what had been done in the whole period of class. The teacher reviews the past knowledge of the students, both previous and newly gained knowledge and also provide for future learning by homework or assignment.

Conclusion

In a nutshell, it can be concluded that a well planned lesson with targeting objectives proves a more satisfactory result for both teachers and students. The teacher will be able to deliver a good class, engage students in learning, create a good interaction with them, and measure a good quality and quantity of learning outcome of the students and gets satisfaction out of a good class. On the other hand, the students receive a good class, respond to it well, develop better interest in the subject, learn well and have a great appreciation for the great teachers who deliver a wonderful science class. A great science class is well planned, well executed and well conquered. It can be summed up in the words of **R.L. Stevenson**, 'To every teacher I would say,' "Always **plan** out your **lesson** before hand but **do not** be **slave** to it."

Reference

1. Babu, A. and Dandapani, S. (2006). *Microteaching Vol I.* Neelkamal Publication Pvt. Ltd. Hyderabad.
2. Carpenter, J. M. (2006). Effective Teaching Methods for Large Classes. *Journal of Family & Consumer Sciences Education,* Vol. 24, No. 2.

3. Laxmi, D. V. And Rao, D. B. (2004). *Basic Education*. Discovery Publishing House. New Delhi. 178.
4. Lee, Y and Takahashi, A. (2011). Lesson Plans and the Contingency of Classroom Interactions. *Springer Science and Business Media B.V.*
5. Mangal, S. K. (2011). *Essential of Educational Psychology*. PHI Learning Private Limited. New Delhi. 243.
6. Sharma, R. C. (1992). *Modern Science Teaching.* Dhanpat Rai and Sons. Delhi.
7. Tella, A. (2007). The Impact of Motivation on Student's Academic Achievement and Learning Outcomes in Mathematics among Secondary School Students in Nigeria. *Eurasia Journal of Mathematics, Science & Technology Education.* 3(2), 149-156.
8. http://cbse.gov.in/publications/science_activity_class_viii.pdf Dr. Srijata Das, Education Officer, CBSE, Delhi.
9. http://www.unesco.org/webworld/ramp/html/r8810e/r8810e04.htm

16

Teaching and Learning Mathematics with Technology and Applications

Jibitesh Dutta

"The single most important catalyst for today's mathematics education reform movement is the continuing exponential growth in personal access to powerful computing technology" – M. K. Heid

Abstract

In the present growth and evolution of mathematics and mathematics teaching, one of the strongest forces that have played a pivotal role is the power of new technologies. Now-a-days researchers agree that computer soft-wares can be used as a cognitive tool for teaching and learning mathematics. Multimedia and graphical features of these soft-wares lend a sensory component that may help students reinforce concepts and visulalize geometric figures. There are various computer algebra systems such as Maple, MatLab, and Mathematica etc., and it is mainly a matter of taste which system one chooses to use. In this paper I present a brief review of various mathematics soft-wares that can be used for teaching. In particular, it is shown by examples how *Mathematica* can be used for teaching elementary and advanced mathematics. Finally, a different approach is presented to teach mathematics incorporating internet and discussion forums.

Key words: *Mathematics, Mathematica, CAS, Wolfarm alpha, Teaching.*

Introduction

We all know and few people will deny that most spectacular successes of mathematics have been in the Physical Sciences. But over the last few decades mathematics has broken out into a whole new range of applications in social sciences, biology, medicine and management. It seems in almost every field of human endeavour, there are mathematical models providing qualitative if not quantitative information where none had existed or even contemplated before. In spite of being so important a subject and occupying a central position since the early period still it has not been of interest to many students. Even after so many commissions, policies, programmes were formed; the scenario in the field of Mathematics has not been satisfactory. The pass percentage of higher secondary school examination in this subject is very low in comparison to other subjects of the school curriculum. Surveys show that many students find the subject difficult, dull and as a result they try to avoid this subject which is reflected in their performance. So we ought to look for an efficient method to make the subject interesting. Two possible methods which can be used to address this issue are imbibing a sense of motivation with real life applications and use of the cognition enhancing technology.

Teachers should try to take a more creative and interesting approach for students in order to gain their attention and foster their interest in Mathematics. Motivation occupies a central place in teaching-learning process and is one of the most important objectives of teaching. Motivation does arouse interest in learners, which in turn make them attentive. Motivation energizes and accelerates the behaviour of the learner and also results in the inculcation of interest. The learner will remain attentive as long as their interest is retained in the learning of the subject. Therefore, a Maths teacher should observe the interest and inclinations of his students and should try to make his teaching and classroom activities as interesting as possible. The teacher can motivate the students by pointing out the usefulness of the topic in daily life situations. Application of maths in various professional fields and other subjects, its recreational values (fun, pastime, game puzzles), contribution of Maths in the development of various field can also be pointed out in this endeavour.

Another innovative method which can be followed is the use of the technology in Teaching and learning mathematics. In the present growth and evolution of mathematics and mathematics teaching, one of the strongest forces that have played a pivotal role is the power of new technologies. Nowadays researchers agree that computer software can be used as a cognitive tool for teaching and learning mathematics (Bruce & Levin, 2001) (Bransford, Brown, & Cocking, 2000). It is found that Information Communication Technology Tool (ICT) can support learning when appropriately integrated with teaching methods (Means & Haertel, 2004). Technology can help increase students' focus on more important mathematics and can reduce the effort devoted to tedious routine calculations. More importantly, technology can represent mathematics in ways that help students understand concepts. In fact, (Dede, 2000) indicates that technology can be used to strengthen student learning and enhance pedagogy. In fact, the National Council of Teachers of Mathematics (NCTM), which is the world's largest association of mathematics teachers, declared technology as one of their six principles for school mathematics.

'Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning' (NCTM, 2000). Moreover, weaker students can be provided with activities that meet their special needs and help them to overcome their individual difficulties. Thereby, students "may focus more intently on computer tasks" and "may benefit from the constraints imposed by a computer environment" (NCTM, 2000).

There are various software packages such as *Maple*, *Mat Lab*, *Mathematica* etc., and it is mainly a matter of taste which system one chooses to use. These packages allow learners to discover patterns, to explore and to test conjectures by constructing their own sketches. Multimedia and graphical features of these software's lend a sensory component that may help students reinforce concepts and visualize geometric figures. In this paper is presented a brief review of popular mathematics soft-wares that can be used for teaching. In particular, it gives examples how *Mathematica* can be used for teaching elementary and advanced mathematics giving an approach to teach mathematics incorporating internet and discussion forums.

The paper is organized as follows: Section 2 deals with a brief review of popular soft-wares that can be used for teaching while in section 3 deals with the popular software package *Mathematica* and some specific examples that can be used for teaching. The paper ends with some closing comments.

Technology Used in Mathematics Education: A Brief Review of Popular Software Tools used for Mathematics Education

The four main types of educational software currently used for mathematics teaching and learning are Computer Algebra Systems (CAS), Dynamic Geometry Software (DGS), Dynamic Mathematics Software (DMS) and spreadsheets. Each type of the software has its own advantages and is especially useful for treating a certain selection of mathematical topics or supports certain instructional approaches. Nonetheless, the boundaries between those types of software become increasingly blurred and features characteristic for one type are often added to another one. In what follows, a brief description of each type of software is given.

(i) Computer Algebra Systems

A Computer Algebra System (CAS) is a programme that facilitates manipulation of symbolic mathematics. These types of soft-wares mainly deal with the symbolic and numeric representation of mathematical objects. They allow for manipulating a variety of algebraic expressions and functions, and can deal for example with basic mathematical operations, simplication, factorization, derivatives, integrals, sequences, and matrices. Also they can be used for plotting graphs of functions and equations. Examples of CAS are Derive [Texas Instruments Inc., 2008], Maple [Maplesoft, 2008], and *Mathematica* [Wolfram Research Inc., 2008]. As of today, *Mathematica* and Maple are the most popular commercial CAS, which are commonly used by mathematicians, scientists, and engineers. Another popular freely available CAS is SAGE (System for Algebra and Geometry Experimentation) with the initial goals of creating an "open source" alternative to Mathematica, Maple and MATLAB. The leader of the SAGE project, William Stein, is a professor of mathematics at the University of Washington. The benefits of using CAS in teaching and learning Mathematics have been reported in many conferences and literatures (Artigue, 2002), (Pierce & Stacey, 2004), (Lavicza, 2006).

(ii) Dynamic Geometry Software

Dynamic geometry soft-wares are used as a generic term to describe a certain type of software which is mainly used for the construction and analysis of problems primarily in plane geometry. Cabri Geometry [Cabrilog SAS, 2007] and Geometer's Sketchpad [Key Curriculum Press, 2008] are two examples of dynamic geometry softwares. In general, dynamic geometry software provides three main features that normally can't be found in CAS or spreadsheets although they differ in terms of their functionality and use. These are drag mode, customizable tools, and trace or locus of objects [Graumann et al., 1996, p.197].

(iii) Spreadsheets

It is an ideal bridge between arithmetic and algebra and allow the student free movement between the two worlds. These are computer applications that allow the display of alphanumeric text or numeric values in table cells which are organized in rows and columns. Formulas can be used to calculate new values by referring to other cells. All other related cells are updated automatically whenever the content of one cell is modied. Examples of spreadsheets are MS Excel [Microsoft Corporation, 2007] and Calc [CollabNet Inc., 2008a].

(iv) Dynamic Mathematics Software

Dynamic Mathematics Software (DMS) is designed to combine certain features of dynamic geometry software, computer algebra systems, and also spreadsheets into a single package. The two prominent examples of DMS are GeoGebra [Hohenwarter, 2008] and GEONExT [Universität Bayreuth, 2007]. This software allows learners to discover patterns, to explore and to test conjectures by constructing their own sketches.

Teaching with Mathematica

Mathematica is a system for doing mathematics by computers. It is extremely flexible and teacher gets many options for applications. It was first released in 23rd June 1988 by Wolfram Research Inc as *Mathematica* 1.0. Its main developer is Stephen Wolfram and it had a profound effect on the way computers are used in technical and other fields. Subsequently many versions are released and Mathematica has gradually emerged as a major force in many other areas of computing with many new areas covered in each successive version. Major breakthroughs came in the 2007 and 2008, with release of version 6.0 and 6.0.2. The latest version is Mathematica 9.0.1 released in 2013. Even after 25 years of its existence where it has grown and broadened immeasurably, the core of it is still what was in *Mathematica* 1.0—and it looks as fresh and modern as ever. This software can be approached from many different points of view: as a high level numerical and symbolic calculator, as a graphing program, as a mathematical experiment program, as a programming language like C or like Prolog, or as a word processor with special mathematical abilities. All the diverse commands use uniform syntax and same data structures. One can quickly learn *Mathematica* because of its vast library of built in functions. The largest part of *Mathematica's* user community consists of technical professionals. But it is heavily used in teaching and there are hundreds of courses from high school to graduate- based on it. Though *Mathematica* can be used to study almost all topics including abstract algebra but a better option would be to use specialized software like *Group Explorer* and *GAP* (Groups, Algorithms and Programming) for teaching abstract algebra. Recently Schubert et *al* (Schubert, Gfeller, & Donohue, 2013) investigated the use of *Group Explorer* in an undergraduate course. In what follows, I give two examples where *Mathematica* can be used for visualization, experimentation and computation for effective understanding in mathematics classroom.

Examples

(a) Improving visualization

Mathematica's graphing capabilities can be used for drawing graphs of functions quickly and accurately. For instance the command

Plot [x^2-x+5, {x,-4,4}] draws the graph of function $y = x^2 - x + 5$ (Fig. 16.1)

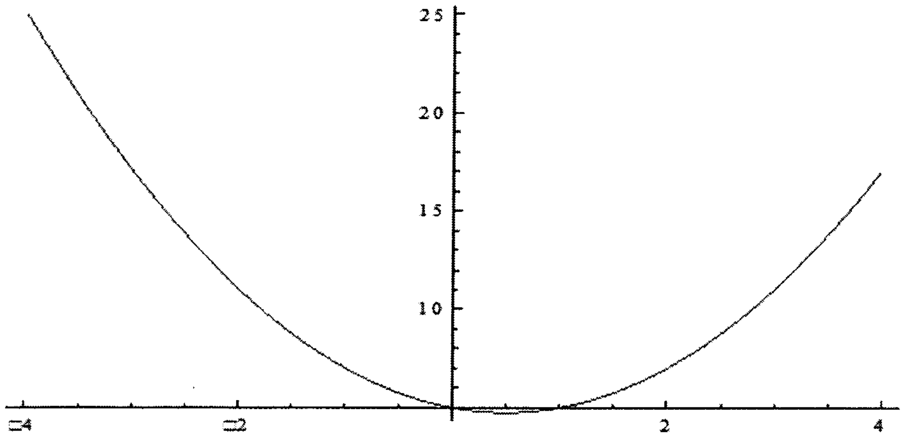

Fig.16.1 Model Graph of Mathematica function

The single command **Manipulate** lets us create an astonishing range of interactive applications. For instance the command Manipulate [Plot3D[Sin[a * x] * Cos[y], {x, −2,5}, {y, −4,6}], {a, 1,10}], plots the surface $z = Sin\ axCosy$ in Fig. 16.2

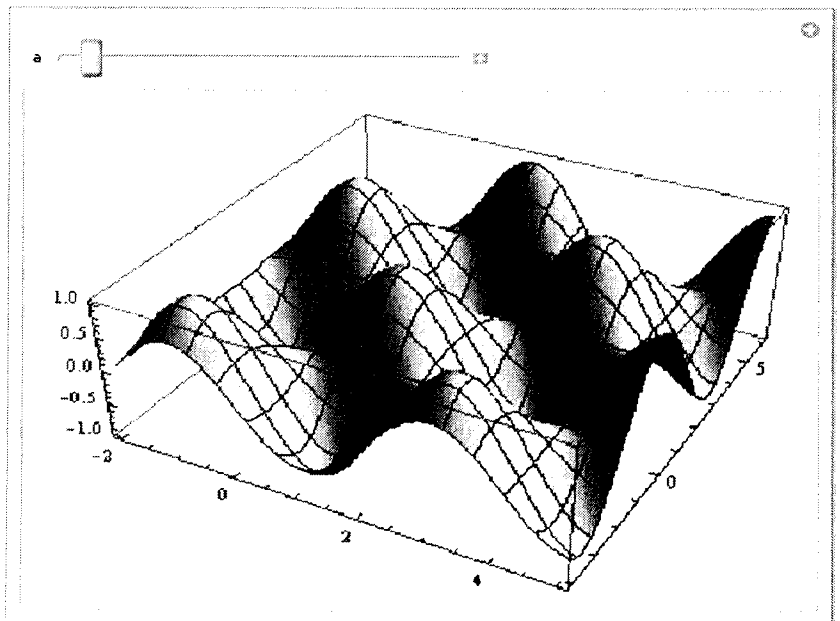

Fig.: 16.2 Interactive Applications - Model Graph of Mathematica function

The output we get from evaluating Manipulate command is an interactive object containing one or more controls (slider) that can be used to vary the value of parameters. Here a is a parameter which can be varied.

(b) Experimentation and Computation

The possibility of performing long tedious mathematical calculation very quickly using *Mathematica* helps us design new strategies for solving problems. For example one can integrate $\int \frac{1}{x^5-1} dx$ in Mathematica by the command Integrate [1/(x^5-1), x] and the output is

$$\frac{1}{20}(-2\sqrt{2(5+\sqrt{5})}\text{ArcTan}[\frac{1-\sqrt{5}+4x}{\sqrt{2(5+\sqrt{5})}}]-2\sqrt{10-2\sqrt{5}}\text{ArcTan}[\frac{1+\sqrt{5}+4x}{\sqrt{10-2\sqrt{5}}}]+$$

$$4\text{Log}[-1+x]+(-1+\sqrt{5})\ \text{Log}[1-\frac{1}{2}(-1+\sqrt{5})x+x^2]-(1+\sqrt{5})\text{Log}$$

$$[1+\frac{1}{2}(1+\sqrt{5})x+x^2])$$

.Then one can use the command Manipulate[Integrate $\left[\frac{1}{x^n-1}, x\right]$, {n, 2, 10,1} to bring a dynamic formula (Fig. 16.3)

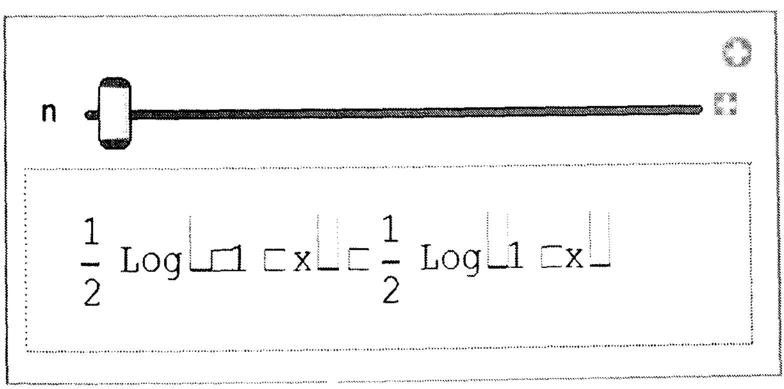

Fig. 16.3 Variation of n can be varied with the help of slider from 2 to 10 in steps of 1

(c) Mathematica Over Web

WebMathematica is a new web-based technology developed by Wolfram Research which augments *Mathematica's* main capabilities and features over the web. It allows instructors to create dynamic web content which helps distance students to explore and experiment with some of the mathematical concepts. Without webMathematica the teacher has to be an expert with Java programming to make a page mathematically active. Another product developed by Wolfram Research and released on May 15, 2009 based on Mathematica's computational power is Wolfram Alpha. It is a free browser-based computational knowledge engine or answer engine that represents new type of knowledge on the web. Users can ask computational request in natural language such as 'what are the roots of $x^3 = 0$' via a standard text box. Wolfarm alpha responds with computed results in textual, symbolic and graphical form as shown in Fig 16.4. The paid version Wolfram Alpha Pro was released on February 8, 2012 offering additional features for a monthly subscription fee. Its reduced emphasis on syntax allows students to focus on main topic at hand. In addition it provides more information as it will report all knowledge from its database. This feature is incredibly helpful in better understanding the problem and solution (Schoeller, 2009). For some graphics and demonstrations, one can easily go back and forth between Wolfram alpha, Mathworld (Mathworld) and Wolfarm Demonstration Project (wolfram). One case study "Teaching Calculus with Wolfram Alpha" (Dimiceli, Lang, & Locke, 2010) gives strong evidence that proper use of technology enables students to develop deeper conceptual understanding. In addition to web deployment, mobile devices such as iPhone and iPad can also be used to access Wolfram alpha through iPhone App (Fig 16.5). Thus *Mathematica* helps in creating online content

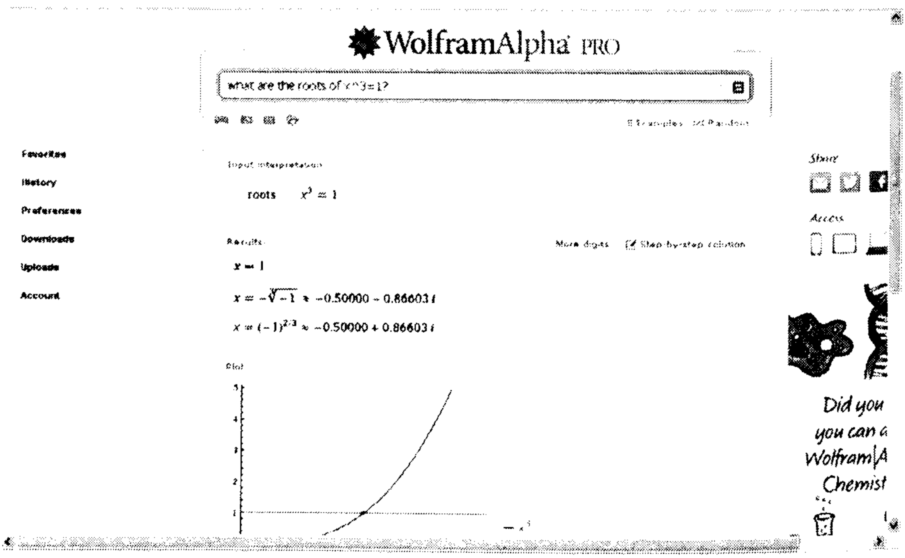

Fig. 16.4 Wolfram Alpha

which can be shared on discussion forum. The use of the online discussion forum provides a more comfortable environment than face to face settings for teachers to discuss sensitive issues. These tools could also boost their engagement and participation in collaborative learning that would allow them to create work and share with other students and teachers.

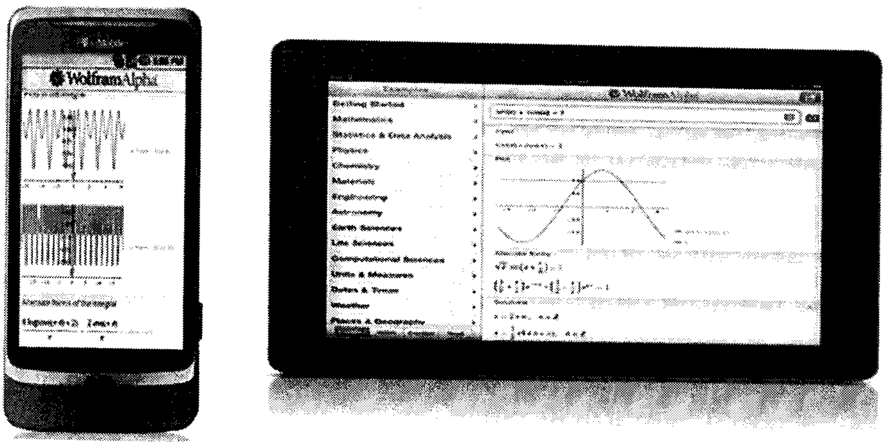

Fig.: 16.5 Wolfram Alpha through iPhone App

Closing Comments

Mathematics often thought of as a dreaded area and dealing with mathematics phobia is a very important issue. It will not be wise to expect that all students will be able to learn the difficult materials through reading and lectures only. Computer algebra packages like *Mathematica* can be used to address this problem. This technology can generate a movement like 'mathematics for all' where mathematics is fun and we could expect greater proportion of students taking maths. Computer compute better than human beings, so instead of performing routine calculation we should focus more on developing ideas, exploring consequences, justifying solutions and understanding connections- the real heart of mathematics. Incorporating technology can result faster students' progress and higher interest to learn Mathematics. The internet and its use through social networking forum are only platforms that can contribute to exemplify learning of mathematics in terms of its importance and range of applications.

References

1. Artgue, M. (2002), Learning Mathematics in a CAS environment, *International Journal of Computer for Mathematical Learning*, 7 (3), 245-274.

2. Bransford, J. D., Brown, A., & Cocking, R. (2000). *How people learn: Brain, mind, experience and school.* Washington, DC: National Academy Press.
3. Bruce, B., & Levin, J. (2001). *Roles for new technologies in language arts :inquiry,communication, construction, and expression.* (Vol. The handbook for research on teaching the language arts.). (J. Jenson, J. Flood, D. Lapp, & J. Squire, Eds.) New York: Macmillan.
4. Dede, C. (2000). Emerging influences of information technology on school curriculum. *Journal of Curriculum Studies , 32* (2), 281-303.
5. Dimiceli, V. E., Lang, A. S., & Locke, L. A. (2010). Teaching Calculus with Wolfram |Alpha. *International Journal Of Mathematical Education in Science and Technology , 41* (8), 1061-1071.
6. Lavicza, Z. (2006). The examination of CAS integration into university-level mathematics teaching. *Proceedings of ICMI Study#17: Digital Technologies in mathematics education -Rethinking the terrain.*
7. Mathworld. Avaliable at http://mathworld.wolfarm.com/.
8. Means, B., & Haertel, G. (2004). *Using technology evaluation to enhance student learning.* New York: Teachers College Press.
9. NCTM. (2000). Principles and Standards for School Mathematics.
10. Pierce, R. L., & Stacey, K. (2004). A framework for monitoring progress and planning teaching towards towards the effective use of Computer Algebra Systems. *International Journal for Mathematical Learning , 9*, 59-93.
11. Schoeller, P. (2009, November 2). The Wolfarm|alpha App, two weeks later.
12. Schubert, C., Gfeller, M., & Donohue, C. (2013). Using Group Explorer in teaching abstract algebra. *International Journal of Mathematical Education in Science and Technology , 44* (3), 377-387.
13. WDP. http://demonstrations.wolfram.com/.
14. Wolfarm, S. (1996). *The Mathematica Book.* Cambridge, UK: Cambridge University Press.

17

Some Innovations in Teaching of Mathematics (at Under Graduate level)

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Wannarisuk Nongbsap

Abstract

Presently, science educational approaches have resulted in a mismatch between what is taught to the students and what a student really needs. As such, many institutions are moving towards problem-based learning as a solution to produce students who are creative, can think critically, analytically and are able to solve problems. As Mathematics is one of the pillars of Basic Sciences, one of the solutions is to remove the mathematics phobia that has been cribbing into the minds of the students. In this paper, we focus on the problems, objectives, needs and on the innovative methods of teaching and attracting students to this subject. Some pedagogic tools with which a teacher should be equipped have been mentioned. A brief survey of the number of students, of some colleges in the state, opting for this subject has been done and highlighted in this paper.

Keywords: *Innovations, Mathematics, Undergraduate, Syllabus enrichment, Oral Presentation*

Introduction

Mathematics, being an important subject and occupying a central position since the ancient period till date, has not been of interest to many students. The reason is mainly because while there is aspiration yet it is hard to achieve. Being highly abstract, it is concerned with ideas, which are interrelated, and with the manipulation of symbols. Teaching of mathematics is not only concerned with the computational knowhow of the subject but is also concerned with the selection of the mathematical content and communication leading to its understanding and application. So while teaching mathematics, one should use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate responses from the students. Teaching and learning mathematics involves complexities which can be overcome if certain rules are followed. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics. Mathematics has a role to play in many different fields: innovations in medicine, digital encryption, communication technology, modeling real life phenomena, predicting disasters, organization of enterprises, business and transport to name a few.

At the heart of mathematics education lies undergraduate mathematics education. It would be impossible to tackle any of the problems associated with mathematics education, at any level without intervention at the undergraduate level. After all, the harbingers of change, if there are to be any, will be the teachers, policy makers, the creators and imparters of curriculum and pedagogy. And each one of them will have been shaped by their undergraduate (mathematics) education. Hence it is necessary to examine the doctrines that govern undergraduate mathematics education in India.

Objectives

In this paper, efforts to discuss innovations and innovative practices in teaching mathematics at the undergraduate level, under teaching methods, strategies and pedagogic resources have been made. The process of innovation is generally described as consisting of three essential steps, starting with the conception of an idea, which is then proposed and is finally adopted. Though many ideas have been conceived to bring about change in the teaching of Mathematics, it is yet to be proposed and adopted. So, the innovations discussed may not be new in terms of the idea but is new in terms of practice.

Innovations in Teaching Mathematics

This can be diversified in terms of methods and Pedagogic resources used in teaching-learning process.

Methods

Method is a style of presentation of content in classroom. The following are the innovative methods that can be used to make teaching-learning process of Mathematics effective.

Inducto-Deductive Method

Inductive method is to move from specific examples to generalization and deductive method is to move from generalization to specific examples. In classrooms, usually instructions start with the abstract concepts which are beyond the understanding of the students. Formulas, theorems, examples, results are derived, proved and used. But a teacher needs to start with specific examples and concrete things and then move to generalizations and abstract things. The teacher again needs to show how generalization can be derived and it holds true through specific examples. This method helps students better understand; they donot have to cram things and will have long lasting effect.

Example:

(i) Pythagoras Theorem - In a right-angled triangle, ABC, right angled at B, $AB^2 + BC^2 = AC^2$, (Considering right angle triangles of different measurements leading to generalization and then establishing it through the theoretical proof)

Example:

(ii) The sum of two sides of a triangle is greater than the third side.

(Ask the student to take any triangle, measure the sides, add any two of them, the result will always be greater than the third. The teacher can then proceed with the general proof.)

Analytico-Synthetic Method

Analytic is breaking down and moving from unknown to known and Synthetic is putting together known bits of information and moving from known to unknown. These methods are basically used in proving the results and solving problems. In textbooks, mostly synthetic method is used, to prove something unknown we start with a certain known thing, but that leaves doubts in the minds of students as to why we have started with that step and using this particular known thing. So a teacher has to combine both in order to explain and relate each step logically.

Table 17.1 Comparison of Synthetic and Analytic Method

Synthetic method	Analytic method
$\int \tan x dx = \int \frac{\tan x \sec x}{\sec x} dx$ $= \log\lvert\sec x\rvert + c$	$\frac{d(\log\lvert\sec x\rvert + c)}{dx} = \frac{1}{\sec x} \sec x \tan x$ $= \tan x$

Play-Way Method

This method includes play and fun activities that are related to numbers.

Example:

(i) Checking of divisibility of one number by another number, 123456712345688 is divisible by 4

Example:

(ii) Generation of Pythagorean triplets (3,4,5), (6,8,10), (5,12,13)

Example:

(iii) Formation of Pascal's triangle in solving $(1+x)^n$

Students don't realize that they are learning but in a way they are gaining knowledge through participating in these activities.

Laboratory Method

With the advent of computers, many of the colleges are well equipped with computer laboratories. The availability of computing softwares can be utilized in complementing classroom mathematical teaching to promote students′ active engaging and learning; to exchange long and difficult numerical and algebraic manipulations by communication of supporting reasoning when answering mathematical questions; to make experimental activities easier to handle; to develop problem resolution skills dealing with more interesting and difficult problems in so far as numerical, algebraic graphical and programming resources are available; to encourage discussion of different solutions or strategies as one works with multiple representations of the same mathematical object or process; to motivate the development of paired notions like discrete/continuous and finite/infinite. The pedagogical work needed to construct and implement learning situations to actualize these potentialities constitutes a major challenge to teachers.

Some mathematical problems can be solved through Computer programs such as Maple, Mathematica, Matlab, Group algorithm program (GAP), which are powerful software programs used to solve general-purpose mathematical problems. Problems in the areas of mathematics, science and engineering (and many more) can be investigated using in-built commands of these programs or by utilizing these programming languages to create one's own personalized programs. They can be used for solving problems in Calculus, Algebra, Solution of Differential Equations, Linear Programming, Statistics, plotting of points in two and three dimensions and also to create a three dimensional view of an object and many more.

Hence, introduction of laboratory component, in mathematics teaching, at the under graduate level, may enhance a better understanding of the subject for all papers for which there is feasibility of working in a laboratory environment.

Oral Presentation in Mathematics Learning

Anne B D'Arcy-Warmington (2008) mentioned that " it is important to consider the merits of oral presentations in mathematics service units as students' educational needs are diverse. Reaching parts of the brain that usual educational methods do not reach may be the answer to those poor students who do not have a 'mathematical brain'. The theory of multiple intelligences and brain-based learning may be the tool that will aid these students to be more confident about their mathematical ability. Oral presentations provide all students with a chance to display their knowledge in fun and creative ways. The interest aroused when researching the topic may give rise to a new curiosity about mathematics. With the declining number of students wishing to study mathematics perhaps, an injection of creativity in service units may spark an interest in mathematics in these and other students".

A study done by Lianghuo and Shu Mei (2007) showed that both teachers and students overall developed positive views about the benefits and usefulness of using oral presentation tasks in their daily mathematics teaching and learning. Oral presentation is an activity of sharing ideas and clarifying understanding verbally. Firstly, this method is regarded as an alternative mode of assessment for teachers to gather information about their students' learning of mathematics and hence make relevant instructional decisions. Secondly, it is also viewed as a tool for developing students' communication skills. One general purpose of oral presentation is to allow teachers to hear what students think about mathematics, and how they express it and their understanding of mathematics in their own words. Furthermore, teachers using oral presentation tasks must provide opportunity for students to think through questions and problems; express their ideas; demonstrate and explain what they have learnt; justify their own opinion; and reflect on their own understanding and on the ideas of others.

Thus, in the existing syllabus, changes can be made so as to include oral presentation as a process of mathematics learning by allocating some grades/ marks to every paper. This incorporation may induce a better understanding of the subject.

Syllabus Enrichment

Generally the Mathematics courses of both BSc and BA programmes (with Honours/ Major in Mathematics) are the same; the two programmes differ in the nature of the stream, a student chooses from, in addition to mathematics, that is, whether from science or social sciences stream. The BA/ BSc (Honours/ Major in Mathematics) curriculum of most of the universities include the following as compulsory courses:

- Algebra (Classical and Linear Algebra) and Trigonometry.

- Calculus (Differential and Integral Calculus, Advanced Calculus).
- Differential Equations (Ordinary Differential Equations and Partial Differential equations).
- Vector Analysis.
- Analytic Geometry of two and three dimensions.
- Analysis (Real and Complex analysis, Metric Spaces).
- Modern/Abstract Algebra.
- Mechanics

Optional papers may be: (1) Principles of Computer Science-Theory and Practical; (2) Differential geometry; (3) Discrete Mathematics; (4) Mathematical Modeling; (5) Applications of Mathematics in Finance and Insurance; (6) Special theory of Relativity; (7) Combinatorial Number Theory; (8) Computational Mathematics Laboratory; (9) Numerical Analysis; (10) Operational Research; (11) Astronomy; (12) Complex function Theory and Real Analysis.

With new ways of improvement in the teaching-learning process, the Syllabus may also be modified keeping pace with the all round development of the society. Some of the above mentioned optional papers in many of the colleges are options made by the teachers and college authorities and not by the students themselves and as a result the purpose of an optional paper at undergraduate gets defeated in many cases. Thus in order to eliminate such practices, some of the vital optional papers mentioned above can be included into core courses. The courses that can be incorporated into the core courses, to name a few, are topics from:

- Computer Science (Data storage, Data Manipulations, Operating system and network, algorithm, Programming languages, Software Engineering, Data Structures).
- Discrete Mathematics (Propositional logic, Relations, Lattices, Boolean algebra, Graphs, Combinatorics).
- Mathematical Statistics (Probability theory, Descriptive Statistics , Statistical Methods (Sampling, Statistical Tests), Distributions, Sampling theory, Correlation and Regression and multivariate analysis).
- Differential Geometry (Curves, Surfaces, Manifolds, tensor Analysis).
- Cryptography (Classical and Modern techniques, Elliptic curves Cryptography).

The inclusion of the above topics to the present syllabus can prove beneficial for the students in enhancing their employability.

Pedagogic Resources

These are resources that a teacher may integrate in a method for the transaction of a particular content and draw upon to advance the students' learning.

Programmed Learning Material (PLM)

As internet usage by the students is increasing day by day, colleges can provide soft copies of important textbooks/learning materials and make them available to students through the colleges/ institutions websites. *An interactive environment by the use of web 2.0 can also be created by every department of a college/Institution so as to encourage students-teachers interaction as a PLM through which a learner can proceed his self study at his own pace.* It has the characteristics of all sequential steps, learner's response, self-pacing, immediate feedback, reinforcement and self-evaluation. It is helpful in acquisition of concepts like fractions, number systems, etc. and can be used as a remedy for slow learners for a specific content.

Tablet is essentially an interactive whiteboard (IWB) or EWB that enables the lecturer to write with a special pen on the screen of a tablet that is connected to a data projector. Any work done on the tablet is then simultaneously (real time) broadcast to the whole class. The tablet enables the lecturer to, inter alia, annotate notes, make comments and use colour schemes to highlight important points in a lecture.

Activities

Activities here include works wherein students play active roles, interact with different resources and generate knowledge. Some activities are listed below.

Table 17.2 Activities Related to Effective Teaching of Mathematics

Activity	Situations related to Activity
Quiz competition	Mathematical rules, results, formulae, Properties of numbers
Projects	Contribution by Mathematicians
Seminars	Applications of Mathematics, talks on Ancient Mathematics etc.
Discussion	Concept of Pi , Golden ratio, Presence of Mathematics in real world viz, nature and music
Mathematics Clubs	Preparing models , Paper folding
Assignments	Solving problems, proving of theorems
Field trips	Visit to banks, Insurance companies
Self study	Library, internet, resource centers
Scholarship exams	Mathematics Olympiads, Mathematics Training and Talent Search (MTTS), Advanced Training in Matnematics etc, all funded by NBHM (National Board for Higher Mathematics)

Explorative Study

A brief explorative study is done in connection with mathematics performances of the students in the state by using the data obtained from Meghalaya Board of School Education and North Eastern Hill University, Shillong.

One can draw a clear picture (Table 17.3) that the percentage of students failing in Mathematics is increasing at an alarming rate. If this persists then the number of students going for Professional Courses, Banking and Insurance and many other courses, related to the subject, may decline which may be a threat to the society.

Table 17.3 Number and percentage of students who failed in Mathematics at the Secondary School Leaving Certificate (Std X) Examination conducted by Meghalaya Board of School Education

Year	Number Appeared	Number Failed in Mathematics	Percentage Failed
2010	36153	14027	38.79
2011	36122	17874	49.48
2012	38942	38942	54.93

Source: MBOSE

Data from Table 17.4 reveals a sharp decline on the percentage of students failing in Mathematics in the year 2011. However, it may not be authentic to draw a definite conclusion about this percentage as it again shows an increase in the following year. But an overall study reveals that more than 50% of the students are not able to stand to the subject and as a result few of them may continue with higher studies related to the subject

Table 17.4 Number and percentage of students who failed in Mathematics at the Higher Secondary School Leaving Certificate (std XII), Science Examination conducted by the Meghalaya Board of School Education

Year	Number Appeared	Number Failed in Mathematics	Percentage Failed
2010	2946	1941	65.89
2011	3058	1708	55.8
2012	3072	1803	58.69

Source: MBOSE

The figures from Table 17.5 are inconsistent and do not show an increase or a decrease in the trend. The previous data revealed that approximately 3000 students appeared for the class XII exams in Meghalaya. However, in spite of this, only a handful of students opt for Mathematics as an Honours paper.

Mathematics is believed to be the key to all other subjects but it is surprising that most students fail and yet pass in other subjects. Some of the reasons may be because there is a negative attitude towards mathematics, fear due to pressure from friends that the subject is tough, failure of the teachers to give proper and simple explanation of mathematical terms, limited or even lack of learning materials or lack of enough practice by the students.

Table 17.5 Number and Percentage of Students who Appeared as Mathematics Major Students at the First year Bachelor of Science Examination conducted by North Eastern Hill University

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number Appeared	65	57	99	72	40	59	45	51	66

Source: NEHU

Conclusion

At present, we are in the growing needs of our society and the needs of the discipline itself, unless we take strong ameliorative steps, the rate at which we are improving is just not going to be enough. If we take a closer look we can see many gaps and lacunae that require immediate healing. There is a requirement to both work out long-term strategies and at the same time to also have good achievable short-term goals.

To sum up, the curriculum in most of the high weightage undergraduate mathematics Programmes seem to be focused on fast-tracking young men and women to be research Mathematicians. On average, however, much less than a fourth of undergraduate Mathematics students actually decide to pursue an academic career in mathematics. Further the pedagogy and assessment patterns followed actually do not do much to foster or enhance the ability to think originally or to critically analyze and solve unseen questions. Thus on average, the undergraduate programmes in mathematics fail in at least two important ways: firstly, they are not really equipping and training the minority that plan to take up a career in mathematics in the manner they should; secondly, the majority are neither gaining any understanding of the role of mathematics in society nor are they learning the skills required by all in terms of communication, presentation, or the use of modern computer technology.

References

1. Lianghuo, F and Mei, Y,S.(2007) .Integrating oral presentation into mathematics teaching and learning: an exploratory study with Singapore secondary students, *the Montana mathematics enthusiast*, issn 1551-3440, monograph 3, pp.81-98 ©the Montana council of teachers of mathematics.

2. Patel, R. Innovations in teaching of mathematics, www.waymadeedu.org/StudentSupport/ Rachnamadam.pdf
3. UGC model curriculum statistics 2001
4. Venkataraman, G et al,. (2012). Curriculum and pedagogy in mathematics: Focus on the tertiary level, Proceedings of the Indian national presentation on mathematical education 2012.
5. Warmington, A. (2008). Look Who's Talking- Incorporating oral presentations into mathematics Presentation Reports, 11 international congress of mathematical education, Mexico. (ICME July, 2008)

18

Web 2.0: Toolbox for Tomorrow's Classroom

Probidita Roychoudhury

Abstract

Over the last few years, there has been a sudden spurt of web applications which are collectively termed as "Web 2.0" tools. These tools have transformed the 'read-only' web to 'read-write' web making it more participatory. While many new web applications often become hyped beyond reality, the Web 2.0 tools have brought about an amazing change at least in the field of education. These tools have taken the teaching-learning process outside the formal classroom and changed the way people teach and learn. They allowed the learners to create and share their own content and thus opening new windows for interaction and collaboration. A comparison among different Web 2.0 tools and their application in the field of education is presented herewith.

Introduction

The world today is being termed as a "knowledge-driven society"; and we are living in the "information age". This stress on information, together with rapid growth in information and communication technology, has placed higher demands on our education system. The search for new pedagogical models to sustain this ever increasing demand for knowledge combined with technological advancements has made us look at our educational system from a different perspective. The focus is found to be shifting towards a more personalized, collaborative and community based-learning and towards developing skills necessary for lifelong learning or, in other words, "learning to learn" (Owen, 2006). Emergent Web 2.0 concepts and technologies are opening new doors for more effective learning and have the potential to support life-long competence development (Ralf Klamma, 2007).

The term Web 2.0 was coined by Tim O'Reilly in 2004 at the O'Reilly Media Web 2.0 Conference. Tim O'Reilly, in his paper, "What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software ", defined Web 2.0 as "a set of principles and practices that tie together a veritable solar system of sites that demonstrate some or all of those principles, at a varying distance from that core" . Some of the features that distinguish Web 2.0 from Web 1.0 include software as a service, harnessing collective intelligence, user as content creator and lightweight software models (O'Reilly). Many of these Web 2.0 applications like wiki, blogs, RSS, social networking, social bookmarking, multimedia sharing etc. are becoming popular as educational tools for achieving the core educational agendas of collaboration, personalization and life-long learning. The implication of these tools, which can also be grouped under the term "social software", on education, stems from their affordances of sharing, communication and information discovery (Catherine McLoughlin, 2007).

This paper aims to elucidate on various Web 2.0 tools – their features and applicability as educational tool. Section 2 of the paper discusses various Web 2.0 applications and compares some tools available for each of these applications along with their possible use in education. Section 3 concludes the paper.

Web 2.0 Tools

This section elaborates on certain Web 2.0 tools, which include – Blogs, Wiki, Document sharing and Multimedia sharing, and discusses their features as well as their applicability for new-age learning. As for the methodology of collecting information provided here, the author has registered and created accounts in each of the tools discussed here to understand and compare their feature sets.

Blog

Due to its flexibility and context independent nature, Blogs (or Web Logs as they were earlier known) have emerged as a popular tool for educational purposes. Technorati, a blog search engine, has approximately 133,000,000 blogs indexed since 2002 (Singer). A Blog can be defined as an online journal where the owner regularly puts down his/her thoughts and reflections on a varied range of topics and the entries are displayed in a reverse chronological order. While most blogs allow users to add graphics, audio, images, etc., the main component is usually text. Today, blogs provide a simple way of sharing knowledge within an open or closed community. They facilitate a dialogue between people from various backgrounds and interests in the form of visitor's comments. The "tagging" option allows categorization of the entries for archiving and search indexing. Features like, linking of blog entries takes this conversational nature of blogs even further. Linking is achieved through the use of permalink (a URI for a blog entry). The permalink remains the same even if the content of an entry is changed. Linking and inter-linking leads to the creation of a network or community. A blog also has other features like – trackball (notification to visitors who have received a reply to their comments) and blogroll (list of favorite links by the blog owner) (Anderson, 2007). Following is a look at three popular blog sites – Blogger, WordPress and TypePad.

Blogger is a free blogging service which can be used to create blogs incorporating all types of media like – text, audio, video and images. The simple interface makes the learning curve short. Fully customizable interface, selection of domain where blog is to be hosted, multi-author (or group blogs), privacy settings for comments, comment moderation, notifications through mobile, RSS, email, etc are some important features of Blogger. Wordpress is another blog site which is similar to Blogger and is fast becoming popular due to its rich feature set and simple interface. It's two account types – Free and Premium allows full customization, hosting in another domain, privacy through the use of passwords and reader invites, site storage capacity of 3GB and spam control are some important features of this service. TypePad is a paid blog site which has three plans – Plus, Unlimited and Premium. TypePad has also launched its free service named "TypePad Micro" with limited features. Most features are similar to Blogger and Wordpress. A distinguishing feature of TypePad is the scheduling of posts to be displayed on a specified date.

The table below summarizes the features of Blogger, Wordpress and TypePad.

Table 18.1 Comparison among Blogger, Wordpress and Typepad

Feature	Blogger	WordPress	TypePad
Pricing	Free Service	Free and Premium	Paid service – three plans (Plus, Unlimited, Premium) Free service – TypePad Micro
Ease of use	Simple	Simple	Simple
Content Type	Text, audio, video, images	Text, audio, video, images	Text, audio, video, images
Interface	Simple	Rich in features	Simple
Layouts and Themes	Allows third-party themes	90+ themes but difficult to customize	Wide range of choices, allows drag-and-drop
Full Customization including HTML and CSS	Yes	Only in Premium	Unlimited and Premium only
Domain Mapping to host in another domain	Yes	Only in Premium	Yes

Notifications on posts and comments	Email, mobile, RSS	Email, mobile, RSS	Email, mobile, RSS
Tagging	Yes	Yes	Yes
Comment moderation	Yes	Yes	Yes
Multiple Authors for blog	Yes	Yes	Unlimited and Premium only
Statistics	Third-party apps	Yes	Yes
Posting by email, mobile	Yes	Yes	Yes
Schedule post	No	No	Yes
Restricted Access	Yes – can be restricted to invited readers only	Yes-through password protection, reader invites	Yes
File Storage Capacity	1 GB	3 GB	Unlimited
Spam Block	No	Yes	Yes
Additional Pages	Yes (limited)	Yes	Yes
Help	Basic	Comprehensive	Comprehensive
Language support	41 languages and Transliteration in 5 Indian Languages	50 languages	
Audio, Video Podcasts	Yes	Yes	Yes
Widgets	Limited	Wide range	Wide Range

Educational benefits of Blogs

As cited by Will Richardson, blogs promotes critical, analytical, creative, intuitive, analogical and associational thinking (Richardson, 2006). They also help in developing creativity and writing style. Activities that require students to read, analyze critically and write regularly can use blogs as an effective tool (Richardson, 2006). Further, the ease of creating and maintaining a blog makes it easier for the learner to concentrate more on the content rather than tasks like formatting, uploading etc. Group blogging leads to formation of communities of learners where students actively took part in collaborative construction of knowledge. The comments and responses become feedback for the students on their reflection which in turn provides an opportunity for learning (Seitzinger, 2006).

Wiki

A wiki is a collaborative web site whose content can be edited by visitors to the site, allowing users to easily create and edit web pages collaboratively (Chao, 2007). In addition to creating and editing web pages, users can also link to existing or new pages, take part in discussions, etc. This open nature of a Wiki makes it liable to malicious attacks (Stvilia, 2008). However, these attacks are quickly resolved due to the community-based approach of Wiki. This resolution can be hastened by two features – history (which is a log of all earlier versions of the page), and rollback (which allows switch back to a previous version).

Three wiki tools, i.e. – MediaWiki (Used for Wikipedia), DokuWiki and

TikiWiki are discussed here. All three tools are free and open source and can run on multiple operating systems. Some common features of these tools includes – creating pages, viewing history and summaries, viewing differences among page revisions, use of WYSIWYG editors etc. The following table compares some of the important features of these three wiki services.

Table 18.2 Comparison of the Important Features of Different Wiki Services

Feature	DokuWiki	MediaWiki	TikiWiki
Service Type	Free and Open Source	Free and Open Source	Free and Open Source
Audience Type	General	Individuals, Education	General
Page Storage	As Text files	As Database entries – MySQL, PostgreSQL, SQLite	Database - MySQL
Permissions	Through access control lists	General	General
Spam Control	Yes	Yes	No
Number of page revisions	Unlimited	Unlimited	Unlimited
Language Support	51	140	34
Page Templates	Yes	Yes	Yes
Recent Visitors	No	Yes	Yes
Linking	Linking to other wikis, Displays links to the current page	Linking allowed, Displays list of links to current page	Linking to other wikis, Displays links to the current page
RSS feeds	Allowed	As a plugin	Yes
Mobile	No	No	No
Export Formats	RAW,HTML,PDF	RAW,HTML,PDF, XML	RAW,HTML,XML,PDF (as plugin)
File Attachment	Yes, Does not allow revisions of attached files to be stored	Yes, Allows multiple revisions of files to be stored	Yes Allows multiple revisions of files to be stored, Also allows image editing
Forums and Blogs	Blogs	Forums	Forums and Blogs

Educational benefits of Wiki

Wikis provides an excellent educational tool by combining the benefits of collaborative learning with constructivist approach of self construction of knowledge (Parker & Chao, 2007). Wikis make the content as well as the content-creation process visible. The version tracking feature allows for assessing the evolution of thought process of the learner as he/she interacts with the content (Seitzinger, 2006). A Wiki can also be an efficient tool for tracking student projects and coordinating group activity (Duffy P, 2006). An emphasis on assessment has been on the authenticity of the assessment tasks. This can be rightly captured by the use of wiki for assessment. In addition to all these, wikis helps in the assessment of reflective thinking and critical reasoning. The use of comments in wikis helps in creation of personal knowledge and enhances meta-cognitive capabilities (Notari, 2006).

Document Sharing

Often, for collaborative work, there arises the need for sharing of different types of documents. While sharing through email is possible, it is not very effective as changes to the documents will not be visible to all users at the same time. Web 2.0 provides a number of services for sharing documents, spreadsheets, presentations etc. These services provides facilities like uploading documents, editing from anywhere, restricting access to files, real time collaboration and organization of documents. Archiving of edited versions and embedding of document links in blogs are some additional features. Three document sharing services – Google Docs, Slideshare and Scribd – are discussed here.

Google Doc provides all basic facilities that is require for collaborative sharing of documents as listed above. Users can be invited as collaborators and viewers. Tracking of revisions, exporting of documents in many popular formats, protecting documents are some of its features. Slideshare is a service for sharing presentations, documents and PDFs, either to all or to a select group. Additional features include – searching, downloading, commenting, adding audio, formation of groups and sharing from other sites. This service does not allow editing of documents. Scribd provides similar facilities to Slideshare. It has more features of a social publishing and reading software. The table below summarizes the main features of the three services.

Table 18.3 Main Features of Three Different Types of Documents

Features	**Google Docs**	**Slideshare**	**Scribd**
Service Type	Free	Free	Free
File Types	Documents, Spreadsheets, Presentations	Documents, Videos (new feature)	Documents
Registration	Required.	Required only for uploading	Required for uploading
Max file size	1 GB for free , additional storage on payment	Unlimited no. of 100MB for documents and 500 MB for videos each	Unlimited no. of documents of 100 MB each
Organization	Yes	Yes	Yes
Editing of files	Yes	No	No
Sharing	Through Groups	Through groups, links and emails	Through groups, sharing of link, email, social networking
Comments	No	Yes	Yes
Privacy	Through privacy settings	Through privacy settings	Through privacy settings
Revisions stored	Yes	Not applicable	Not applicable

Educational benefits of document sharing

Document sharing provides a way of making information accessible to a wider audience. Google Docs provides an excellent platform for collaborative work. Other document sharing features can be utilized by teachers to upload course content, schedules, syllabus, etc.

Multimedia Sharing

Web 2.0 has turned 'information consumers' into 'information producers'. While user-generated textual content can be found in blogs, wikis, etc.; enhanced forms of the same which shares other contents like video, images, etc. can be made using multimedia sharing. Technologies like streaming audio and video enables fast access to high quality content. The emphasis is on the quality of the content rather than the quality of the audio or video. Commenting feature available in these multimedia sharing sites enables different users to discuss and offer feedback. Finally, the ease of use of these sites and the availability of low-cost recorders like mobile phones makes sharing of multimedia an easy task. Three multimedia sharing sites - Flickr (For image sharing), YouTube (For video sharing) and Audiofarm (For audio sharing), are discussed below.

YouTube is a highly popular video sharing site which allows users to share, discuss and rate videos on varied subjects. A user can subscribe to other users to get direct access to their newly added videos directly from the subscriber's channel. YouTube also has a section for paid viewing of videos where videos are streamed through YouTube to the user. Flickr is a photo sharing site which has two types of accounts – a free and a pro service, the latter offering features like additional storage, bandwidth, etc. for a price. An interesting way of organizing photos is through the use of maps where the user can drag and drop a collection to a map location to indicate the location where these photographs were taken. AudioFarm is an audio sharing service provider which also allows sharing of images. The home page provides several groupings of the audio files like –Daily, Weekly and Monthly Charts, Most Played, Most Liked etc. Users can share URL of video with friends and can add it to their playlist. They can also share audio with several social networking sites. Tagging of audio files is allowed and so is RSS feed.

The table below summarizes the main features of these three sites.

Table 18.4 Main Features of Three Popular Video Sharing Sites

Features	Flickr	YouTube	AudioFarm
Service Type	Free – Basic account, Paid – Pro account	Free, Some video are pay-per-view	Free
Media	Images and Video	Videos	Audio and Images
Registration	Required.	Required.	Required
Upload	From software downloaded and installed in the user's computer From site From email From mobiles From third-party software.	Upload file or record from camera	Upload from file
Elements of Home Page	Displays list of photos uploaded by user, by contacts, option for uploading and searching for photographs, options for organizing photographs, blog	Called a Channel. Displays links of videos uploaded by the user, favorites lists, subscribers lists, comments by other users, friend list	Search Listing of popular charts Recently added files
Media Organization	As Sets, Collections and Organizer	As Categories	As categories
Editing of files	Yes, through third-party software	Not allowed	Not allowed
Sharing	Through Groups Public-private and completely private.	Through Contacts and emails	Through sharing of link, email, social networking
Feedback and Interaction among users	Through private messages, comments, notes (in the image itself), discussion board	Comments, private messages, discussion board	Comments
Privacy	Through privacy settings	Through privacy settings	Not available
Ratings	Not available	Based on no. of comments and ratings of users (5 star max)	Not available
Linking from other sites	Possible through hyperlink	Possible by embedding the Video tag in website	Possible by link sharing
Statistics	Provided	Provided	Not Provided

Educational benefits of multimedia sharing

Multimedia sharing has enormous benefits for education. The sharing of lecture audios/videos ensures access to all irrespective of geographical location or time zones. The commenting feature available in all multimedia sharing tools provides feedback to the creator and also encourages critical thinking in the part of the commenter. The videos of experiments, screenshots etc can assist in self-learning. On-image annotations, offered by Flickr, provide a good way of eliciting teacher's comments and discussion.

Conclusion

The core competencies of Web 2.0 tools include – "Architecture of participation" and "Harnessing Collective Intelligence" (O'Reilly). This makes Web

2.0 tools suitable for implementing recent pedagogical theories of constructivism, collaborative learning and social construction of knowledge. In this paper, we have discussed the features of six Web 2.0 tools and their potential benefits in education. Other Web 2.0 tools, like Social Networking, Virtual Conferencing, Virtual Reality, Podcasts etc, have equal potential as teaching-learning tools. A common focus of all these tools is the social and community approach. The use of these tools for learning will create a genre of independent and self-sufficient learners. Further, new assessment methods and new pedagogies will emerge out of the use of these tools. However, there is a need to educate both teachers and students regarding the use of technology in the teaching-learning process. Innovation and creativity, on the part of the teacher, and active participation, on the part of the student, will ensure the success of Web 2.0 tools in the field of education.

References

1. Anderson, P. (2007). What is Web 2.0?Ideas, technologies and implications for education. JISC.
2. Catherine McLoughlin, M. J. (2007). Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era. ascilite, Singapore , 644-675.
3. Chao, J. (2007). Student project Collaboration using Wiki. Proceedings of the 20th Conference on SoftwareEngineering Education and Training (CSEE&T 2007) .
4. David R Millen, J. F. (2006). Dogear: Social Bookmarking in the Enterprise. ACM, pg. no. 111-112.
5. Duffy P, B. A. (2006). The use of blogs, wikis and RSS in education: A conversation of possibilities. Online Teaching and Learning Conference, (pp. 31-38). Brisbane.
6. Hargadon, S. (n.d.). Educational Networking: The important role Web 2.0 will play in education. Retrieved from Elluminate.
7. Notari, M. (2006). How to Use a Wiki in Education:'Wiki based Effective Constructive Learning'. WikiSym'06, ACM, (pp. 131-132). Odense, Denmark.
8. O'Reilly, T. (n.d.). What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software . Retrieved 06 11, 2010, from www.pku.edu.cn
9. Owen, M. G (2006). Social software and learning. Retrieved 06 11, 2010, from FutureLabs:http:/www.futurelab.org.uk/resources/documents/opening_education/Social_Software_report.pdf
10. Parker, K. R., & Chao, J. T. (2007). Wiki as a Teaching Tool. Interdisciplinary Journal of Knowledge and Learning Objects, (pp. 57-72).
11. Ralf Klamma, M. A. (2007). Social Software for Life-long Learning. Journal of Educational Technology & Society , 72-83.
12. Richardson, W. (2006). Blogs, wikis, podcasts, and other powerful web tools for classrooms. Thousand Oaks, CA: Corwin Press.

13. Seitzinger, J. (2006, 07 31). Be Constructive: Blogs,Podcasts, and Wikis as Constructivist Learning Tools. Learning Solutions, pp. 11-13.

14. Singer, A. (n.d.). Technorati's 2008 State of Blogsphere Released. Retrieved 6 8, 2010, from The Future Buzz: http://thefuturebuzz.com/2008/09/22/technoratis-2008-state-of-the-blogosphere-released/

15. Stvilia, B. T. (2008). Information quality work organization in Wikipedia. JASIST, 983–1001.

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Remote Sensing and GIS Technology: Its Applications

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Abstract

Remote Sensing (RS) is the art and science of acquiring information about objects or phenomenon without coming in contact with the same. In modern application, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation emitted from aircraft or satellites). It works in harmony with other data collection techniques or other tools of mapping science including Geographic Information System (GIS). The synergism of combining the scientific knowledge with real world analyst experience allows the interpreter to extract meaningful information from the imagery. A geographical information system is a facility for preparing, presenting and interpreting facts that pertain to the surface of the earth. GIS is a computer-based information system used to digitally represent and analyze the geospatial data or geographic data. It captures, stores, analyzes, manages, and presents data that refers to or is linked to location. The acronym GIS is sometimes used for geographical information science or geospatial information studies and refers to the academic discipline or career of working with geographic information systems, which is a large domain within the broader academic discipline of Geo-informatics. In the simplest terms, GIS is the merging of cartography, statistical analysis, and computer science technology. The importance of RS and GIS in different educational levels is pointing out the need of adaptation of the acquired knowledge in their respective field of study. This paper will focus on imparting knowledge of the basis and principles of RS and GIS, their application in different fields and its potential in job prospects.

Keywords – *Remote Sensing, Geographical Information System, Geoprocessing, Geo-informatics*

Introduction

The science of remote sensing has emerged as one of the most fascinating subjects over the past three decades. Earth observation from space through various remote sensing instruments has provided a vantage means of monitoring land surface dynamics, natural resources management, and the overall state of the environment itself (Joseph, 2005). Remote sensing is defined, for our purposes, as the measurement of object properties on the earth's surface using data acquired from aircraft and satellites. Remote sensing is, thus, the science and art of acquiring information about distance object without coming in contact with it. It is therefore an attempt to measure something at a distance, rather than in situ.In modern application, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation emitted from aircraft or satellites).

A geographic information system (GIS) is a computer-assisted system for acquisition, storage, analysis and display of geographic data. GIS technology integrates common database operations such as query and statistical analysis with the unique visualisation and geographic analysis benets offered bymaps (Burrough, 1990).

A GIS can be thought of as a system—it digitally creates and "manipulates" spatial areas that may be jurisdictional, purpose, or application-oriented. Generally, a GIS is custom-designed for an organization. Hence, a GIS developed for an application, jurisdiction, enterprise, or purpose may not be necessarily interoperable or compatible with a GIS that has been developed for some other application, jurisdiction, enterprise, or purpose. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries (Sun and Sun, 2012).GIS has benefited greatly from developments in various fields of computing. Better database software allows the management of vast amounts of information that is referenced to digital maps. Computer graphics techniques provide the data models for storage, retrieval and display of geographic objects. Advanced visualization techniques allow us to create increasingly sophisticated representations of our environment. GIS data display functions go far beyond static two dimensional displays and provide animation and threedimensional modeling capabilities. Just as the input of textual information is facilitated by optical character recognition, fast, high-resolution scanning and sophisticated software speed up map data conversion that previously relied exclusively on manual digitizing (United Nations, 2000).

The methods and the theories of the Traditional Geography became insufficient to apprehend the reality and its complexity and, mainly, to explain it, considering the changes that happened in the World in the last 30 years. The surveying done through empiric studies became insufficient. It is necessary to accomplish studies interrelated to the analysis of the World interaction. On the other hand, the technical and scientific transformations get strong influence in the researches accomplished to the field of the Geography. The geographical spatial study, in the new global view, begun to appeal to technologies as the remote sensing and computer sciences, this one as articulator of the amount of data that developed for the geographical information systems - GIS (MEC, 1999).The educational use of RS and GIS outside the universities and institutes of higher learning has been limited until now. One of the many reasons for this has been the absence of the same from the curricula. Its novelty and unclear legal requirements have not encouraged schools to adopt RS and GIS in the classrooms. The objectives of this paper are to impart and explain the importance of RS and GIS applications in the different fields of study by introducing the subject right from school level.

Different Applications of Remote sensing and GIS In Urban Planning

The modern technology of remote sensing which includes both aerial as well as satellite based systems, allow us to collect lot of physical data rather easily, with speed and on repetitive basis, and together with GIS helps us to analyze the data spatially, offering possibilities of generating various options (modeling), thereby optimizing the whole planning process (Verma*et al.*, 2009). These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful. Recent technological advances made in the domain of spatial technology cause considerable impact in planning activities. This domain of planning is of prime importance for a country like India with varied geographic patterns, cultural activities etc. The purpose of using GIS is that, maps provide an added dimension to data analysis, which brings us one-step closer to visualizing the complex patterns and relationships that characterize real-world planning and policy problems (United Nations, 2000). Visualization of spatial patterns also supports change analysis, which is important in monitoring of social indicators. This in turn should result in improving need assessment.

In Sustainable Agricultural Management

The solution for providing food security to all people of the world without affecting the agro ecological balance lies in the adaptation of new research tools, particularly from aerospace Remote Sensing, and combining them with conventional as well as frontier technologies like Geographic Information Systems (GIS). Sustainable agricultural development is one of the prime objectives in all countries in the world, whether developed or developing. The broad objective of sustainable agriculture is to balance the inherent land resource with crop requirements, paying special attention to optimization of resource use towards achievement of sustained productivity over a long period (Lal and Pierce, 1991).

According to Bhan*et al.* (1997), sustainable agricultural development or sustainable increase in crop production could be achieved by adopting a variety of agricultural technologies, which may be summed up as:

- Improved crop management technology through the use of high yielding, input responsive and soil, climatic and biotic stresses - tolerant crop varieties.
- Suitable cropping systems for different agro-ecological regions based on soil, terrain and climatic suitability.
- Integrated nutrient management for improving soil productivity and minimization of the risk of pollution of soil, water and environment.
- Integrated pest management for effective pests control as well as to reduce the adverse effects of pesticides on environment.
- Soil and water conservation for controlling soil degradation and improving moisture availability.
- Input use efficiency maximization in terms of economic return with minimal.

Natural Resources and Management

In natural resource management, remote sensing and GIS is mainly used in the mapping process. These technologies can be used to develop a variety of maps (Oisebe, 2012). Examples include: (1) Land cover maps; (2) Vegetation maps; (3) Soil maps; and (4) Geology maps.

However, before these maps are developed, there are a variety of data that need to be collected and analyzed. Most of this data is collected with the help of remote sensing technology. Data can be collected using either ground photographs, aerial photographs or satellite photographs of the area of study. The choice of the photograph usually depends on the topography of the area of study and the aim of the study. For instance, aerial photographs (vertical or oblique) are always useful when spatial data need to be collected in the same area of study within intervals (hours, days, seasons, years etc.). This form of data collection shows the variations of the area of study within different periods of time (Elias, n.d.).Satellite photographs can also be used to collect relevant data for the study. These types of photographs are however superior to aerial photographs in the sense that they have higher spectral, spatial, radiometric and temporal resolutions. Thus, satellite images are more detailed hence a lot of data can be generated from them. However, for remote sensing data to be effective, it needs to be incorporated together with topographical maps that show the variation of climate, soils, and other factors. The visual and digital data that has been collected is usually analyzed to generate a pre-field map. Various components and elements of the data are analyzed. According to Elias (n.d.), elements such as tone, texture, pattern, association, size and shape are essential in the analysis process. These elements bring about a detailed view of the area of study. The pre-field map that has been generated together with the results from the analysis of the various elements is used to determine the characteristics of different elements and themes found on the ground.

With the use of the pre-field map that was generated, information from ground verification procedure and any other secondary source that might have been used, the final map is usually prepared. The scale of the map is also variable depending on the nature and extent of the study and the goals that it aims to achieve (Oisebe, 2012).

Ecology

The ability to map and monitor ecological phenomena over large spatial extents has become a focus of renewed research in the context of increasing awareness of human activities and environmental change (Busby, 2002; Liu and Taylor, 2002; McDermid*et al.*, 2005). Human activities substantially affected most of the terrestrial biosphere, currently at rates and spatial extents far greater than in any other period in human history (Kerr and Ostrovsky, 2003). Numerous organizations, disciplines and initiatives have formed in the last 15 years, in response to the myriad challenges to sustainable resource management and ecological protection. These interdisciplinary and integrative initiatives agree that scientifically sound and sustainable resource management requires ecological data of variable spatial and temporal characteristics to provide the scientific understanding required to measure, model, maintain and/or restore landscapes at multiple scales. Research efforts in support of sustainable ecosystem management have focused on characterizing ecosystem condition and change, exploring the effects of different management schemes, and understanding how natural and anthropogenic processes affect ecosystem functioning (EPA, 1998).Solutions to these problems require spatially explicit, timely, ecological data, often combined with statistical models in a geographic information system (GIS). Currently, researchers illustrates how ecological problems ranging from biodiversity loss to land-use change have benefited greatly from advances in geospatial technologies such as GIS and remote sensing, both in the provision of data and access to spatial data analysis tools. The integration of GIS and remote sensing for ecological mapping and monitoring, while addressed in earlier research (Stoms and Estes, 1993; Goodchild, 1994; Franklin, 1995) has become even more important as these data and technologies continue to evolve, and as ecological issues become more critical.

Geology and Geoscience

Research in geospatial sciences, remote sensing, geographic information system (GIS) and global positioning system (GPS) involves mapping and monitoring geological features and processes (Milla*et al.*, 2005). It cover all aspects of geospatial research including acquisition of ground based, airborne, and satellite data; development of software tools and data processing techniques; and use of data and tools for a variety of applications. These applications include, but are not limited to, mapping and modeling in support of exploration, volcanology, planetary science, ecology, and cryospheric studies.

Hydrology and Water Resources

Remote Sensing and GIS technologies are well-established tools and are routinely used in applied hydrology, forestry, land use dynamics analyses, etc (Akingbogun, 2012). Abilities of remote sensing technology in hydrology are to measure spatial, spectral, and temporal information and provide data on the state of the earth's surface (Rango, 1994; Running *et al.,* 1994).It provides observation of changes in hydrological states, which vary over both time and space that can be used to monitor hydrological conditions and changes. Sensors used for hydrological applications cover a broad range of electromagnetic spectrum. Both active sensors that send a pulse and measure the return pulse (like radar, microwave etc.) and passive sensors that measure emissions or reflectance from natural sources (like Sun, thermal energy of the body) are used. Sensors can provide data on reflective, thermal and dielectric properties of earth's surface (Engman and Gurney, 1991).

Remote sensing applications in hydrology that are being used today are mainly in:

- Precipitation estimation
- Runoff computations
- Snow hydrology applications
- Evapotranspiration over land surface
- Evaluation of soil moisture content
- Water quality modelling

- Groundwater identification and estimation
- Hydrological modelling (Source: Gupta, 2010)

GIS can play fundamental role in the application of spatially distributed data to hydrological models. In conventional applications, results either from remote sensing or from GIS analyses serve as input into hydrological models (Baumgartner and Apfl, 1996). Land use and snow cover are the most commonly used input variables for hydrological models. The integration of GIS, database management systems and hydrological models speed up the use of remote sensed data in hydrological applications.

Atmosphere Sciences and Meteorology

Remote sensing provides additional information to the existing network of ground based precipitation gauges, for mapping the extent and amount of precipitation. It is unlikely that remotely sensed data will replace the existing network of precipitation gauges. There are several remote sensing techniques, which have potential to assist in mapping the extent of precipitation patterns. Several reviews provide background on the use of satellite remote sensing to estimate precipitation (Arkin and Ardanuy, 1989; Rasmussen and Arkin, 1992;Barrett and Beaumont, 1994; Petty, 1995). Nowadays, public agencies, research laboratories, academic institutions, private and public services, have established their own GIS. Due to increasing pressure on land and water resources, land use management and forecasting (crop, weather, fire, etc.) become more essentials every day. GIS are, therefore, an irreplaceable powerful tool at the disposal of decision-makers (Maracchi, 2000).

In Agro-meteorology, to describe a specific situation, all relevant information available on the territory may be used: water availability, soil types, land cover, climatic data, geology, population, land-use, administrative boundaries and infrastructure (highways, railroads, electricity or communications systems). Each informative layer provides to the operator the possibility to consider its influence to the final result. However, more than the overlap of the different themes, the relationship of the numerous layers is reproduced with models (ranging from simple "indicator" formula, such as the USLE to physically process based models).The final information is extracted using graphical representation or precise descriptive indexes (Maracchi, 2000). Developed countries use agricultural and environmental GIS to plan the times and types of agricultural practices, territorial management activities, population security, to monitor devastating events and to evaluate damages. The analysis of data, such as the vegetation coverage with different levels of inflammability, the presence of urban agglomeration, the presence of roads and many other aspects, allows the mapping of the areas where risk is greater. The use of other informative layers, such as the position of the control points and resource availability (staff, cars, helicopters, airplanes, firefighting equipment, etc.), can help the decision-makers in the management of the territorial systems. Obviously some data sets, such as the under pinning DEM and temporally invariant (or static), whereas other data sources such weather conditions (either near real-time observations or short-term forecasts) are temporally dynamic (Sivakumar, 2003).

Oceanography

The application of satellite imagery to oceanography is still in its infancy as evidenced by the many algorithms and methods for spatial analysis of chlorophyll alone (Breitlow, 2007). A number of satellite sensors are currently being employed, each with its own strengths and limitations that need to be taken into consideration during analysis such as spatial and spectral resolution. In fact, while chlorophyll is generally used to give estimates of net primary productivity in the oceans, recent studies have proposed alternatives using backscattering coefficients to measure phytoplankton carbon to give a much more accurate estimate of productivity.

However, much research needs to be done before a consensus on optimal methodology for even the more basic measurements can be reached. In the meantime, empirical descriptions and the development of various indices have been used in an effort to categorize basic regions according to their characteristics, as is the case for "bioregions" (Breitlow, 2007). The future applications of GIS with further implementation of complex data models and software currently under construction such as ArcMarine (ArcGIS Marine Data Model) that will hopefully minimize the gap between the mathematical based scripts used in MATLAB (a numerical computing environment and fourth-generation programming language) by researchers and the commercial GIS packages used by marine management and conservation agencies.

Environmental Impact Assessment

Sustainable development in its simplest form advocates that the present generation develops (manage) the available resources to achieve growth and social and economic well-being in such a manner that will not jeopardize the chances of generation yet unborn in meeting their own needs (Abbas and Ukoje, 2009).But then, how do we attain sustainable development? Well, this can be achieved through Environmental Impact Assessment (EIA).Environmental Impact Assessment in turn can be done holistically only through the technique of Remote Sensing (RS) and Geographic Information systems (GIS).

Natural Hazard and Disaster Management

One technology which has had an enormous impact on disaster management has been remote sensing. In the past decade, this technology has been used extensively to explain the extent of impacts caused by earthquakes, tsunamis, hurricanes, floods, wildfires and terrorist attacks. Through high-resolution optical imagery and active sensors (e.g., synthetic aperture radar, or more commonly known as SAR, and light detection and ranging or LIDAR), remote sensing technologies have demonstrated significant efficacies in quantifying post-disaster damage, monitoring recovery and reconstruction progress after significant disasters, and more recently, in developing information on our urban infrastructure (Eguchiet al,. 2008). One main reason for this rapid progress has been the introduction of high-resolution, commercially available satellite imagery. Where these technologies used to be available to mainly government agencies (mostly military), they have now become readily accessible to the public. The impact of this development has been most noticeable – in our opinion - in the disaster management area (Eguchi, 2013).

Discussion

Pointing out to the need of introducing RS and GIS in schools and colleges, imparting this education in different strata of education levels is a must. Basics and applications of the technique can be introduced at secondary school level along with geography and elementary science. Several Multinational companies directly dealt with RS and GIS applications or in the field of developing tools for a particular application, are absorbing students as interns or professionals. Applications of RS and GIS became part and parcel of almost all major projects of many organizations in India and abroad. Offering this course to the future bachelor and teacher technical subsidies to facilitate the urban and regional environmental characterization and monitoring. In this way, the domain of the techniques of remote sensing products interpretation enlarges the possibilities of the professional's performance in the job market (Di Maio-Mantovani and Costa, 1997).

References

1. Abbas, I.I. and Ukoje, J.A. (2009). Application of Remote Sensing (Rs) and Geographic Information Systems (Gis) to Environmental Impact Assessment (Eia) for Sustainable Development. Research Journal of Environmental and Earth Sciences 1(1): 11-15.
2. Adeniran, M.A., Effiong, E., Alagbe, A.O. and Ibekwe, V.J. (2013). Application of Geographic Information System (GIS) In Internal Security Operations, A Case Study Of Jos Metropolis, Plateau State, Nigeria. In: FIG Working Week 2013, Environment for Sustainability, Abuja, Nigeria, 6–10 May, 2013.
3. Akingbogun, A.A., Kosoko, O.S.O.A. and Aborisade, D.K. (2012). Remote Sensing and GIS application for forest reserve degradation prediction and monitoring. In: First FIG Young Surveyors Conference Knowing to create the Future, Rome, Italy, 4-5 May 2012.
4. Arkin, P.A., Ardanuy, P.E. (1989). Estimating Climatic-Scale Precipitation from Space: A Review. Journal of Climate 2: 1229–1238.

5. Baumgartner, M.F. and Apfl, G.M., (1996) Remote sensing and geographic information systems. Hydrological Sciences Journal 41(4):593-548.

6. Bhan, S.K., Saha, S.K., Pande, L.M. and Prasad, J. (1997). Use of Remote Sensing and GIS Technology in Sustainable Agriculture Management and Development. In: Proceedings of the International Conference on Geo-Information for Sustainable Land Management (SLM), organized under the aegis of Subcommision F (Land Evaluation) of the International Soil Science Society, Enschede, 17-21 August 1997.

7. Breitlow, K.A. (2007). Ocean Productivity: Applications of Remote Sensing and GIS. GEO 565 Annotated Biblography.

8. Busby, J.R. (2002). Biodiversity mapping and modelling. In: Skidmore, A. (ed.), Environmental Modelling with GIS and Remote Sensing.Taylor and Francis, London, UK, pp: 145–165.

9. Di Maio-Mantovani, A.C.and Costa, S.M.F. (1997). O Ensino de Sensoriamento Remotona Universidade do Vale do Paraíba - UNIVAP, São José dos Campos, SP. 1°Jornada de EducaçãoemSensoriamentoRemoto no âmbito do MERCOSUL, Camboriú, SC, pp: 16- 20.

10. Eguchi, R.T. (2013). Hurricanes, Tornados, Floods and other Disasters: A View from Space. In: 12th Americas Conference on Wind Engineering (12ACWE), Seattle, Washington on June 16-20, 2013.

11. Eguchi, R.T., Huyck, C.K., Ghosh, S. And Adams, B.J. (2008). The Application of Remote Sensing Technologies for Disaster Management. In: The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China.

12. Elias, M. (n.d.). GIS and Remote Sensing for Natural Resource Mapping and Management. 8p.http://www.saudigis.org/FCKFiles/File/SaudiGISArchive/2ndGIS/Papers/2_E_MohamedElias_UAE_F.pdf.

13. Engman, E.T. and Gurney, R.J. (1991). Remote Sensing in Hydrology. Chapman & Hall, London, UK.

14. EPA (Environmental Protection Agency). (1998). Ecological Research Strategy. EPA/600/R-98/086, June 1998. EPA, Washington DC, USA.

15. Franklin, J. (1995). Predictive vegetation mapping: Geographic modelling of biospatial patterns in relation to environmental gradients. Progress in Physical Geography 19(4): 474-499.

16. Goodchild, M.F.(1994). GIS and Geographic Research. In: Pickles, J. (ed.), Ground Truth: The Social Implications of Geographic Information Systems. New York: Guilford, pp. 31–50.

17. Gupta, S.K., (2010). Modern Hydrology and Sustainable Water Development. Wiley-Blackwell, India.

18. Joseph, G. (2005). Fundamentals of Remote Sensing. 2nd edition, Universities Press (India) Private Ltd.

19. Kerr, J.T. and Ostrovsky, M. (2003). From space to species: Ecological applications for Remote Sensing. Trends in Ecology and Evolution18: 299–305.

20. Lal, R. and Pierce, M. (1991). Soil Management for Sustainability. Soil and Water Conservation, Ankeny, Iwo, USA.

21. Liu, J. and Taylor, W.W. (eds). (2002). Integrating Landscape Ecology into Natural ResourceManagement. Cambridge University Press, Cambridge, MA, USA.
22. Maracchi, G., Pérarnaud, V. and Kleschenko, A.D. (2000). Applications of geographical information systems and remote sensing in agrometeorology. Agricultural and Forest Meteorology 103: 119–136.
23. McDermid, G. J., Franklin, S.E. and LeDrew, E.F. (2005). Remote sensing for large-area habitat mapping. Progress in Physical Geography29: 449–474.
24. Milla, K.A., Lorenzo, A. And Brown, C. (2005). GIS, GPS, and Remote Sensing Technologies in Extension Services: Where to Start, What to Know. Journal of Extension 43(3).
25. Ministério da Educação e Cultura (MEC). (1999). Secretaria de EducaçãoMédia e Tecnológica. Parâmetros Curriculares Nacionais: Ensino Médio. Brasília, 188p.
26. Oisebe, P.R. (2012). GIS and Natural Resource Management. GIS Lounge (www.gislounge.com).
27. Rango, A. (1994). Applications of Remote Sensing by satellite, radar and other methods to hydrology. Operational Hydrology Report No. 39, WMO-No. 804, World Meteorological Organization, Geneva, Switzerland.
28. Running, S.W., Justice, C.O., Salomonson, V., Hall, D., Barker, J., Kaufman, Y.J., Strahler, A.H., Huete, A.R., Muller, J.-P., Vandebilt, V., Wan, Z.M., Teiliet, P. andCarneggie, D. (1994) Terrestrial remote sensing science and algorithms planned for EOS/MODIS. International Journalof Remote Sensing 15: 3587-3620.
29. Sivakumar, M.V.K., Roy, P.S., Harmsen, K. and Saha, S.K. (2003). Satellite Remote Sensing and GIS Applications in Agricultural Meteorology. In: Proceedings of the Training Workshop 7-11 July, 2003, Dehra Dun, India, Organised by World Meteorological Organisation, Geneva.
30. Stoms, D.M. and Estes, J.E. (1993). A remote sensing research agenda for mapping and monitoring biodiversity. International Journal of Remote Sensing 14: 1839-1860.
31. Sun, Z. and Sun, J. (2012). GVSM: A GPS/GSM based Vehicle Management System for the Army. Jin, D. and Lin, S. (Eds.): Advances in Mechanical and Electronic Engineering, LNEE176, pp:509-514, Springer-Verlag, Berlin Heidelberg.
32. United Nations. (2000). Handbook on Geographic Information Systems and Digital Mapping. Series F, No. 79. Department of Economic and Social Affairs, Statistics Division. United Nations Publication, New York.
33. Verma, R.K., Kumari, S. and Tiwary, R.K. (2009). Application of Remote Sensing and GIS Technique for Efficient Urban Planning in India. In: Proceedings of Geomatrix at IIT, Mumbai, 2009.

20

Documentation of Lesser Known Fruits of East Khasi Hills District, Meghalaya, India

Dalari Lyngdoh
Darina Kharshandi

Abstract

This paper deals with the documentation of lesser known fruits from the East Khasi Hills district of Meghalaya with a view to popularise them and identify their economic potential. Meghalaya having a diverse type of climatic conditions and considered as one of the richest botanical regions of India is blessed with a rich diversity of fruits ranging from tropical and sub-tropical to temperate fruits. Many of these indigenous fruits have still remained unexploited due to lack of awareness and scientific knowledge. These fruits have unlimited potential in terms of value addition products which needs to be explored for commercialisation to boost the economy of the indigenous people. The genetic resources of many of these indigenous fruits are facing a great threat of extinction due to climate change, urbanisation and large scale developmental projects, therefore there is an urgent need for further exploration and documentation in this field. From the survey conducted a total of 17 lesser known fruits were documented with their local names, family, botanical name and uses.

Key words: *Lesser Known Fruits, Uses, Conservation Issues, East Khasi Hills District.*

Introduction

Fruits are nature's gift to mankind; they are not only delicious and refreshing but are an important source of food and medicine, thus playing a vital role in providing nutritional and economic security to the poor masses in the rural areas[1].

The tribal people living in the rural areas leading an intricate life and highly dependent on nearby forests, have gathered a vast knowledge about the uses of the various plants, fruits, etc. However besides the popular fruits like banana, mangoes, apples, oranges, pineapples, grapes, etc. there are other fruits, termed as lesser known fruits or underutilised fruits which are confined to the natural wild condition. Meghalaya, one of the richest botanical regions of India with diverse type of climatic conditions is blessed with a rich diversity of fruits ranging from tropical to sub-tropical and temperate fruits that have tremendous potential but are vastly unexplored. These lesser known fruits are sometimes available in the local village markets and rarely known to the outside world, they are cheap, highly nutritious, highly perishable and difficult to store in fresh form. Some of these too have a distinct flavour and taste and these are easy to grow even under harsh conditions as compared to exotic fruits like apples, mangoes, kiwis, cherries, grapes and their hybrids. Three to four decades back in the rural and urban areas, the local people sold several lesser known seasonal fruits. But in the fast changing life style and urbanization as well as invasion of several exotic fruits, the lesser-known fruits are gradually vanishing from the markets all over the country[2].

Moreover, these plant resources and their indigenous uses are in danger of being lost in areas where environmental transformations is taking place due to urbanization and industrialization leading to destruction and loss of habitat[3]. These less important fruits are store houses of genes for adaptation to hardy climate and serve as potential horticultural species. Most of these lesser known fruits were found to be very useful in Indian traditional medicine[4].They have multipurpose uses as fruits, as vegetables, they also have therapeutic, medicinal and nutritive properties.[5, 6]

A number of ethno-botanical studies have been carried out on plants of Meghalaya [7, 8, 9]. A few of these have dealt with the medicinal and antioxidant property. A study by Kayang et al on medicinal plants of Meghalaya found that the fruits of *Rhus javanica* are highly medicinal in the treatment for stomachache[9]. Seal (2011) studied the antioxidant activity of *Elaegnus pyriformis* and found that it can be utilised as natural antioxidant[10]. *Mahonia pycnophylla* have dual significance as food and medicine as reported in studies by Ahmed & Borthakur[11] However, there is lack of awareness and scientific knowledge on these lesser known fruits. Therefore, there is an urgent need for their documentation to preserve the knowledge based associated with these lesser known wild fruits and also to access their economic potential and conservation strategies.

Study area

The present study was conducted in the East Khasi Hills District of Meghalaya, India. East Khasi Hills is an administrative district in the state of Meghalaya in India. The district headquarter is located in Shillong. The district occupies an area of 2752 km² and has a population of 824,059 (as of 2011). As of 2011 it is the most populous district of Meghalaya It lies approximately between 25°07" & 25°41" N Lat. And 91°21" & 92°09" E Long. The northern portion of the district is bounded by the plain of Ri-Bhoi District gradually rising to the rolling grasslands of the Shillong plateau interspersed with river valleys, and then falls sharply in the Southern portion forming a deep gorges and ravines in Mawsynram and Shella-Bholaganj, community and rural development block, bordering Bangladesh. The district is bounded by the Jaintia Hills District to the east and the West Khasi Hills District to the west.

The East Khasi Hills District is mostly hilly with deep gorges and ravines on the southern portion. The most important physiographic features of the district is the Shillong Plateau interspersed with river valley, then fall sharply in the southern portion forming deep gorges and ravine in Mawsynram and Shella-Bholaganj bordering Bangladesh. Shillong peak lying 10 km from the city, offer a panoramic view of the scenic country side and is also the highest point in the district as well as in the State.

The climate of the district ranges from temperate in the plateau region to the warmer tropical and sub-tropical pockets on the Northern and Southern regions. The whole of the district is influenced by the south-west monsoon which causes rainfall beginning from May and continues till September and sometimes even to October. The weather is humid for the major portion of the year except for the relatively dry spell usually between December and March. The district has a unique biodiversity and is endowed with rich natural vegetation ranging from evergreen coniferous pine forests type to sub tropical and tropical evergreen and deciduous types.

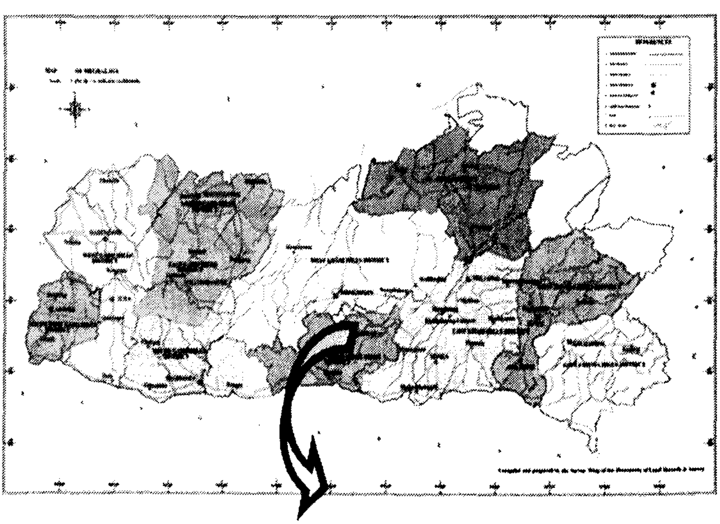

Fig 20.1(a): Map of East Khasi Hills District showing the locations of 8 study sites.

Eight villages under East Khasi Hills District were selected as study sites based on the availability of wild edible fruits, these are: Mylliem, Mawphlang, Mawkynrew, Tyrsad, Mawsynram, Pynursla, Cherapunji, Shella (Fig. 20.1).

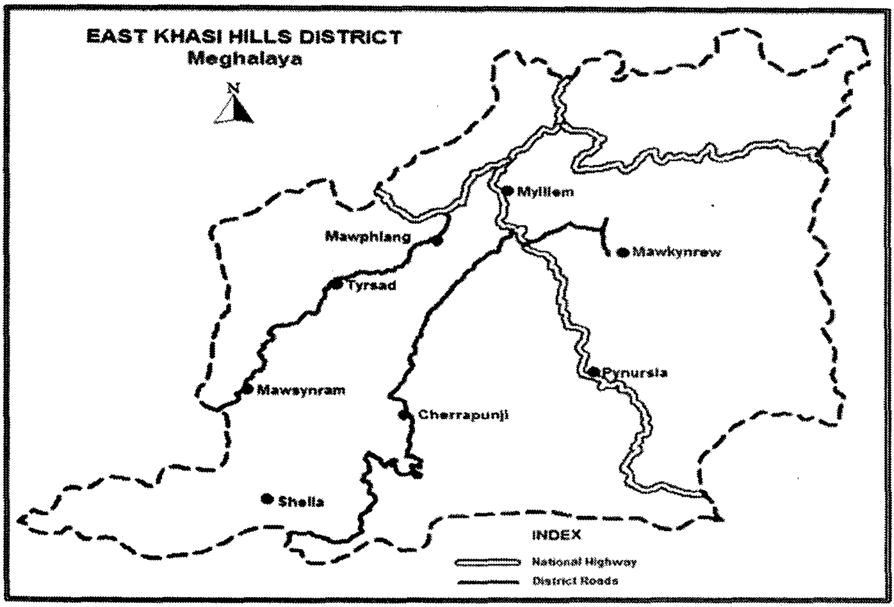

Fig 20.1(b): Map of East Khasi Hills District showing the locations of 8 study sites

Methodology

Several field trips were undertaken throughout the eight villages of the district at different seasons. An inclusive study of these lesser known fruits was undertaken to document their uses, local names and other important information. A record was carried out every season during the study period to ensure complete listing of species. Villages under the jurisdiction of the East Khasi Hills District and local weekly markets of different villages were visited from time to time to study and compare the availability of these lesser known fruits in different seasons and also to gather information on the economic importance of various wild edible fruits. Fresh specimen and available photographs were shown for local identification. Local informants with firsthand knowledge of plant species were taken for identification and collection from their habitat of occurrence. The scientific names of these fruits were checked from local and regional flora[12, 13, 14] and the specimens were then counter checked from the herbarium of the Botanical Survey of India, Eastern Circle, Shillong. Plant samples and fruits are preserved as bottled specimens as herbarium sheets and kept in the Department of Botany, Shillong College for future references.

Results and Discussion

From the survey conducted, a total of 17 species of lesser known edible fruits belonging to 17 genera under 15 family were collected and recorded with their family, local names, habit and uses as shown in Table 20.1 .The results of this study also showed that out of a total of 17 species, the most commonly used species belong to trees (9 species; 52.94%), followed by climbers (6 species; 35.29%) and shrubs (2 species; 11.76%) (Fig.20.2). The results of this study revealed that these fruits trees are confined to the natural wild with their area of distribution restricted to specialised habitats, they remained uncared for, and are

Table 20.1 Lesser Known Fruits of East Khasi Hills District

Sl. no	Botanical name	Family	Local name	Habit	Flowering& Fruiting	Uses
1	*Aporusa dioica* (Roxb.) Muell.	Euphorbiaceae	Soh khyrwiat	Tree	Nov-May	Ripe fruits are edible.
2	*Artocarpus lakoocha* Buch. -Ham	Moraceae	Soh ram	Tree	Feb-July	Ripe fruits are eaten. Seeds are also roasted and eaten. Ripe fruit are also use as antiseptic, in constipation and fever.
3	*Elaegnus pyriformis* HK. f	Elaegnaceae	Sohkhlur	Shrub	Nov-Apr	Ripe fruits are eaten raw, unripe fruits are made into pickles.
4	*Elaeocarpus lancifolius* Roxb	Elaeocarpaceae	Soh khyllam snieh	Tree	Mar-Dec	Fruits are edible.
5	*Flacourtia jangomas* (Lour.) Raeusch	Flacourtiaceae	Sohmluh	Tree	Mar-Oct	Ripe fruits are acidic and edible. Fruits are also use in bleeding gums,toothache and diabetes.
6	*Garcinia xanthochymus* Hook f. enT Anders	Clusiaceae	Soh khyllung	Tree	Mar-Jan	Acidic fruits are edible.
7	*Gironniera reticulata* Bl.	Ulmaceae	Sohbrai	Tree	May-Dec	Ripe fruits are mixed with salt and eaten; they are also made into pickles.
8	*Hodgsonia macrocarpa* (Bl.)	Passifloraceae	Soh myrthar	Climber	Feb-Nov	Seeds are roasted in fire and grounded with dry fish to make a chutney.
9	*Holboellia latifolia* Wall.Tent	Lardizabalaceae	Soh langkait	Climber	Mar-Nov	Ripe fruits are eaten as substitute for banana.

11	*Prunus jenkinsii* Hk. f	Rosaceae	Sohiong khlaw	Tree	Oct-Mar	Ripe fruits are sour and edible.
12	*Rhus javanica* L.	Anacardiaceae	Sohma/ Sohmluh	Tree	Aug-Mar	Ripe fruits with salty taste are eaten fresh or grounded into powder and taken with water. The fruits are soaked in water which is drunk for stomachache. Buds are boiled and taken for diarrhoea.
13	*Rubus niveus* Thunb.	Rosaceae	Sohshiah iong	Shrub	Mar-Oct	Ripe fruits are edible
14	*Stropanthus wallichii* A. DC.	Apocynaceae	Soh rengblang	Climber	May-Oct	Fruit is sour in taste and eaten raw.
15	*Tetrastigma obovatum* (Laws.)	Vitaceae	Soh langnar/ Soh larpung	Climber	May-Oct	Yellowish ripe fruits resembling grapes are edible.
16	*Toddalia asiatica* (L) Lamk.	Rutaceae	Sohsat	Climber	Sept-Oct	Globose yellow fruits are highly pungent and edible.
17	*Willoughbeia edulis* Roxb.	Apocynaceae	Sohbrab khlaw	Climber	May-Dec	Ripe fruits are edible; the pulp of the fruit is acidic but palatable.

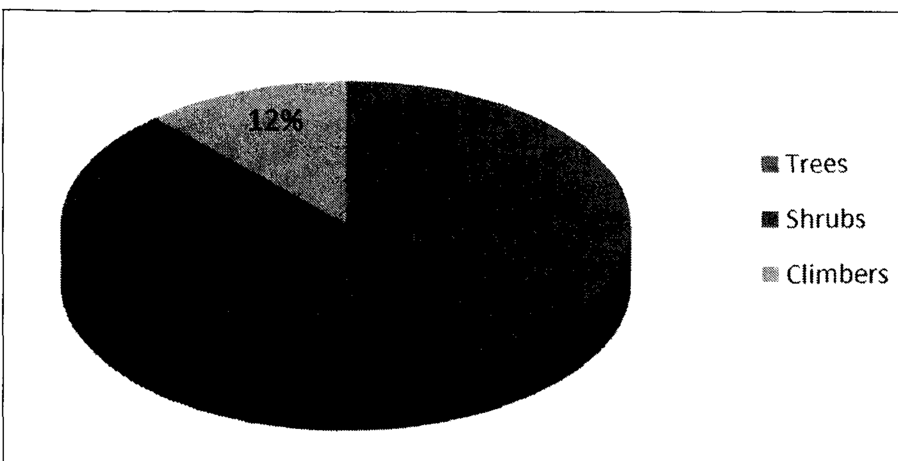

Fig. 20.2 Distribution of lesser known fruit species in different life form

unknown to the urban population as many of them are not available in the local markets. These fruits are lesser known because of lack of awareness and scientific knowledge, moreover most of these fruit trees are not cultivated and there is scant and dispersed knowledge about their fruits and their nutritive value. Fruits such as *Artocarpus lakoocha, Flacourtia jangomas*, *Rhus javanica* were found to be medicinal as well[15, 9]. The findings of this study revealed that the picking of these wild edible fruits from the nearby forest is a very popular leisure activity, collected and utilised for domestic and household purposes. In certain cases, *Holboellia latifolia* are being consumed as replacement for banana whenever the latter is not available especially in interior places. Though many of these lesser known fruits are unacceptable because of their unpleasant or strong astringent taste yet they are today gaining importance because the present generation are becoming more conscious about their health and prefer natural herbal products extracted from these fruits to cure various ailments and also to increase their immunity.

Conclusion

The present study described the traditional knowledge of the local people of East Khasi Hills on the usage of these lesser known wild fruits particularly in their food habit. Due to their comparatively low commercial importance, the lesser known fruits have not received the desired attention and at present there is limited research and no conservation strategy on the genetic resources of these species.

Many of these plants can survive under stress and harsh conditions and are incidentally store house of genes for adaptation to hardy climatic condition, therefore this study would be significant to the farmers as tremendous scope lies in the introduction, evaluation and exploration of these lesser known fruits at a commercial level. The studies also contribute to the record of traditional knowledge of these lesser known fruits as a food. Hence, further research can also be carried out for analysis of their nutritional and medicinal values as well.

Acknowledgement

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References

1. Sankaran M, Prakash J, Singh N P & Suklabaidya A, Wild edible fruits of Tripura, *Nat Prod Rad*5 (4) (2006) 302-305.
2. Kulshreshtha K, Germplasm Collection of Some Lesser-known Edible Fruits, National Conference on Biodiversity, Development and Poverty Alleviation, 22nd May 2010.

3. Acharya K P & Acharya R, Eating from the wild: Indigenous knowledge on wild edible plants in Parroha VDC of Rupandehi District, Central Nepal, *Intl J Soc Forestr*, 3 (1) (2010) 28-48.
4. Khare C P, *Indian Medicinal Plants*, Springer Science+BusinessMedia, LLC, 2007.
5. Karunai Raj M, Balachandran C, Duraipandiyan V, Agastian P, Ignacimuthu S, Antimicrobial activity of Ulopterol isolated from Toddalia asiatica (L.) Lam.: a traditional medicinal plant. *J Ethnopharmacol*. 2012 Mar 6; 140 (1):161-5.
6. Malik S K, Choudury R, Dharwal O P, Bhandari D C, *Genetic Resources of Tropical Underutillised fruits in India* (National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi, India)2010.
7. Jeeva S, Lyndem F G, Sawian J T, Laloo R C & Mishra B P, *Myrica esculenta* Buch. - Ham. ex D. Don. - a potential ethnomedicinal species in a subtropical forest of Meghalaya, northeast India, *Asian Pacific J Trop Biomed*, (2011) S174-S177.
8. Sawian J T, Jeeva S, Lyndem F G, Mishra B P & Laloo R C, Wild Edible Plants of Meghalaya, North-east India, *Nat Prod Rad*, 6 (5) (2007) 410-426.
9. Kayang H, Kharbuli B, Myrboh B & Syiem D, Medicinal Plants of Khasi Hills of Meghalaya, India ,Proc. WOCMAP III, Vol. 1: *Bioprospecting & Ethnopharmacology*, Eds. J. Bernáth, É. Németh, L.E. Craker and Z.E.Gardner, Acta Hort 675, ISHS 2005 pp75-80.
10. Seal T, Antioxidant Activity of Some Wild Edible Fruits of Meghalaya State in India, *Adv Biol Res*, 5 (3) (2011) 155-160.
11. Ahmed A A & Borthakur S K, *Ethnobotanical Wisdom of Khasis (Hynniewtreps) of Meghalaya*, (Bishen Singh Mahendra Pal Singh. Dehra Dun), 2005.
12. Haridasan K & Rao R R, *Forest Flora of Meghalaya*, Vols I & II, (Bishen Singh Mahendra Pal Singh, Dehra Dun), 1985 & 1987.
13. Kanjilal U N, Kanjilal P C & Das A, *Flora of Assam*, Vols I & II, (A Von Book Company), 1982.
14. Kanjilal U N, Das A, Kanjilal P C & De R N, *Flora of Assam*, Vols III & IV, (A Von Book Company), 1982.
15. Khumbongmayum A O, Khan M L & Tripathi R S, Ethnomedicinal plants in the sacred groves of Manipur, *Indian Journal of Traditional Knowledge*, Vol. 4(1), January 2005, pp.21-32.

21

Project Work on Environmental Education: an innovative tool at the Higher Secondary School Level

D. Kharshandi

Abstract

Environmental education is an integral part of every pupil's learning. It is based on building awareness about environmental issues, exploring possible solutions and laying the foundation for a fully informed and active participation of individuals in the protection of the environment and the rational use of natural resources. A project work is a learning experience which aims at providing a platform for students to learn beyond their text books. Project work as one of the standard methods at the higher secondary level has been developed with a view that this stage of school education is crucial and challenging for the need of environmental education as an integral part of curriculum to instil environmental ethics in the fabric of our society. The Meghalaya Board of School Education has introduced project based approach on environmental education as a curriculum in the higher secondary level of schools.

This paper presents the analysis of Project reports on environmental science of the class xii students of Shillong College for the last 2 years. The students develop their skills in critical thinking and problem solving qualities, to think scientifically and logically. Students become aware of the increasing environmental disasters, they are motivated to conserve nature and find solutions to the problem that loom in the horizon today. Project work curriculum is not only subject centric but a student centric activity where due importance is given to the student who is permitted to choose the topic of his interest, involves whole heartedly in the learning process and make use of the abilities to the maximum possible extent. An optimum level of self esteem is associated on achievement of their goals as they learn to appreciate the value of their own efforts. Students arrive at a deeper understanding of the subject investigated than what they normally would have learned from merely listening and learning.

Keywords: *Environment Education, National Curriculum Framework, Project*

Introduction

Environmental education is an integral part of every pupil's learning. The objective of environmental education is to increase awareness about environmental issues, explore possible solutions and lay the foundation for a fully informed and active participation of individuals in the protection of the environment and the rational use of natural resources. Environmental education is aimed at providing the basic knowledge and understanding about the environment and its interrelationship with humans. The protection of the environment today is the concern of people around the globe. Environmental education as an interdisciplinary subject has been included as a compulsory subject at all stages of education to sensitise the young minds to environmental related issues and concerns and to inculcate in them a healthy positive social attitude and behaviour towards the environment. The recommendations of the National Curriculum Framework (2005) have been followed keeping the disciplinary approach with rigour and depth, appropriate to the comprehensive level of the learners. Environmental studies as a compulsory subject at the higher secondary level is extremely important to imbibe in the learners an environmental consciousness so as to make them aware about environmental disasters facing the world today. The Meghalaya Board of School Education has introduced a project based environmental curriculum at the higher secondary level with the following objectives:-

1. To inculcate environmental related issues and scientific spirit of enquiry in students from arts, science and commerce streams.
2. Promoting process skills, solving abilities and application of environmental concepts/contents, useful in real life situations for making environmental studies/environmental education more relevant, meaningful and interesting.
3. Emphasis on the use of numerous illustrations to give students the exact mental image of the subject discussed and to critically and creatively apply knowledge to real life situation.
4. Emphasis on environmental related technologies/industrial aspect to cover up with the fast changing scenario and prepare students for lifelong learning and challenges in the future. (M.B.O.S.E. syllabus)

A project work is a learning experience which aims at providing a platform for students to learn beyond their text books. It can be defined as an educational method where students working individually or in small groups analyse and develop "real life" problems or tackle a present day themes within a present time limit working independently with the division of tastes clearly defined "whole hearted purposeful activity proceeding to a social environment" (Kilpatrick, 1918). It is one of the most interesting, efficient and meaningful ways to cover the curriculum, teach and address the learning styles. It is generally considered a means by which students (a) develop independence and responsibility, (b) practice social and democratic modes of behaviour (Knoll,1997). The Project work on environmental education was introduced to increase students' awareness about the environment and enhance public participation in activities that intended to conserve, protect, manage and sustain the environment.

Based on the above information, the aim of the present study is to review and analyse the project work as an innovative tool of learning and how it influences the education and learning environment.

Methodology

The project reports on environmental education (for the last 2years) of class xii (science) students of Shillong College were qualitatively analysed on the basis of the following criteria:- (a) selection of topic, (b) selection of the project area, (c) effort made by the student, (d) the style, quality of presentation and organisation of the project report, (e) originality and creativity including the quality of expression in English.

Analysis

On analysis of the various project reports submitted by the students, it was found that:

1. The students selected topics of their interest, having educational value and related to real life situations.
2. These reports were on various environmental issues like Deforestation, Greenhouse effect, Climate change, Pollution of Umkhrah river, Waste disposal in Shillong city, Conservation of Biodiversity, etc.
3. The student is whole heartedly involved in the learning process wherein he investigates, collects data and information and arrives at a much deeper understanding of the subject investigated than what he would have normally learned from merely listening and being taught.
4. It is an outdoor activity where students get the opportunity to investigate the natural environment, enabling the students to learn beyond their texts books.

5. Students developed the problem solving qualities, creative capacity to think scientifically and logically to find solutions to the How? When? Why? And Where? of the problem investigated.
6. Students displayed their creativity and expressed their own ideas and views and developed a positive attitude towards the environment.
7. The students became aware of the increasing environmental disasters, motivated to conserve nature and find solutions to the problems that loom in the horizon today.
8. The project work also enhanced constructive social relationship among students and developed a rapport between the teachers and the taught.

Discussion

Environmental education projects are common nowadays and are an important part of many nature protecting programmes. Environmental issues and environmental concerns were identified as core areas in the curriculum. Including project work in the curriculum promotes children's intellectual development by engaging their minds in observation and investigation of selected aspects of their experience and environments (Katz and Chard, 2000). Findings of this study revealed that project work provided an opportunity for the student to investigate and study about the environment, thus increasing awareness of the environment leading to an active participation in resolving environmental issues. The project curriculum goes beyond the mere acquisition of knowledge with emphasis on learning by doing, exploring and problem solving thus making the study more real and interesting enabling students to make use of their knowledge and acquired skills. The project work is a bridge to independent learning where an optimum level of self esteem is enhanced on the achievement of their goals as they learn to appreciate the value of their own efforts. Environmental curriculum does indeed increase students' awareness to issues relating to the environment and provide the education that children need to make informed decisions later in life with regards to environmental issues. Therefore, through project works, students become more acquainted with environmental related issues, investigate and study the environmental issue by collecting facts and data and learn to integrate the information so as to be able to come out with scientific ideas and decisions. The project methods provide the students hands on experience away from the class room learning and note book learning and students develop critical thinking, which truly is the nerve centre of science thinking. Interestingly, the beneficial aspects of the project work on environmental education are that the students' knowledge about the environment is tremendously increased and interactions between teachers and students improved. It is a whole hearted effort put in by students providing them with the opportunity to analyse the problem skilfully and come out with suitable scientific solutions. It provides a well rounded mode of education developing emotional intelligence, creative capacity in addition to intellectual ability. In this context, Szallassy (2008) pointed out that creative problem solving is particularly useful during development and accomplishment of environmental projects and this can be used efficiently in resolving environmental problems by students in a creative way. Exposure of students to environmental curriculum enabled them to acquire skills. According to (Kilpatrick, 1918) this curriculum appears to be an effective tool of learning which is constructive and enjoyable where students explore and experience real life situations. It is not just about investigation but it includes the views, opinions, the sharing of results, concerns and questions among students. The exposure of students to the project curriculum produced a more positive attitude towards the environment as they become more aware of the impact of human activities on the environment in their day to day life. It enhances their self confidence, discipline and inculcates a sense of social responsibility towards society. Through project work, students become active learners, acquire scientific knowledge in a meaningful context and they develop styles of enquiry and communication that will help them to be effective lifelong learners (Edelson, 1997). Therefore, the project work as a curricular activity at the higher secondary level appears to be important because it is through the project work that skills, scientific, social and educational attitudes and values can be inculcated in students so that a better tomorrow with a sustainable future can be achieved. Impressively, it serves as an effective tool in motivating students and society at large to be environmental friendly.

References

1. Edelson, D. C. (1997), Realising Authentic Science Learning through Adaptation of Scientific Practice, International Handbook of Science Education.
2. Katz, L. and Chard, S.C. (2000). Engaging Children's Mind, The Project Approach 2nd edition Norwood, NJ, Ablex.
3. Kilpatrick, W.H. (1918). The project method. Teachers College Record, pp 319-335.
4. Knoll, M. (1997). University of Bayrenth. The Project Method: Its Vocational Education Origin and International Development.
5. National Curriculum Framework, (2005). NCERT Edition, Aurobindo Marg. New Delhi.
6. Szallassy, N. (2008). Project Method as One Of The Basic Methods Of Environmental Education. Acta Didactica Napocensia, 1(2): 44-49.

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Molecular Graphics Visualization of Biomolecules in 3-D Conformation using PDB Structures to Assist Undergraduate Biology Teaching

Banteiskhem Kharwanlang

Abstract

The Protein Data Bank (PDB), a data archive of three-dimensional biomolecules determined by x-ray crystallography and NMR, is maintained by the worldwide Protein Data Bank. PDB has become a versatile data resource for various fields ranging from drug design, structure-functional relationship studies and structure prediction to supporting biochemist and molecular biologist in designing new hypothesis and developing new experiments. PDB is also found useful and informative for people of various backgrounds and interests who keep track of novel scientific discoveries. In addition to its application in research and pharmacology, visualization of PDB structures can be applied to assist in teaching biology to postgraduate, undergraduate and school students. It is easy for a teacher and a trained researcher to visualise and explain the biological molecules like the DNA, RNA and proteins which are practically invisible or presented as drawings in textbooks, but it is daunting for students to grasp and understand the structure and function of these molecules in their imagination. It can even be more complicated when the molecules are involved in complex processes like in replication. This reduces the intellect communication from the teacher output to the student input. However, with the present day technology these molecules can be virtually viewed in 3-D using molecular graphics and whether viewed by the teacher or a student will deliver the same information.

Enzyme-substrate, receptor-hormone, antigen-antibody, DNA-protein interaction in replication and structural malfunction of proteins arising due mutation can also be viewed. Assisting undergraduate and school biology lessons with PDB structures will make teaching and learning more communicative, dynamic and delighting; as well it may attract and motivate young minds with talent to basic science. This paper will focus on the binding of oxygen to haemoglobin and malfunction of haemoglobin in sickle cell anaemia by studying the 3-D representations of haemoglobin molecule using PDB resource.

Keywords: *Protein Data Bank, Bio-molecules, Physical Models, PDB, RCSB, Haemoglobin.*

Introduction

The Protein Data Bank (PDB) is the single data archive for experimentally determined three-dimensional structures of proteins, nucleic acids and their complex assemblies. Originally established in 1971 at Brookhaven National Laboratories (1), the PDB is currently maintained by the members of world wide protein data bank (wwPDB) which includes Research Collaboratory for Structural Bioinformatics Protein Data Bank (RCSB PDB), the PDB in Europe (PDBe) and PDB in Japan (PDBj). The PDB data is mainly determined by X-ray crystallography, nuclear magnetic resonance (NMR) and electron microscopy (EM), with a small number determined by fibre diffraction, neutron diffraction and solution scattering. PDB has become a versatile resource with the aid of the World Wide Web. The users of these websites include students (ranging from school to graduate school), academicians, industrial researchers and scientists. For computational biologist, the PDB offers data for drug design, structure prediction and other molecular modelling. In research, it helps in the interpretation of experimental data, designing new experiments and developing fresh hypothesis. Academicians and students access the structures from the PDB to obtain the authentic view of biomolecules and studying the mechanism of action, whereas the common man learn about the PDB in relation to the role played by molecular structures in identifying new discoveries and therapeutics in clinical science. The RCSB PDB web site hosts ~240 000 unique visitors per month in 2012, an increase from the 180 000 visitors last reported in 2011. For education and learning purpose and activities, a separate section on the RSCB PDB page offers the 'Molecule of the Month' that tell the functional story of selected macromolecules (2, 3, 4).

Structure – Function Relationship of Biomolecules

Biological or physiological functions of biomolecules are correlated to their biochemical activities. Biochemical activities can be simply described as their interaction with substrates and catalysing a chemical reaction. Understanding the biochemical function gives a clear understanding of the biological or physiological objective of the biomolecule. However, understanding biochemical function requires an understanding of structural geometry. Structural geometry played an important role in studying the reactivity and specificity of molecular interactions. Molecular geometry is taught using a variety of tools which include paper sketches and physical models. Thus, understanding the structural geometry is of utmost importance in deciphering the biochemical function and ultimately biological or physiological function. Since structure is a central pillar in biochemistry, some authors have coined a new term "three-dimensional molecular literacy" that students of biological science have to grapple with (3, 5, 6, 11).

Representation of Biomolecules Imaginatively in the Mind, Physical Model and with the Aid of Animation

Classroom teaching involve a flow of ideas and information from a teacher to a student, however an obstruction to the flow of information can reduce the intellect information from the teacher output to the student input. In biology, the obstruction to the flow of information can be the inability of a student to view a biomolecule in the same format as the teacher. Presentation of biomolecules in the form of drawings or pictures in textbooks cannot decipher the total structural information to a student. This may hamper the student's understanding on its biological function. Visualization and understanding the biomolecules is easy for a trained researcher or a teacher, as they can represent or visualise the textbook picture imaginatively in their minds in the 3-D format or even rotate the molecule in their minds to meet their rational understanding. However, the students may adopt a different approach of visualizing the same picture or the visualization constructed in their minds may be restricted and wrongly construed by their inexperience on the subject. Thus, the message that a teacher wants to convey to the student can be unsuccessful. Further, the teacher will not be able to correct or moderate the visualization of the student. So a common approach to solve such a problem is by using physical model. However, these models are expensive, fragile and restricted to manoeuvring (6). Further, representation of biomolecules with physical model is impossible due to the large structural information. Molecular interaction of biomolecules in processes like replication, transcription and translation further limits the application of physical models.

To address the above problems, textbooks come with CDs containing animations on these processes or one can view animation of molecular interactions on the internet. Undoubtedly these lessons help students to visualize the complex structure–function relationships of biochemical systems. The teacher's inability to have a free hand in controlling the molecular motion of the molecule in the animation or the deficient in information related to the instant query of the student or live audience, may limit the usefulness of these animations.

In order to overcome the limitations of physical model and animation, the visualization of biomolecules in 3-D format having almost gratifying information can be achieved by mining the data from PDB and viewing the biomolecule using molecular viewers (3,5,6).

Haemoglobin exemplify the Relationship between Structure and Function

Hemoglobin and myoglobin are the first proteins to have their 3-D structure determined by x-ray crystallography and have played a significant role in biochemistry. They are one of the most studied and best understood proteins in terms of structure and function. The basic protein functions such as storage, transportation, allosteric regulation and inhibition are displayed by hemoglobin. Hemoglobin is a model for quaternary structure and allosteric function. Subunit-subunit interactions in hemoglobin reveal the importance of quaternary interaction in relation to its function and allosteric regulation. Hemoglobin is found in the red blood cells and specialised for transportation of oxygen from the lungs to the tissues and carrying carbon dioxide back to the lungs from the tissues (7, 8).

Hemoglobin (Hb) is a compact globular tetramer. Each of the polypeptide chain bears a heme as a prosthetic group. Heme is a porphyrin ring system containing an iron ion. Oxygen molecule binds to hemoglobin via heme. Since, each heme complexed to a globular protein can bind one molecule of oxygen, thus hemoglobin binds in total four molecules of oxygen. In human adult hemoglobin, there are two identical á-chains each of 141 amino acids and two identical â-chains each of 146 residues. The tetrameric structure of hemoglobin enables it to be an efficient oxygen transporter; moreover it creates a condition where by the binding of one oxygen facilitates the binding of subsequent oxygen molecules clearly exhibiting the property of cooperativity (7, 8).

A single amino acid substitution in the β-chains of Hb causes sickle-cell anemia. The only difference between the primary sequence of β-chain of Hb and sickle cell Hb is the substitution of glutamate at the 6^{th} position with valine. This substitution creates a region of hydrophobicity resulting in intermolecular hydrophobic interactions and aggregation among the chains into polymeric structures (7, 8).

The interactions of oxygen with hemoglobin, the illustrations of the cooperative property and even the sickle cell abnormality of hemoglobin can be dissected and efficiently depicted in the 3-D structure of hemoglobin.

Studying the Structure and Function of Haemoglobin using PDB and Molecular Viewer Software

Resources

Downloading of PDB from RCSB webpage

The PDB files of hemoglobin in various conditions, i.e., deoxyhemoglobin

(2HBB), oxyhemoglobin (1HHO) and sickle cell hemoglobin (2HBS) can be downloaded from RCSB webpage (9).

Viewing and Analysing of PDB Files using Molecular Viewer

The PDB files can be viewed using various viewers, some of which are Rasmol, Cn3D, Chime, Protein Explorer, Molegro Viewer, etc. Depending on the information that the user wants to derive and the format to reproduce the structure from the PDB file, one can choose any of the molecular viewer tools to view and analyse the structure (3, 10).

The visualisation of molecules in 2-D format and its limitation will also be touched in order to appreciate the use of 3-D structures in teaching and learning. Visualisation of haemoglobin in 3-D format will include live explanation on the interaction of the heme and the protein component, interaction of the iron atom with the heme, the displacement of iron atom during oxygen binding and its effect on the allosteric property of hemoglobin, the reversible binding property of oxygen with the heme and the sickle cell activity of hemoglobin which involves intermolecular interaction among the subunits.

Future Perspective

Proteins are not static but dynamic entities having molecular vibrations and small movements of amino acid residues. Such a protein is said to be breathing and these changes in conformation are important in executing the function of the protein (7). In the near future, it may be possible to view a live classroom presentation on the structural changes occurring in a protein while it is performing its real-time function.

References

1. Bernstein FC (1977). *J. Mol. Biol.* 112, 535–542.
2. Rose WP et al (2013) The RCSB Protein Data Bank: new resources for research and education *Nucleic Acids Res* 41(D1): D475–D482.
3. Bateman RC et al (2002) Teaching and Assessing Three-Dimensional Molecular Literacy in Undergraduate Biochemistry *Journal of Chemical Education* 79 (5): 551-552.
4. Dutta S et al (2010) Promoting a structural view of biology for varied audiences: an overview of RCSB PDB resources and experiences *Journal of Applied Crystallography* 43: 1224–1229.
5. Centeno NB et al (2003) Teaching Structural Bioinformatics at the Undergraduate Level *Biochemistry and Molecular Biology Education* 31(6): 386–391.
6. Sansom CE et al (1996) Use of Graphics Workstations to Illustrate Protein and Nucleic Acid Structure: A Description of Three Modelling Experiments Carried out by Second-year Undergraduates *BIOCHEMICAL EDUCATION* 24(1) 32-35.
7. Nelson DL and Cox MM (2005) LEHNINGER Principles of Biochemistry 4th Edition.

8. Berg JM et al Biochemistry 5th Edition.
9. www.rcsb.org.
10. www.molegro.com.
11. Yonetani T and Labarge M (2008) Protein Dynamics Explain the Allosteric Behaviours of Hemoglobin *Biochim Biophys Acta* 1784(9): 1146–1158.

23

Applications of Nuclear Physics for the Needs of the Modern Society

B. Jyrwa

There are various applications of physics, which have withstood the test of time and serve as blessings to mankind. Here we innumerate a few of them which are vital and play a very important role in our lives.

Alpha-Decay Applications

The long lived heavy nuclei emit particles which have two important properties:

(1) They are emitted at a discrete energy;

(2) The rate of emission is constant.

Let us consider the α-decay of ^{238}Pu which has a decay rate of 6 x 10^{11} decays/s/gm.

Now each decay releases 5.6 MeV and the power output per gm is 0.6W. Now 0.6W is not enough to light a house but it can power simple electrical circuits, and it continues to operate at a constant rate in extreme conditions (like a vacuum and low temperature of space).

Replacement can be done only after 86 years which is the half life of Pu^{238}. Where does one find its uses?

1) Cardiac pacemakers – which require stable and reliable power sources.

2) Voyager spacecraft that photographed Jupiter, Saturn and Uranus.

In cardiac pacemakers, the α-decay energy is converted into heat energy which in turns changes into an electric pulse via a thermoelectric converter. Around 300 m W power is produced continuously for about 86 years. The phenomena α-particle scattering is applied in smoke detectors ^{241}Am with a half life of 433 years have Q value 5.6 MeV. Normally α-particles ionize air molecules in the detector, the ions migrate to their respective electrodes and a small steady current is obtained.

The products of combustion consist of heavy ionized atoms; in the detector they collide with the ions as a result of which the current decreases, this in turn triggers the alarm. Thus the device is sensitive to charged invisible ions (which are products of combustion).

Rutherford backscattering

This can be applied to determine the presence of various elements. It is based on the following working principle.

The energy loss of the α particle is

$$\Delta T = T[4m_p m_{T/(1-} m_{p/} m_{T)}{}^2]$$

Where T is the inc energy of the α particle

m_p is the mass of the α particle

m_T is the mass of the target

Now, $\Delta T \alpha 1/m_p$, for heavier nuclei $T \approx 0.5$ MeV. Scattering from a target made up of a variety of isotopes will give rise to a spectrum of α-energies, each agreeing to a definite mass of the struck atom, from which we can draw conclusion about the composition of the target.

This method has been used for the study of soil samples by the surveyor spacecraft that landed on the Moon. Basically Cm-242 was used; it has a half life of 163 days.

Diagnostic Nuclear Medicine

X-Rays

We are all familiar with the medical applications of X-rays to diagnosis. Since X-rays can traverse through soft body tissue, but hard tissues like bones are opaque to X-rays. But the limitations are the following.

1) X-rays cannot differentiate between different types of soft tissue (e.g. locating tumors) since they produce a flat 2-d image.
2) X-rays cannot be used to determine the depth of any abnormality within the body.

Soft tissues like the brain which is shielded by the skull cannot be analyzed by X-rays.

Subsequently the development of techniques in experimental nuclear physics have led to the production of medical imaging X-ray cameras, known as nuclear medical radioisotopes for diagnostic purposes. Only nuclear physicists working in close association with doctors are mostly employed in centres dealing with nuclear medicine. A dynamic function study determines the rate at which a thyroid, kidney or any other organ absorbs or eliminates the material. As an example, let us consider an amount of ^{99m}Tc being taken up by the thyroid, and activity is measured by the counter held against the throat. Any changes from the usual patterns of uptake and excretion indicate possible irregularity.

In a γ-ray camera, one sees a picture produced by detecting the radiation from an absorbed radioisotope. There is a scintillating crystal which emits light when β or γ-ray pass through it. The counter is moved over the region of interest and the pulses generated are amplified and recorded.

CAT Scan

In the 1970's the availability of high speed digital computers gave birth to powerful new medical imaging systems, including the computer assisted – Tomography (CAT) or CT scan whereby one analyses the organ of internal body in slices, these minute details would not have been possible to get using X-ray.

In a CT scan an X-ray beam is collimated into a thin fan along each narrow path, there are several ionization detectors feeding a computer with their data of the transmitted X-rays. The source and the detector array rotate about the body axis, and measurements are made at a large number of angles over a total period of just a few seconds. This process gives a line of information to the computer, which in turns brings out a 3-D picture of a cross section of the body with good contrast and sensitivity CT scans can differentiate tissues with density differences of a fraction of 1% and one can easily detect tumors which could not be seen by older techniques.

PET Scan

The latest imaging system is the positron-emission-tomography (PET) which is needed in metabolic studies. The procedure is as follows:

A compound which is basically positron-emitting radionuclide is given to the patient. The positron travels a short distance before they are annihilated by electrons and thereby producing 0.511 MeV of γ-ray photons giving in opposite directions. These photons are detected by a circular ring of detectors placed around the patient. Subsequently the computer interprets the data so as to construct the image of the distribution of the absorbed radionuclide in the particular organ under investigation.

NMR

Another modern imaging technique uses nuclear magnetic resonance (NMR) phenomena is the MRI (magnetic resonance Imaging) or MRT (Magnetic resonance tomography). This is in lieu of ionizing radiation.

The patient lies within a large rotating magnet whereby the magnetic field is used to align the magnetization of the nuclei belonging to certain atoms of the body e.g. hydrogen. The idea is that the body contains 75% of water. In this way one can distinguish normal and abnormal tissues, by studying the flow of blood in capillary beds, and thereby doing chemical analyses in the body. The advantage of this method is that the contrast is good.

The high frequency ultrasonic sound can be used in the treatment of various diseases such as arthritis, mastitis and rheumatism. One can avoid the painful experience when undergoing tooth extraction by the application of ultrasonic drills. Ultrasonic signals of frequency that are not harmful to the body are transmitted and used for scanning the organ of interest in the body. Since the body contains a large amount of fluid, the sound waves are easily transmitted through the tissues of the blood vessels and muscles. Bones and cartilages however reflect the ultrasound signals. Thus investigations use the principle of reflection and transmission.

For example one can have ultrasound of the eye to detect any eye disease. Sonogram of the liver, breast, kidney, and uterus are established procedures to detect any deformities. Today we also have the echocardiography which uses the principle that besides transmission of ultrasonic signals through tissues, there is also a receiver that records changes in blood flow velocity thereby the condition of heart can be easily detected. Basically a transducer directs ultrasound signals into the chest at a certain rate. Responses to the signals are seen on a CRT and the images obtained thereby can be interpreted as abnormal heart valves, vascular anomalies and pulmonary stenonis.

Dating in Archaeology and Geology

If we can determine the ratio of the original radionuclide in an object, to that of the present day quantity, we can say something about the time lapsed since the object was formed or made. The original quantity of radionuclide can be found out indirectly.

Carbon -14 Dating

C-14 is always present in the environment because of the effects of cosmic radiation in the atmosphere coming from outer space. These particles collide with atomic nuclei to produce neutrons and in turn the latter bombard with nitrogen to form C-14 with the release of protons.

Now for the last two decades there has been a drastic increase of elephants being poached. Many governments have huge quantity of ivory and it is not clear how and when this ivory was obtained.

Using C-14 dating scientists can distinguish whether the ivory was acquired before or after the trade ban i.e 1989. The concentration of radiocarbon found in minute quantities of animal tissue can accurately determine the year the animal died.

Be-10 accumulates in ocean sediments; it can be used to date sedimentary rocks. Since 1 decay/min corresponds to 10^{12} atoms of Be. People have studied circulation of deep ocean layers and of underground water reservoirs with C-14 and Cl-36.

Geo-Chronology

Many radio nuclides used for dating rocks have half lives comparable to geological times. The oldest rock on earth is 3.3 billion years old, and the earth itself is 4.5 billion years.

Table 23.1 Radio-nuclides used in Chronology

Natural Radionuclide	Stable Nuclide Produced	Half-Life (Billion Years)
U-238	Pb-206	4.49
U-235	Pb-207	0.71
Th-232	Pb-208	14.1
Rb-87	Sr-87	50
K-40	A-40	1.3

Neutron Activation Analysis (NAA)

Basically NAA is a nuclear method to determine the presence of elements in samples in parts per million (ppm). The procedure involves the following:

1) Small quantities of the samples are rendered radioactive by bombarding them with neutrons for a certain period of time.

2) Then one counts them, following a suitable radioactive decay period. Ge semi conductor γ-ray detector is used coupled to a MCA.

The method is highly accurate, since using a neutron flux 1013n/cn^2/S one can detect in the range of 10^{-7} mg to 10 mg of an element for about 70 elements of the periodic systems. Due to its great detection sensitivity, the NAA method can be applied in medicine, biology, geochemistry, industry art, archaeology, environmental sciences and forensic chemistry.

The Detection of Gunshot Residue (SR)

Using the NAA test for the detection GSR requires analyzing moistened swabs of the back of the hands of a suspect for the elements like Ba, Sb typically present in the swab of the shooting hands in a minute quantity of 1mg. Normally results obtained from GSR analysis have been presented in count in several cases. Let us consider a stark example of the assassination of President Kennedy. The latter was shot and killed in Dallas on November 22nd 1963. The investigation reports conclude that the assassin was Lee Harvey Oswald. The conclusion was based on the following evidences.

1) The copper jacketed bullet specimens were analyzed for Sb, Ag, Cu and As.

2) The specimens were of one or the other of two.

There were two groups

i. One group consisted of specimen taken from Guenut Connolly stretcher and wrist which shows 815 25ppm Sb.

ii. Another group contains fragments from President Kennedy's brain.

Some fragments found in the car were also analyzed and it was seen to contain 622 20ppm. The two groups of specimens differed significantly in their Ag and Cu concentrations. It was established that

1) 2 Cu jacketed bullets recovered from 1st group were fired from Owald's revered 6.5 mm Mannlicher-Carcano rifle as corroborated from the analytical findings of the swabs at the back of his hand.

2) Oswald fired 3 shots out of which one missed the limousine.

3) The President was first hit in the back with the bullet ejecting harmlessly from his throat.

4) The President was then hit at the back of the head resulting in massive brain damage.

All these findings were found to be conclusive by the select committee at Washington in 1978, simply by basing on the technique of NAA. (There were conspiracy assassination theories that there could have been several assassins, however NAA has proved beyond doubt that Oswald alone is the assassin. This is because his prints on the rifles and the boxes, his clipboard, his paper bag, his photo with the rifle, most important is the analysis of the swab at the back of his hand using NAA technique tallies with the findings of the bullet specimens).

This is a sterling example of nuclear science in the public interest. NAA is truly the "queen of the physical evidence" in the Kennedy conspiracy assassination.

Arsenic-in-Hair Measurements in Arsenic Poisoning cases

For ages, As has often been used to poison individuals. If administered in large quantities, it can result in instant death. There is also slow death by As poisoning, if the poisoner adds small amount of As in the form of As_2O_3 repeatedly in the food or drink of the victim. This weakens the victim's body were long period of time and results in death ultimately.

The most famous studies of As using NAA of hair samples is that carried out on samples of Napoleon's hair by Hamilton Smith. Basically he took samples of Napoleon's hair that had been cut at various times when the latter was exiled on St. Helena. Each sample was cut into 3 mm length, activated then and counted on a Ge g-ray spectrometer (for 20 min) to detect the presence of radioactive As (26.3 hr As^{-76}). The levels were found to be quite high around 30 ppm As- as compared to a normal level of only ^{1}ppm As. The final verdict was astounding in the sense that As was used in those days as medicine, so As was given to Napoleon to cure his stomach illness. What the present day doctors found was that he had stomach cancer like his father and sister. The cause was the poor diet which lacked fruits and vegetables. His stomach was filled with a grainy substance indicating gastrointestinal bleeding. There was no evidence of haemorrhaging inside the heart which is closely associated with Arsenic poisoning. The verdict was path breaking and dispels the theory of As poisoning which was believed to be so, for quite a long time.

24

A Study of Nutritional Status Among Adolescent School Girls in Shillong

Sankar Goswami

Abstract

The study aims to assess the nutritional status of adolescent school girls in Shillong, India, by different levels of Body Mass Index viz., under weight, normal weight, over weight and obese, with respect to dietary habits and some socio-economic characteristics such as age, place of residence, religion, parents' education, ethnic group, etc. Primary data from 750 girls of age 11 to 18 years were collected from 10 schools by using the method of stratified random sampling under UGC sponsored MRP. In the study, 20.4 percent were found under-weight, 7.2 percent over- weight and 1.9 percent obese. The highest proportion of under-weight was found among the girls of 11 years and the prevalence of healthy-weight status was more among tribes (74.8%) than that among non-tribes (66.1%). Prevalence of under-weight status among primitive Khasi tribes was 16.7 percent. Pearson's Chi-square test indicate that age, religion, ethnicity, parents' education, total children ever born to mother, monthly family income and dietary habits (skipping breakfast, intake of fish, meat, milk, etc.) are significantly associated (p-value <0.05) with the nutritional status.

Keywords: *Adolescence, Shillong, Haemopoietic Nutrients, Ethnic and Religious Groups.*

Introduction

Shillong is the capital of Meghalaya, one of the smallest states in India and is the headquarters of the East Khasi Hills district situated at an average altitude of 4,908 feet (1,496 m) above sea level, with the highest point being *Shillong Peak* at 6,449 feet (1,966 m) [1]. It is said that the rolling hills around the town reminded the European settlers of Scotland. Hence, Shillong is also known as *Scotland of the East.* As per 2011 India census, Shillong has a population of 314,610. Males constitute 46% of the population and females 54%. Average literacy rate of 86%, higher than the national average of 63.5%: male literacy is 85%, and female literacy is 88%. Khasi tribes make up the majority of the population. All the other north-east Indian tribes, viz. Jaintias, Garos, Mizos etc. as well as a moderate number non-tribes making the city a fairly cosmopolitan.

Adolescence, a period of transition between childhood and adulthood and is one of the most dynamic periods of human development [2]. This period is characterized by an exceptionally rapid growth and is one of the most dynamic periods of human development. Physical, cognitive, social and emotional changes are observed during this period. These changes along with the adolescents' growing independence, search for identity, concern with appearance, need for peer acceptance and active lifestyle can significantly affect their eating behaviours and nutritional status. Rapid physical growth creates an increased demand for energy and nutrients. Nutrients are chemical components derived from food, which help maintenance of body function, body growth and protection of organs of the body; and nutritional deficiencies can lead to many far reaching consequences. Nutrient requirement varies according to age, sex, and phases of life. In girls, middle adolescence growth happens earlier (i.e. during 12-15 years) than in boys (i.e. during 13-16 years). Adolescent girls form a crucial segment of the society and constitute the vital bridge between the present generation and next [3]. In developing countries, anaemia is one of the glaring deficiencies in adolescent girls, probably due to low intake of haemopoietic nutrients since childhood and increased demand for nutrients coupled with menstrual loss of iron. So if their nutritional needs are not met, they are very likely to suffer from anemia and give birth to under-nourished children, thus transmitting malnutrition to future generation [4].

The objective of the study is to analyze the nutritional status of adolescent school girls of Shillong according to some socio-economic, anthropometric, demographic, physical activities and dietary factors.

Data Methodology

The study is based on the primary data of 750 girls of 11 to 18 years of age from 10 schools of different localities of Shillong. The data were collected using the technique of stratified random sampling. The information on anthropometric, socio-economic and dietary habits was taken and the sample data were analyzed to assess the nutritional status according to age, place of residence, religion, economic status of family, ethnic group, parents' education, mother tongue, food habits, physical activities etc. Different levels of BMI, viz. under-weight, healthy weight, over-weight and obese, was used as an indicator of nutritional status. BMI is calculated by dividing the body weight (in Kg.) by the square of height (in meter); and for children and adolescents, the BMI classification is gender and age specific. The 'CDC BMI-for-age growth chart', developed by National Centre for Health Statistics, USA, was used to classify the individuals into different weight-status categories. The growth chart shows the weight status categories used with children and teens by using age and sex specific percentiles. Descriptive statistics were used for estimation of parameters and Pearson's Chi-square test was used to assess the significant association of nutritional status with socio-economic, dietary and physical activities. SPSS software was used to analyze the data.

Results and Discussion

The study includes subjects from different ethnic and religious groups. Christianity constitutes the major religious group (45.9) among the selected students, followed by Hinduism (42.5%), Islam (7.3%), Sikh (1.2%), Khasi Religion (1.1%) and other. Amongst the sample girls, 50.8% were tribes and 49.2% were non tribes. The findings showed that 20.4 percent were under-weight, 70.5 percent healthy weight, 7.2 percent over-weight and 1.9 percent obese (Fig 24.1).

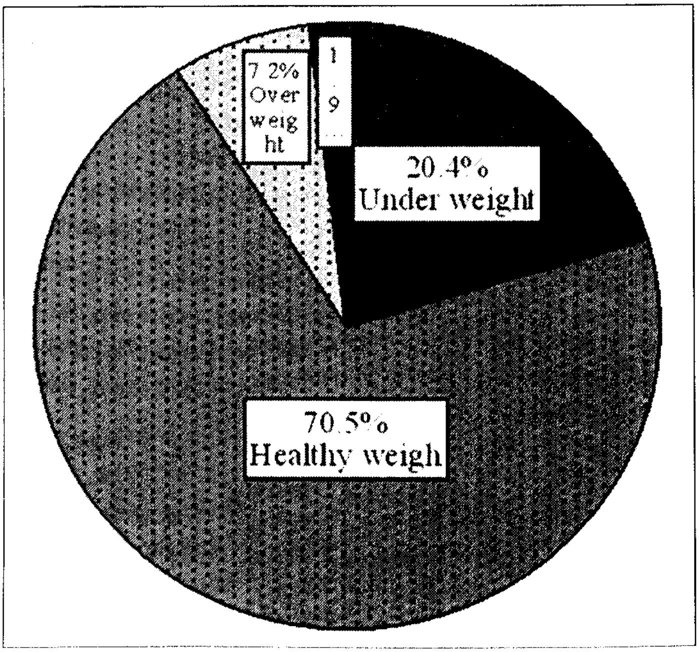

Fig. 24.1 BMI Status of Sampled Girls

The prevalence of under-nutrition among primitive Khasi tribes was found to be 16.7 percent and that for other tribes are as follows:

Percentage of under-weight Status

Jaintia = 6.8%

Garo = 8.0.

Manipuri = 12.5%

Mizo = 16.7%

Bengali = 17.6%

Assamese = 19.4%

Nepali = 27.3%

Hindi = 31.6%

Punjabi = 46.7%

Others = 16.0%

In the subsequent analysis, because of low cell frequencies, over-weight and obese groups were clubbed into one category. Table 24.1 to table 24.6 give an overview of the findings. The findings show that the highest proportion of under-weight status was from the girls of 11 years (40.4%) and the prevalence of under- weight girls are more among non-tribes (24.7%) than that among tribes (16.3%). As regards religion, the highest proportion of healthy weight has been found among Christians (76.5%) followed by Hindus (67.7%); and the highest proportion of under-nutrition was amongst Muslim girls. So far as dietary habits are concerned, only 5.7% of the sampled students are vegetarians and the proportion under-weight status is more among them (23.3%) as compared to that among non-vegetarians (20.2%). The findings indicate that 73.7 percent of the girls, who take milk every day, are of healthy weight states as against 70.1 percent who never take. About the habit of skipping breakfast, 10% of girls skip breakfast every day and 42.7% of them are of under-weight status as against 17.4% who never skip breakfast. In the study, only 13.3 percent of the girls go for exercise or morning walk everyday and the prevalence of healthy-weight status among them is more (72.0%) as compared to those who never do (70.0%).

Information about family income reveals that prevalence of under-weight status is more among the girls of comparatively low-income families and that of over-weight status is more among girls of higher-income families. Pearson's χ^2 test statistics reveal that age, religion, ethnicity, dietary habits, parents' education, family income and total children ever born to mother have significant association (p-values < 0.05) with the nutritional status.

Table 24.1 Age Vs. BMI Cross Tabulation

Characteristics	Nutritional Status			Total
	Under Weight	Healthy weight	Over weight and Obese	
Age (Years)				
Less than 12	21 (40.4%)	28 (53.8%)	3 (5.8%)	52 (100.0%)
12 to 13	57 (21.3%)	190 (70.9%)	21 (7.8%)	268 (100.0%)
14 to 15	44 (16.4%)	199 (74.3%)	25 (9.3%)	268 (100.0%)
16 or above	31 (19.1%)	112 (69.1%)	19 (11.7%)	162 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's, χ^2 = 17.476 with p-value 0.008			

Table 24.2 Religion and Ethnicity Vs. BMI Cross Tabulation

Characteristics	Nutritional Status			Total
	Under Weight	Healthy weight	Over weight and Obese	
Religion				
Hindu	75 (23.5%)	216 (67.7%)	28 (8.8%)	319 (100.0%)
Muslim	19 (34.5%)	30 (54.5%)	6 (10.9%)	55 (100.0%)
Christian	49 (14.2%)	263 (76.5%)	32 (9.3%0	344 (100.0%)
Other	10 (31.3%)	20 (62.5%)	2 (6.3%)	32 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 20.037 with p-value 0.003			
Ethnic group				
Tribe	62 (16.3%)	285 (74.8%)	34 (8.9%)	381 (100.0%
Non tribe	91 (24.7%)	244 (66.1%)	34 (9.2%)	369 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 8.485 with p-value 0.014			

Table 24.3 Food Habits vs BMI Classification

Characteristics	**Nutritional Status**			**Total**
	Under Weight	Healthy weight	Over weight and Obese	
Skip breakfast				
Every day	39 (51.3%)	33 (43.4%)	4 (5.3%)	76 (100.0%)
Sometimes	71 (18.8%)	272 (72.1%)	34 (9.0%)	377 (100.0%)
Never	43 (14.5%)	224 (75.4%)	30 (10.1%)	297 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 26.190 with p-value < 0.001			

Fish/ Meat consumption				
Everyday Sometimes Never	22 (11.1%) 117 (23.2%) 14 (29.8%)	150 (75.4%) 349 (69.2%) 30 (63.8%)	27 (13.6%) 38 (7.5%) 3 (6.4%)	199 (100.0%) 504 (100.0%) 47 9100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.971 with p-value 0.018			
Milk consumption				
Everyday Sometimes Never	28 (14.3%) 94 (21.3%) 31 (27.4%)	143 (73.0%) 311 (70.5%) 75 (66.4%0	25 (12.8%) 36 (8.2%0 7 (6.2%)	196 (100.0%) 441 (100.0%) 113 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.320 with p-value 0.402023			
Fruits consumption				
Everyday Sometimes Never	30 (14.8%) 118 (22.0%) 5 (50.0%)	158 (77.8%) 367 (68.3%) 4 (40.0%)	15 (7.4%) 52 (9.7%) 1 (10.0%)	203 (100.0%) 537 (100.0%) 10 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 12.177 with p-value 0.016			
Leafy vegetables consumption				
Everyday Sometimes Never	62 (17.0%) 79 (22.2%) 12 (40.0%)	270 (74.2%) 242 (68.0%) 17 (56.7%)	32 (8.8%) 35 (9.8%) 1 (3.3%)	364 (100.0%) 356 (100.0%) 30 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ^2 = 11.412 with p-value 0.022			

Table 24.4 Parents' Education vs. BMI Classification

Mother's education				
Below Primary Primary to incomplete Secondary Secondary or Sr. secondary Graduation or above	29 (27.9%) 59 (22.4%) 57 (18.8%) 8 (10.1%)	69 (66.3%) 180 (68.4%) 223 (73.4%) 57 (72.2%)	6 (5.8%) 24 (9.1%) 24 (7.9%) 14 (17.7%)	104 (100.0%) 263 (100.0%) 304 (100.0%) 79 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
		Pearson's χ2 = 16.912 with p-value 0.010		
Father's education				
Below Primary Primary to incomplete Secondary Secondary or Sr. secondary Graduation or above	3 (13.6%) 73 (29.9%) 66 (18.1%) 11 (9.2%)	17 (77.3%) 156 (63.9%) 270 (74.0%) 86 972.3%)	2 99.1%) 15 (6.1%) 29 (7.9%) 22 (18.5%)	22 (100.0%) 244 (100.0%) 365 9100.0%) 119 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's χ2 = 36.310 with p-value <0.001			

Table 24.5 Family Income vs. BMI Classification

Monthly family income (Rs)				
Less than 10,000	77 (29.3%)	171 (65.0%)	15 (5.7%)	263 (100.0%)
10,000 to 20,000	61 (20.2%)	221 (73.2%)	20 (6.6%)	302 (100.0%)
20,000 and above	15 (8.1%)	137 (74.1%)	33 (17.8%)	185 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's $\chi 2$ = 46.596 with p-value <0.001			

Table 24.6 Children ever born to mother vs. BMI

Children ever born to mother				
1 or 2 children	24 (14.0%)	127 (74.3%)	20 (11.7%)	171 (100.0%)
3 or 4 children	60 (18.8%)	230 (71.9%)	30 (9.4%)	320 (100.0%)
5 or 6 children	37 (23.6%)	110 (70.1%)	10 (6.4%)	157 (100.0%)
7 or above	32 (31.4%)	62 (60.8%)	8 (7.8%)	102 (100.0%)
Total	153 (20.4%)	529 (70.5%)	68 (9.1%)	750 (100.0%)
	Pearson's $\chi 2$ = 15.180 with p-value 0.019			

Conclusion

Malnutrition should be completely abolished. The gravity of the study makes it clear that there is a need of well planned strategy to prevent malnutrition among the adolescent girls of the city. In the time of planning, the importance should be given for proper socio-economic and dietary characteristics.

References

1. Official State Portal: Government of Meghalaya.
2. Chilmann S.M. and Nancy, M.C. (1994). Nutrition during Childhood and Adolescence and the later years, London: *Houghton Hiffin Company*.
3. Raman, L. (1992). Health and Nutrition Problems of Adolescent Girls, *Nutrition, 10, (5)*, Hyderabad: National Institute of Nutrition, 9-12.
4. Harrison, K.A., Fleming, A.F., Briggs N.D. and Rossiter, C.E. (1985). Growth during pregnancy in Nigerian primigravidae, *Br J Obstet Gynaecol, 92 (Suppl. 5): 32-39.*

25

Twin Challenges for University Science Curriculum: Balancing Immediate Job-market Relevance and Providing a Guiding Vision for Long-term Sustainability

Amartya Saha

Abstract

The role of an educational institution is to prepare and guide society towards a just, harmonious and ecologically sustainable existence in an ever-changing world. This role requires the continual adjustment of a balance between the guiding collective vision for a peaceful world and individual necessities of attaining meaningful life-sustaining employment upon graduation. The curriculum should help the student choose areas of specialization and impart practical skills relevant to the current/near future job market. At the same time, we all depend upon clean water, air and food to survive; hence it is imperative for each citizen to achieve a basic scientific understanding of Earth's processes that govern the availability of these life-critical resources. Here we propose a college-wide inter-departmental environmental monitoring program that will develop such an appreciation in a practical and enjoyable manner while developing data management, analysis and presentation skills using databases, Geographic Information Systems and publication techniques.

Keywords: *Science Curriculum, Job Market, Training Individuals, GIS, Case Study, Seminar.*

Background: The Dual roles of a University

The Role as Society's Guiding Stars

Universities have historically been conceivedas centers of academia and education that encourage free thought and research. The interdisciplinary and collaborative aspects of universities enable the development of holistic strategies to enable mankind to live harmoniously with each other and with the environment.

Science, that arises from observation of natural phenomena with an unbiased mind, is what allows society to develop methods to live more productively, such as machine development that frees us repetitive tasks, transport, technology, electricity, computers and information technology, medical science, agriculture and so on.The dawn of scientific endeavors coincides with the dawn of humanity.However, the past century has seen a very high use of resources that has in turn led to deforestation and destruction of ecosystems and habitat, pollution of land, air and water and enormous social upheaval. Yet, it is largely science that is showing ways to use resources more efficiently, tackle pollution, manage watersheds to minimize destruction, reuse, renewable energies etc.

The Role for Training Individuals

Universities have another critical function: they also serve as higher education centers for various vocations that are needed for society to function. Getting a meaningful job that ensures financial stability and career growth is the main aim of students and their families. With the job market changing rapidly and being linked to global forces and events, the opportunities and skills keep shifting, requiring university curriculum to keep pace.

Reconciling the two roles

The challenge of a university education then is to provide meaningful job-relevant training as well as a broader universal understanding of basic science, since this understanding isextremely necessary for each citizen to be able to lead and rally for a sustainable manner of living.Many environmental problems arising from human consumption of resources and attendant pollution can be decreased significantly with public awareness of exactly how their activities affect the environment.

On first view, it may seem that these two objectives aren't compatible, especially as they involve different time scales. However, the opportunity lies in designing a program that inculcates concepts of basic science in every student from an applied hands-on perspective without adding any academic burden on both faculty and students.

This paper proposes a campus-wide eco-hydrological monitoring program as such a vehicle to impart basic science concepts as they apply to land and water, critical resources that sustain life. Monitoring programs are emerging as an effective way to engage communities to understand and thereby protect their natural resources, whether water, land or wildlife. Furthermore, the program also imparts tool skills in sampling, data collection and analysis, database management, Geographical Information Systems (GIS), presentation/publications and proposal writing. The program is intended to involve students from all programs of education, whether basic sciences, engineering/technology, medicine, law, social sciences, the arts, finance and business administration, albeit to different extents that is meaningful to the students' areas of specialization.

Ideally a university education not only imparts a set of employable skills but also leaves a deep impression of the fragility of our ecosystems, the limited amount of our natural resources and the dangers of unbridled consumption. If students (the next generation) gain a genuine respect for the earth, the program will have achieved its purpose.

Programme description

In brief, the program will have three components:

A short **seminar series** on basic environmental sciences taken by students from all areas (three 1 hour sessions).

Monitoring Programme

Hydrological monitoring, ecological monitoring, data collection and database management, data analysis and GIS, publication and presentation of results.

Links with meteorological offices and scientific institutions, other universities and colleges and schools, outreach with NGOs and community organizations.

Visualize eco-clubs collaborating with scientists, professionals and society.

Seminar Series

"Where does stuff come from: man-biosphere linkages".

Objective: to understand the sources of materials consumed by society, the impacts upon ecosystems of the production of our consumption items, and the ways we can conserve at an individual level to lessen the impact.

Seminar Components

Introductory film: The Story of Stuff. This is a 10-minute documentary available on youtube that beautifully illustrates how the manufacture, use and disposal of everyday consumption items, such as bottled water or a box of cereal require resources and creates impacts on from various sectors. This is the first step in analyzing the product cycle and thereby working out ways to decrease waste in production and negative environmental impacts upon disposal.

The discussion explores the concepts of limited resources on our planet along with the processes in nature such aswater and nutrient cycles that illustrate the flow of materials and processes in tight recycling loops in the biosphere. The discussion then explains the necessity of designing human activities to follow closed loops to minimize waste in packaging and production thereby decreasing the need for new mines or logging forests for raw materials.We see how intertwined various sectors are, such as agriculture (organic, high chemical input), water supply, treatment and disposal, transport and distribution systems and the energy sector.

Case Studies

Bottled water, local vs imported food, laundry, public transport. Students can select a consumption item (such as fruit juice) or a process (such as waste management in trains) and research the product cycle, from creation of the product to eventual disposal, analyze the possible impacts upon the environment, and then suggest ways to improve the 'green' quotient of the product. They can write a short 2 page report along with a poster that follows an international conference format, thereby preparing students on how to effectively present information. These posters can be displayed on a campus-wide event open to the interested public, possibly on occasions such as April 22, Earth Day.

Campus-based Eco-hydrology Monitoring Programme

Community resource monitoring programs have been found to be extremely effective in inculcating a sense of understanding and ownership of local natural resources. Such programs are being increasingly formed worldwide. A program can be started on campus that monitors local water resources and the processes that affect water quality and quantity. The steps are measurement, data analysis and outreach.

Hydrology monitoring

This comprises of daily rainfall, evaporation and water level measurements, data entry, database design and management followed by analysis. These data will be used to examine the seasonal variability of the parameters using methods of data analysis and interpretation. Table 25.1 summarizes a basic set of hydrology parameters.

Table 25.1 Basic Hydrological Parameters in a Community Water Monitoring Programme

Parameter	Frequency	Method	Output
Rain	Daily	Rain gage	Seasonal and inter-annual patterns
Water level	Daily	Staff gage	The above, plus rainfall-runoff
Evaporation	Daily	Pan evaporation	Estimating evapotranspiration in the absence of weather station data

Rain gages can be constructed very simply from plastic water bottles with the top cut and inverted to form a funnel, and the side graduated with waterproof marker pen. At least three gages can be positioned around the campus to examine for the spatial heterogeneity of rainfall.

Staff gages can be installed in lakes and streams in the watershed where the campus is located. The design of staff gages depends upon the volume and flow velocities of water and can range from a simple painted wooden gage set into the stream or lake bed, to a painted metal bar anchored with concrete and reinforced steel rods into the river bottom. Ratings curves can be developed for sites with staff gages in order to calculate stream discharge. This data can then be used to observe the linkage between rainfall and runoff in the catchment, which is greatly affected by land use. For instance a forested catchment will have lesser flash floods following intense rain events and greater flows in the dry season as compared to a watershed that has been deforested.

Evapo-transpiration (ET) is a significant part of the water balance of a catchment of forests. At the same time, there is no way to measure ET for forests; one can only estimate ET using a variety of techniques, that vary in complexity. The most widely used methods (Penman-Montieth, Priestley-Taylor models etc) require weather station data (net radiation, wind speed, relative humidity and air temperature). However, in areas without weather station data availability, one can get local conditions from daily pan evaporation measurements (that measures evaporation only) and then estimate evapo-TRANSPIRATION by using a pan coefficient. This coefficient can be obtained on a first pass by comparing evaporation values with ET estimates from a global ET dataset (such as www.modis.org).

Data collection and analysis

Students can be exposed to methods of data collection, formatting and storage, by emphasizing the need for a uniform format to increase usability and transferability of the data. Data quality control and assurance steps (QA/QC), the design and management of a database and data backups form integral parts of a data management strategy. By actually doing these, students get hands-on training in these important Information Technology and Management concepts.

Hydrological Analysis

Each of the parameters in Table 25.1 can be formatted, QA/QC'ed and plotted to examine the variability with time, especially on a monthly and seasonal level. Once there is a multi-year data set, time series analysis can reveal inter-annual patterns. Indeed, Cherrapunjee being one of the rainiest places on the planet historically, there are long-term data sets that can be used to demonstrate how to conduct a time series analysis, and correlate with climate tele-connections such as the El Niño.

Parameters can also be combined to observe the connection between rain events and runoff in streams, as well as form a water balance for the basin. Water balances or water budgets give an idea of the water that is available in the catchment and how that varies seasonally.

Ecological Monitoring

The assessment of water quality and the overall health of aquatic and riparian ecosystems is increasingly being based upon the periodic monitoring of aquatic macro-invertebrates in streams. Aquatic macro-invertebrates are the larval stages of insects such as mayflies, stoneflies, dragonflies, caddisflies, damselfliesetc that reside underneath stones on the streambed. They form an important prey source to amphibians and fish. Excessive sedimentation in streams arising from deforestation and the lack of soil conservation in watersheds results in choking the spaces between riverbed stones, thereby removing habitat for the aquatic macro-invertebrates, with attendant negative effects on fish and amphibians. Hence the presence of diverse communities of these macro-invertebrates indicates a healthy aquatic ecosystem thus reflecting upon the catchment's capacity to sustain life. While water quality chemical parameters such as pH and Dissolved Oxygen allude to specific aspects of water quality, monitoring invertebrates offers a holistic view of the life support capacity of an aquatic ecosystem.

To develop a monitoring program for a region, one has to note the species and abundances of aquatic macro-invertebrates present in a pristine or un-impacted stream reach, such as streams flowing through a forested watershed. These observations form the reference data set, to which observations in other areas are then compared against. Students specializing in botany, zoology and environmental sciences can be encouraged to carry out these surveys in the rainy and dry seasons in streams across the local catchment. If there are not any forested watersheds in the local catchment, a trip can be organized to a suitable area.

Dissemination of Information

After data has been processed and analyzed into information, the next step is to disseminate the information periodically, by means of publications, reports and web pages. The publication aspect can be an annual project for students, in addition to poster presentations held as an annual event on campus, as described earlier in the seminar series section.

Outreach

The existence of a monitoring program on campus facilitates connections with local meteorological office and other government and scientific institutions that have weather stations, in order to connect with data in the broader region. Links can also be made with schools that are interested in starting monitoring programs to practically teach water cycle and graphing concepts to their students.

In the end, the ideal vision is to have different organizations form a network of monitoring stations. Such a network can result in a high resolution spatial data that can help water resource management agencies in better manage local watersheds, but more importantly actively involves the public in participation. In that regard it is the colleges and universities that are uniquely positioned to facilitate such active social participation, thereby pave the way for informed social awareness of our common resources that is the requirement of a functioning democracy.

Conclusion

In this paper we have seen how a simple campus-wide monitoring program and seminar series can achieve multiple objectives of imparting:

1. basic science awareness as related our natural resources
2. data collection, management and analysis skills
3. presentation and publication skills
4. outreach with other organizations

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Information Technology as a New Dimension in Entrepreneurship

Donna Rica Diengdoh

Abstract

As we step into the new millennium's century and recount what Information Technology (IT) in the field of information revolution has contributed, all of us those who know about it can visualize its wonderful or tremendous challenges and opportunities through diversified education to meet job prospects. We can convert the challenges into opportunities to ensure job prospects through the internet to communicate with thousands of people in a few seconds. There is also Inter-media (merger of internet with multimedia), net Fusion (merger of network with object), and web Data Base (merger of web computing through Electronic Commerce (e-commerce) or e-business. Government operation through e-governance, education and learning are through e- education. Information Technology in a fundamental sense is a man- power planning aimed at equipping people right from childhood the sense for bringing changes in our society and social life. It aims at creating intellectual awareness of our economic, social, political and cultural ethos. Today the information society is passing through various new challenges and new job opportunities such as information professional skills information, management skills and up-to-date subject knowledge which provide new dimensions in business and industry in a productive way.

Keywords: *Entrepreneurship, Information Technology, e-technology.*

Introduction

Entrepreneurship is one of the main indicators of economic development in the context of privatization, liberalization and globalization of Indian economy. Without entrepreneur, there is no development of enterprises. The dictionary meaning of the word "entrepreneur" according to Oxford Encyclopedic Dictionary is "Organizer, Manager, of (esp. musical), entertainments; managers one who undertakes an enterprise, especially contractor acting an intermediary between capital and labour.

Entrepreneurship is a creative human act. It creates new things or adds new value to the existing one. It involves mobilization of resources from one level of productive use to a higher level of use. Entrepreneurship involves a willingness to take responsibility and ability to put mind to task and see it through from inception to completion. Another ingredient of entrepreneurship is sensing opportunities, while others see chaos, contradiction, and confusion. Essence of entrepreneurship is going against time with maturity and serving as a change agent. Entrepreneurship is an outcome of the development process, which also encompasses the emergence of economic and social innovations.

We have seen tremendous changes in the field of information technology. Different organizations are using Information Technology in different fields of their business. This gives a chance to establish IT industries big or small. Today we have seen the new revolution based on Information Communication Technology (ICT). The computer has evolved from being a number crunching calculator in the 1950's to a data processor in the 1960's; a tool for information management in the 1980's, communication in the 1990's and now to better manage knowledge in the new millennium. Coupled with the pervasive nature of the internet and multimedia, a new digital economy has emerged which is set to change the nature of human civilization. The digital economy gave rise to new electronic business or e-business as the process of using web technology to help business streamline processes, improve productivity and increase efficiencies.

Information Technology (IT) in the field of information revolution has contributed, all of us who know about it can visualize its wonderful or tremendous challenges and opportunities. Today we draw upon the internet to communicate with thousands of people in a few seconds. There is also inter –media (merger of internet with multimedia), fusion (merger of network with object), and web DB (merger of web computing with database) etc. Business today is conducted through Electronic Commerce (e-commerce) or e-business; Government operations through e-governance, education and learning through e-education.

Information has become an essential ingredient for the progress of civilization and society for all times. Entrepreneurship constitutes an integral part of our national economy, and plays an important role in the economic development of our country. Identification of information needs and the sources of obtained information regarding production, marketing, emerging new technology and technical know-how etc. are important if one has to plan for the development of such industries.

In India, entrepreneurship development has been considered as a strategy for achieving the twin goal of solving the present burning problem of unemployment particularly among the educated youths and also for rapid industrialization. It may be said that entrepreneurship and economy go side-by-side and bears the relationship of cause and effect. One can sum up as "an economy is an effect for which entrepreneurship is the cause". Development of information technology ensures accelerated employment. For instance, high literacy intricate capabilities work force is as reflected in their traditional fine handloom products of the state, pleasant and agreeable climate of Meghalaya are all conducive for the development of electronics. The only need is to train them properly by giving exposure to modern computers, computer programming and designing.

There has been lack of awareness among educated youths on discounting entrepreneurial opportunities. The socio-psychological attitude towards industrialization has also been hindering entrepreneurial development. Entrepreneurs need a package of services at different stages like stimulatory, support and sustaining which are applied in the environment conducive to entrepreneurial growth. A good entrepreneurial growth on the other hand is possible only when the various components of entrepreneurial environment such as political, economic, social and technological, cultural etc. are in synchronous manner.

Information Technology as an Aid to Entrepreneurs

Entrepreneurs generally face various types of problems. Many of these problems can be solved with the assistance of Information Technology. Some of such problems are listed below:

(i) Search for a viable project
(ii) Product identification and analysis
(iii) Acquiring professional competence
(iv) Preparing the blueprint of the project
(v) Search for a financier
(vi) Fund management
(vii) Choose a proper technology for production, warehousing, distribution (marketing) functions
(viii) Technology transfer, counseling and legal formalities
(ix) Selection of man power
(x) Creating information network

(xi) Motivating the people for better efficiency

(xii) Managing distress that may confront the process

(xiii) Knowledge of managing risks and uncertainty

(xiv) Creating an environment for adoption of modern technology

(xv) Preparing the people to accept the change

(xvi) Establishing global linkages

All entrepreneurs are faced with one or more of these adversities at some point of time. But he/she is expected to convert every adversity into opportunity. In the solution of the above problems information technology can be of great help. During the last decade, e-technology or e-activities (e-learning, e-communities, e-commerce, e-management, e-marketing, e-governance, tele-working, etc.) has developed at a very fast rate in the new millennium and is considered as one of the essentials of human life. Electronic equipment like computer, e-type writer, e-watches, and wireless telephones and so on has developed with unimaginable speed. India has taken very powerful steps towards e-world which has heralded the new millennium. While global markets continue to be lucrative, the domestic market is also growing. India is strongly positioned to benefit from the wave of electronic industrial and social restructuring.

Table 26.1 Components of Entrepreneurial Environments

Sl.No.	Political	Economic	Social	Technological	Cultural
1.	Political atmosphere	Economic policy	Consumers and Risk	Competition	Aspirations
2.	Quality of leadership	Labour	Labour	Efficiency	Values
3.	-	Trade	Opinions	Productivity	-
4.	-	Industries	Motives	Profitability	-
5.	-	Subsidies	-	-	-

The Effect of Information Technology

Job and being employed have been considered as the most necessary factor for human survival since ancient times. It is actually not only a source of economic survival but also an integrated part of one's social identity. Employment plays such a vital personal, economic and social goal that it is regarded as an indicator for every government's success and programmes. In the over populated world in the new millennium in which the unemployment rate is prone to be on the rise, it has turned to be the most serious challenge for governments.

Consequently, they are trying different strategies to decrease the unemployment rate. It is the reason why "Entrepreneurship" has become a buzzword in the country and the government is spending a hefty amount of money on it through different activities. With the changes in businesses today, information technology (IT) plays a vital role in business survival. Information has become one of the main assets in information era. With the advent of information technology, the unique invention contributed highly in various aspects of human endeavour.

Entrepreneur may not be a technical person but he must be able to determine the level of technology required for the enterprise at every step of the progress. The future will see entrepreneurship, as a key driver of economic development. The role of information technology in entrepreneurship has been studied in some parts of the world. Many factors have been identified as being associated with entrepreneurship. For e.g., entrepreneurial individuals combine many personality traits- innovativeness, risk taking, managing in the sense of doing what is necessary to realize their ideas combined with shouldering responsibility for success of failure.

Information Technology in a fundamental sense is a man power planning aimed at equipping people right from childhood the sense for bringing changes in our society and social life. It aims at creating intellectual awareness of our economic, social, political and cultural ethos. Indeed, Information Technology is the basis of all planning, all development and all progress. As such Information Technology should lie at the base of efforts to forge bonds of common citizenship, harness energies of young aspirants and to develop natural and human resources of every part of the country. The social change involves the transformation of society from traditionalism to modernism, from backward and apathetic ignorance to active enlighten. In other words, Information Technology in entrepreneurship brings about new awakening in the masses with regards to their rights, duties and responsibilities towards society. Therefore, the use of Information Technology in entrepreneurship can bolster new waves. It can enhance and enrich the innovative skill of the common people.

References

1. Batra, B.B. (ed.) (2001) Information Technology: Challenges and Opportunities, Delhi, Kalpaz Publication.
2. Covin,J., and Slevin, D. (1991) A Conceptual Model of Entrepreneurship as Firm Behaviour? Entrepreneurship: Theory and Practice, Vol. 16, 7-25.
3. Morris, M.H.,and Sexton, D. (1996) " The Concept of Entrepreneurial Intensity: Implications for Company Performance", *Journal of Business Research*", Vol.36 No.1, 5-13.
4. Prasain, G.P. (ed.) (2006) Entrepreneurship and Small Scale Industries, Delhi, Akansha Publishing House.
5. Preeti, M. (2004) "Technological Impact on Information Technology: Prospect for India" *Centre of Excellence.*

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Innovative Methods of Teaching – A Better Tool for Learning

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Abstract

Innovative teaching methods include using of multimedia tools such as texts, images, audio and video, into an integrated multi-sensory interactive application or presentation to convey information to an audience. A traditional education method generally involves a black board and chalk which is one way of imparting information to the audience. In the present study, a comparative assessment on the student's performance through the innovative tools of teaching methodologies and traditional methods of teaching were used. The present findings show that the student performance percentage was higher in those groups of students who receive the innovative method of teaching as compared to the other groups who were taught by the traditional method of teaching. Therefore, based on this study it may be concluded that the use of innovative methods of teaching in educational institutions has the potential not only to improve education, but also improving students understanding abilities, increase in interaction with the teachers, their views in their subject matter and finally improving their grades.

Keywords: *Innovative teaching methods, Traditional education methods, Multimedia tools, student performance percentage, Improve education, Interaction.*

Introduction

Education is an engine for the growth and progress of any society. It not only imparts knowledge, skills and inculcates values, but is also responsible for building human capital which breeds, drives and sets technological innovation and economic growth. Basically teaching must include two major components sending and receiving information. Ultimately, a teacher tries his best to impart knowledge as the way he understood it. So, any communication methods that serve this purpose without destroying the objective could be considered as innovative methods of teaching.

Lectures can be traced as far back as the Greeks of the fifth century BC, and in medieval times lectures were the most common form of teaching (Brown and Atkins, 1988). Therefore, the lecture has its merits, otherwise this form of teaching would have ceased.

The 'Chalk and Talk' had been the staple pedagogical approach of teaching Practice. This form of traditional practice created an environment where students were passive recipients of information. In such a lecture students assume a purely passive role and their concentration fades off after 15-20 minutes. But this method of teaching has various limitations; teaching in classroom using chalk and talk is "one way flow" of information besides the teachers often continuously talk for an hour without knowing students response and feedback; the material presented is only based on lecturer notes and textbooks; there is insufficient interaction with students in classroom; more emphasis has been given on theory without any practical and real life time situations; learning from memorization but not understanding.

On the other hand, with the advent of modern technology, computers are used to communicate information to students in a timesaving way, to teach critical thinking and problem solving, to provide simulation to reality and to educate from a distance. In recent times the use of electronic media has become commonplace in Universities, as well as secondary and primary schools. Recent studies have sought to determine whether using PowerPoint or other such media are superior forms of delivery for lecturing over the traditional 'chalk and talk' or the use of transparencies and an overhead projector (Bartsch and Cobern, 2003)

Aim of the Study

The aim of the study is to evaluate the traditional methods of teaching as well as multimedia teaching and to examine the student's performance and effectiveness of replacing classroom 'chalk and talk' with innovative classroom teaching (ICT). This brief research paper looks at the impact of technology on learning and teaching and the extent to which Innovative classroom teaching (ICT) is being used to promote the development of the students; to support the idea that innovative teaching and learning methods is a way to translate the enthusiasm of teaching to students' enthusiasm to learn and that can be attempted in imparting knowledge to the students.

Design and Method

The hypothesis to be tested was that innovative educational tools such as using of audio, visual are more effective in student's learning over the traditional chalk and talk methodologies. In the present study we used 'two groups, static design (post-test only)'which utilizes two groups, only one of which is exposed to the experimental treatment. The other group which is not exposed to any experimental treatment acts as the control group and this permits the comparison that is required in this investigation. We assume the two groups to be equivalent in all relevant aspects at the start of the experimentation. There is no pre-test and the dependent variable measures for the two groups are then compared (post-test).

Comparison is made between two colleges where in one the conventional methods is used i.e., the chalk and talk against another group of in another students in using the modern (ICT). To evaluate the effectiveness of using modern technologies (new method) in teaching students of XII standard (Science), two equivalent groups of Class XII students were selected. One group in one college were taught by the new method and another group of Class XII students in another college were taught by the conventional method. Selected topics were chosen and both the groups were taught for a period of time.

To assess the effect of this change in teaching practice, we recorded exam scores such as responses of the students through test scores and an achievement test were obtained for both the groups at the end of each lessons keeping in mind that same set of questions were administered to both the experimental group as well as the control group and a comparison was made on the achievement of the students of both the groups through their scores. The mean of the post-test (T2) is computed.

Both qualitative and quantitative instruments of measurement were used to collect data. The quantitative method used, entailed the use of a self-administered questionnaire to both the groups. To obtain additional information (qualitative methods), interviews and interactions with the students were conducted.

Statistical Analysis

ANOVA was performed at $p < 0.05$ to check the significant difference between the means for different marks obtained by the students through Chalk and Board and ICT methods of teaching and confirm their validity using SPSS 17.0. The data were all presented as mean ± standard deviation of three class test.

Results and Discussion

Two types of teaching techniques were performed i.e., Chalk and Board and ICT methods of teaching to test the performance of 50 (fifty) students in a class by conducting a 3 (three) class test based on these two teaching techniques. Table 27.1 summarised the range of number of students and the average marks obtained by the group of 10 (ten) students through these two teaching teachings. It was found out statistically that both the teaching techniques are significantly different at $p<0.05$ in the test conducted which shows that all the 50 students performed well in the entire 3 test conducted. The marks obtained in the ICT technique of teaching by the students is much more higher as compared to the Chalk and Board technique of teaching which shows that through ICT technique of teaching the students has a better grasp and understanding of the topic.

Table 27.1 Marks obtained by 50 (fifty) Students through Chalk and Board and ICT Methods of Teaching

No of Students	Marks obtained	
	Chalk and Board method	ICT method
0-10	10.1±1.8***	15.9±1.7***
11-20	12±1.7***	15.7±1.7***
21-30	11.3±2.1***	13.2±2.8***
31-40	10.5±2.3***	15.7±2***
41-50	11.6±2.2***	15.7±1.3***

Data are represented in Mean ± SD and * $p < .05$ ** $p < .01$ ***$p<.001$

Chalk and Board method of teaching are verbal presentation given by a teacher but with the advancement of training systems and computer technology the ICT method is economical and can be used to a large number of students, lectures can be covered in a structured manner and the teacher has a great control of time and material. In the present study, it was found out that the maximum number of students (Table 27.2) have better marks obtained through ICT technique of teaching as compared to the Chalk and Board method of teaching.

Table 27.2 The Number of Students (in percentage) obtaining Marks at Different Ranges through Chalk and Board and ICT Methods of Teaching

Range (in marks)	No of Students (%)	
	Chalk and Board method	ICT method
0-5	0	0
5-10	36	2
10-15	52	40
15-20	12	58

The classroom lecture is a special form of communication in which voice, gestures, movement, facial expression and eye contact can either compliment or detract from the content. McCarthy (1992) and Davis (1993) stated that strength of lecture methods that represent facial material in direct, logical manner, contains experience which inspires, stimulates thinking to open discussion and useful for large groups. In the present study, it was found that most of the students preferred ICT methods of teachings in which the students performed much better in the test conducted where 58% of the students score the more marks in the range of 15-20 marks (Fig 27.1).

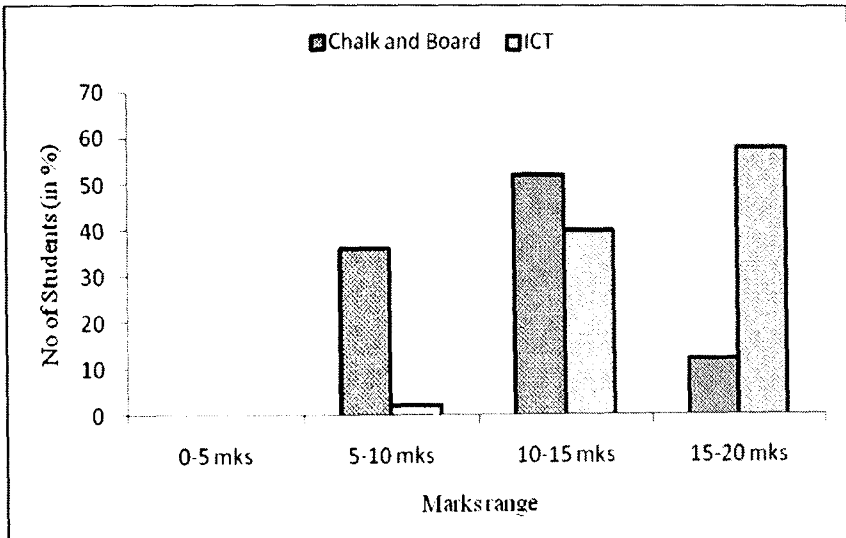

Fig 27.1 Performance of the Number of Students (%) through Chalk and Board and ICT Methods of Teaching

On an average as depicted in Table 27.3 the average of all the three test conducted it was found out that in all the test it was found out that the ICT method of teaching have a marked influence on the students performance in their understanding, grasp of the topics and performance in the test conducted as compared to the chalk and board method of teaching.

Tables 27.3 A Comparison on the 3 (three) Test Average obtained by 50 (fifty) Number of Students through Chalk and Board and ICT Methods of Teaching

Total no of Students	Total Marks (per test)	Ist Test Average		IInd Test Average		IIIrd Test Average		Total (in Average)	
		Chalk and Board method	ICT method	Chalk and Board method	ICT method	Chalk and Board method	ICT method	Chalk and Board method	ICT method
50	20	11.36	14.72	11.38	15.76	10.66	15.78	11.13	15.28

Conclusion

The educational material is the information or message. The student is the receiver of the information. An array of new technologies can be applied in the classroom to replace traditional chalk and talk teaching methods. The present findings clearly shows that through chalk and board method of teachings most of the students got an average of 10-15 marks as compared to ICT method of teaching where majority of the students performed much more far better in the test conducted. These findings in the present study, shows that through ICT method of teaching attribute to the student's better understanding, ease in grasping of the topic and expressing their point of view. Thus, it can be concluded that through ICT methods of teaching such as powerpoint presentation accompanied with audio and visual aids are more effective in capturing the response of the students and their understanding as compared to the traditional method of teaching.

Acknowledgments

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References

1. Bartsch R.A and Cobern K.M. (2003), Effectiveness of PowerPoint presentations in lectures, Computers and Education, 41, 77-86.
2. Brown G. (1978); Lecturing and explaining, Methuen, London.
3. Brown G and Atkins M. (1988), Effective teaching in higher education, London, Routledge.
4. Davis B.G (1993). Tools for teaching. Jossey Bass Publishers, San Francisco.
5. McCarthy P., 'Common Teaching Method', 1992, http://honolu.edu/intranet/committees/facDevCom/guidebk/teachtip/comteach.htm. *(visited on 08.06.2013) 08.*

28

Powerpoint Presentation: College and University Teachers' Proficiency and Competency in Teaching

Quendarisa Kharbuli
Baphimon Rynjah

Abstract

Information Communication Technology (ICT) is a diverse set of technological tools and resources used to communicate, to create, disseminate, store and manage information. A central stand of Information Communication Technology (ICT) policy in education has been the development of a technologically empowered teaching force. Microsoft PowerPoint Presentation has become a generic name used when describing slideware applications. This trend is consistent with the increased use of PowerPoint as a presentation and teaching tool in traditional instructional setting including Science content areas and Science education. This paper reports on an observational study which examines the level of technological proficiency through PowerPoint slides of teacher trainees who attended the Orientation Programmes conducted by the UGC-Academic Staff College North-Eastern Hill University, Shillong, Meghalaya, from 2009-2013. The subject of the study consists of 240 Assistant Professors and Librarians of Colleges and Universities from different states of the country. SPSS was used to analyze the data obtained in the study. Findings on this study contribute to our understanding on the computer proficiency and competencies and identification of training needs, in order to embed ICT in teaching and learning.

Keywords: *ICT, Power Point Presentation, Teacher Trainee, Science Education.*

Introduction

The use of computer technology as an innovative method of teaching and learning is a prominent topic in higher education research. Researchers and Instructors could provide feedback through innovative pedagogical explorations on its potential in improving teaching and learning. Incorporating educational technology or computers and technology as part of many teacher training programs has been realized by a number of educational technologist (Hargrave & Hsu, 2000; Northwest Educational Technology Consortium [NETC], 1997; Office of Technology Assessment [OTA], 1995; Smith, 2001). Information regarding teachers' use of technology in the classroom is valuable to educational technologists, teacher educators, and trainers of teachers in in-service settings. Self-reported survey data from teachers have led to suggestions for designing technology training for teachers (Kopcha and Sullivan, 2007; Niederhauser & Stoddart, 2001; Russell, et., 2003; Yildirim, 2000) and the government and researchers (Bober et al., 1998; Niederhauser & Stoddart, 2001; Whetstone & Carr-Chellman, 2001; Yildirim, 2000) have relied on such reports to inform and direct the training of teachers in educational technology practices. One of the readily available computer assisted instruction that could contribute to innovative teaching is the computer–generated slide presentation. Recent technological innovations have made it possible for non-technical individuals to make computerized multimedia presentations which include the use of text and multimedia effects such as graphics, sound, and animation (Klinger and Siegel, 1996; Rankin and Hoaas, 2001). The market leader in computerized multimedia presentations is PowerPoint, part of the Microsoft Office productivity suite (Lindstrom, 1998). Through this paper we attempt to provide insights on the impact that training has on the proficiency and competency of the College and University Professors in their application of the computer generated slides.

Method

Orientation Programmes are conducted for new entrants at the level of Assistant Professors and Librarians of College and University by Academic Staff Colleges (ASC) set up through a scheme by the University Grants Commission in 66 Universities in the country. Amongst its many objectives to enhance the quality of higher education, a bigger thrust has been given, to promotion of computer literacy as well as use of ICT in teaching and learning process. The subject of this study includes, 240 College and University teachers from different states of the country who attended the seven Orientation Programmes coordinated and trained by the authors in the ASC-North-Eastern Hill University during the year 2010-2013. Before the start of the course, the teacher participants were informed about the Seminar Presentation as one of the components for evaluating the teacher trainee, and were encouraged to come prepared for their presentation in

PowerPoint. In the initial Orientation Programmes (7th and 10th) no training on PowerPoint was integrated in the 24 working days course, but sessions on PowerPoint were introduced in the subsequent Orientation Programmes. The data generated concerning the use of PowerPoint as a presentation and teaching aid is through the observation of teacher trainee presentations' in these Orientation Programmes. The items selected for the study in anticipation of their reflection on the quality of presentation with the introduction of training are:- (i) users and nonusers of computer-generated slides for presentation; (ii) PowerPoint presentation users with reference to teaching experience; (iii) Application of slide presentation of participants from different disciplines; (iv) Text Presentation; (v) Static or Dynamic Presentation; (vi) Animation; (vii) Graphics; and (viii) Number of Slides presented for ten minutes duration. The data obtained were analyzed using SPSS 20.

Results and Discussion

The results obtained in percentage for each selected item are represented graphically by bar diagrams and tables. For the users and nonusers the graphical representation (Fig. 28.1), shows that with the introduction of ICT training in subsequent Orientation Programmes there has been an increase in the number of

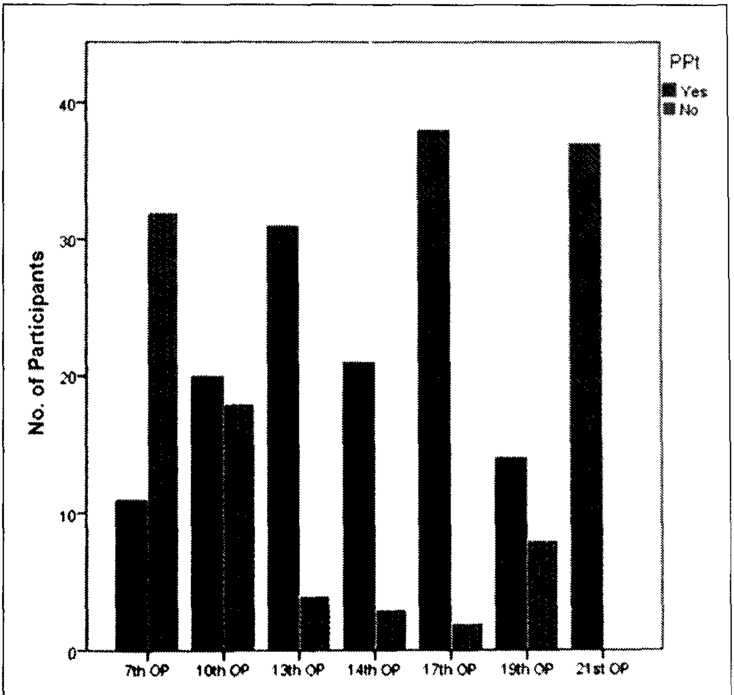

Fig. 28.1 Seminar Presentation using Power Point

users of slide presentation. It was found that with the 21st Orientation Programme it was 100%. The chi square value of 83.26 is significant at $P<0.0001$. Recent survey to collect information regarding teacher practices with instructional design and technology reported that teachers who received computer training as part of educational technology course integrated computers into their lesson plans and found that the technical support for the use of computers by teachers improved teacher attitudes regarding the use of computer technology in the classroom.

The years of teaching experience of these participants range from a few months to 25 years. As reflected in the table (Table 28.1) provided below, the number of users in relation to the number of years of teaching experience, our observation is that the new entrants with 0-5 years of teaching experience are most competent and proficient with technology while with more years of teaching experience the percentage shows a sharp decrease in their competency and proficiency. The chi square value of 11.57 is significant at $p<0.05$.

Table 28.1 PPt * Experience Cross tabulation

			Experience					Total
			0-5	6-10	11-15	16-20	21-25	
PPt	Yes	Count	114	26	13	6	4	163
		% within PPt	69.9%	16.0%	8.0%	3.7%	2.5%	100.0%

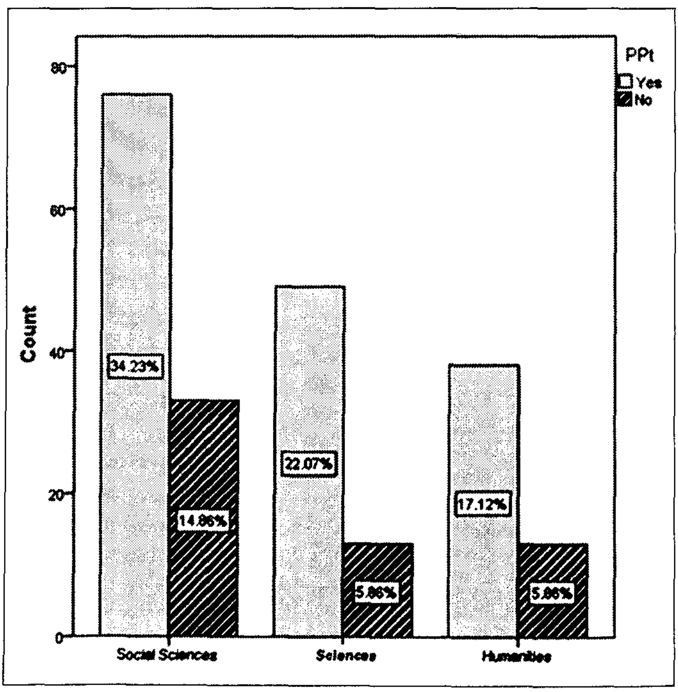

Fig. 28.2 Power Point Presentations by Different Schools

The data (Fig. 28.2) obtained for users of PowerPoint in relation to the Schools they belong to i.e. Social Sciences, Sciences and Humanities is insignificant with the chi-square equal to 1.80 at $p>0.05$. Though the graph projects the highest presenter from the School of Social Sciences, this can be explained from the record that the number of participants attending these courses belong to this group of school.

A guide for students on PowerPoint reveals that the common error of bad PowerPoint teaching is reading slides out loud. Findings show that many professors cram slides and recite the text during class. The advices provided in most literature is that users should avoid using PowerPoint as a summary of lecture notes or mnemonic devise, and abandon bullet points altogether. PowerPoint become effective when used to display primary sources, giving more opportunity to talk and attendees are really there to hear what one has to say (Alexander Maxwell, 2007; Steven J Bell, 2004). Our finding (Fig. 28.3) indicates that the teacher participants exhibit a tendency to use PowerPoint as a summary of lecture notes or mnemonic device through cram text and bullet point especially in the initial Orientation Programmes where no training or minimal training is provided. In the subsequent Orientation Programmes with the introduction of

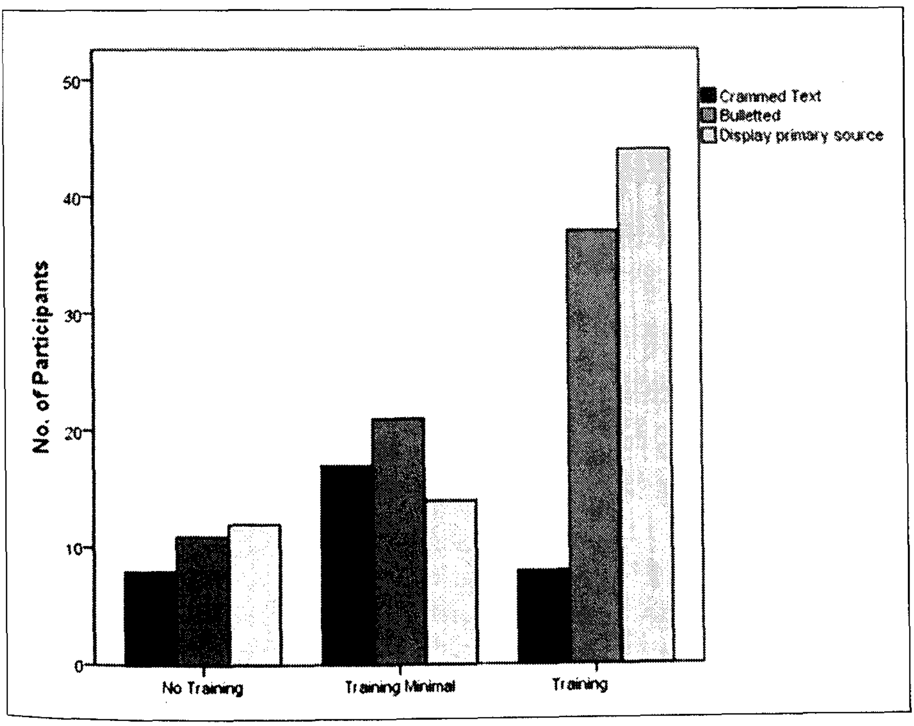

Fig. 28.3 ICT Training Impact on Text Presentation

proper and systematic training on ICT the cram text and bullet point presentation has reduced and we observe a shift to display of primary sources, and this is also supported by the calculated chi square value of 14.20 which is significant at $p<0.05$.

Computerized multimedia presentations provide the ability to integrate multiple modes of media from static text and graphics to dynamic graphics. Static involves overhead-like slides while dynamic involves movement, sound and animation. Users must pay attention to the importance of visual and graphic design in communication, unfortunately most teachers lack familiarity with these skill areas. We observed that there has been an increase in the integration of these multiple modes of media by participants in their presentation with training. The chi square value of 7.13 for static and dynamic presentation (Fig. 28.4) is significant at $p<0.05$, the chi square value of 12.26 for animation (Fig. 28.5) is also significant at $p<0.005$ whereas, for graphics (Table 28.2) we find that their integration in presentation before and after the training is almost the same. This is supported by chi square value of 0.261 at $p> 0.05$. Computerized multimedia presentations are pedagogically useful teaching tools because they engage the

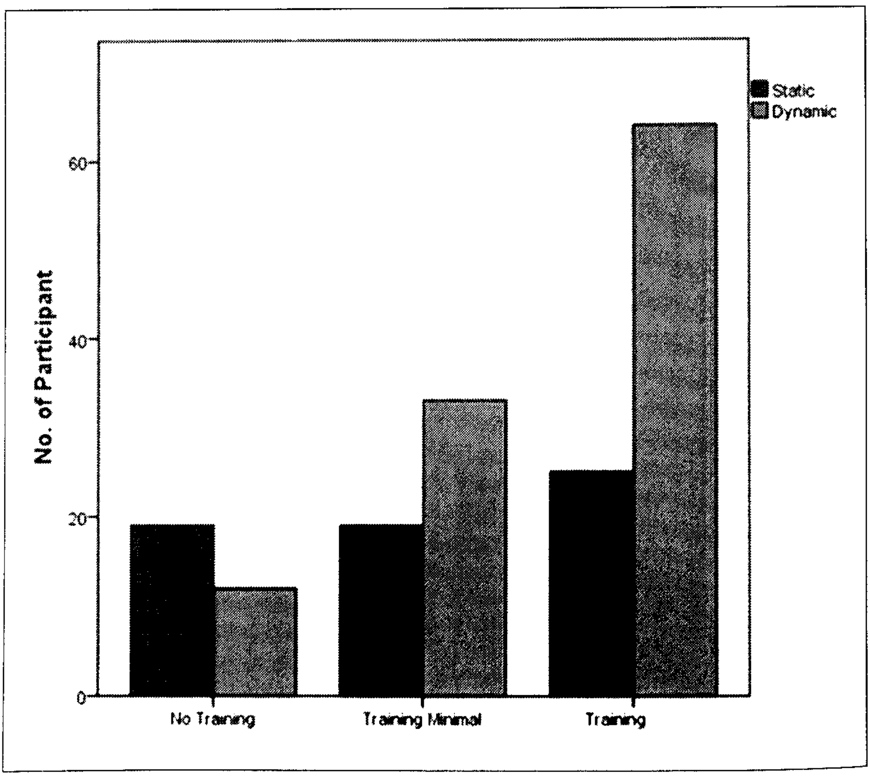

Fig. 28.4 ICT Training on Power Point Presentation Quality

greatest number of viewers' senses and spark the viewers' imagination (Liu and Beamer, 1997). While comparing static and dynamic presentations (Pippert and Moore, 1999) found no significant difference in the test scores of student and course evaluation by students, the only significant difference being better attendance for dynamic presentations. One must ensure that the use of it enhances rather than weaken our presentations.

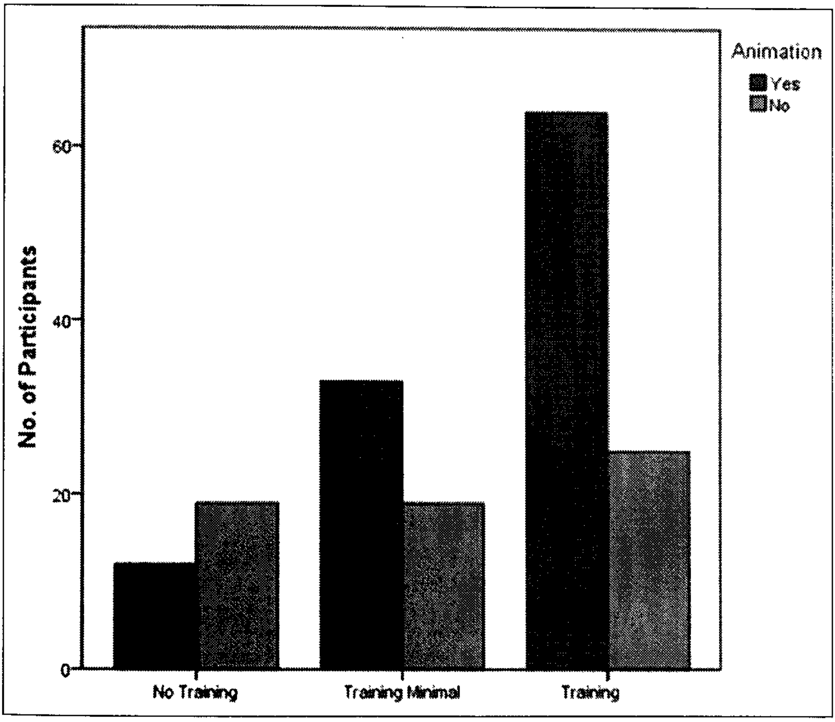

Fig. 28.5 ICT Training & Use of Multimedia

Table 28.2 Comparison of Counts for Trained, Minimally Trained and Untrained Performers

			GRAPHICS	
			Yes	No
ICT Training	No Training	Count	16	14
		% within ICT Training	53.3%	46.7%
	Training Minimal	Count	26	23
		% within ICT Training	53.1%	46.9%
	Training	Count	48	36
		% within ICT Training	57.1%	42.9%

One piece of conventional wisdom about good PowerPoint use is the minimization of slides. Thomas Saylor of Concordia University suggests a maximum of three slides a minute, while Patricia Lopes Don at San Jose State University puts the saturation point at nine slides for a twenty – five minute lecture, roughly three minutes a slide. Alexander Maxwell of Victoria University, Wellington, New Zealand used as many as sixty-six slides in a fifty- minute lecture; reinforcing his paper Ban the Bullet-Point! Content –Based PowerPoint for Historians: he believes a slide can be worthwhile even if its point is brief and audience can digest a large amount of text when it is not broken up into bullet points or identical words coming out of the instructor's mouth. The data (Table 28.3) from our study shows that 42% participants uses <15 slides, 8% between 15-18 slides and 14.3% uses> 19 slides for a ten minute presentation. Depending on the style of presentation we assume that an ideal number of slides for ten-minute duration are in between 15-18.

Table 28.3 Number of Slides for 10 Minutes Duration

		Frequency	Percent
Valid	<15	94	42.0
	15 - 18	18	8.0
	>=19	32	14.3
	Total	144	64.3
Missing	System	80	35.7
Total		224	100.0

PowerPoint is debatably the most universally known technology. Whether it is for presentation purposes or for instructional purposes PowerPoint is being used and arguably overused. Power Point can add value to a program, as in all things, moderation is the key. Teachers, who wish to use PowerPoint effectively, must understand what they wish to achieve from the program, which requires a strategy for effective training.

Conclusion

This study provides a window in examining the effectiveness of training programmes in achieving one of the objectives of the scheme; to promote computer literacy as well as use of ICT in teaching and learning process for new entrants and in-service teachers. The participants attending the Orientation Programmes arrive with varying levels of computer expertise. Our data indicate that dedicating few sessions during the initial classes for computer orientation has been beneficial to these participants in improving their presentation skills. The findings are further strengthened by the evidence in improvement between those participants who received no ICT training, minimal training and proper training.

It is important to thoroughly assess the effectiveness of various forms of ICT in such training courses with participants from diverse disciplines and regions of the country. This finding deserves more comprehensive investigation and future research can develop a larger database for examining information communication technology related activities.

References

1. Bell, S. J. (2004). End PowerPoint dependency now! American Libraries, 35(6), 56-59. Retrieved June, 2013 from http://www.jstor.org
2. Bober, M. J., Sullivan, H. J., Lowther, D. L. and Harrison, P. (1998). Instructional practices of teachers enrolled in educational technology and general education programs. Educational Technology Research & Development, 46(3), 81-97.
3. Hargrave, C. P. and Hsu, Y. S. (2000). Survey of instructional technology courses for pre-service teachers. Journal of Technology and Teacher Education, 8(4), 303-314.
4. Klinger, C. and Siegel, J. (1996). Computer Multimedia Presentations. The CPA Journal, June 1996, 46-49.
5. Kopcha, T. J. and Sullivan, H. (2007). Self-Presentation bias in surveys of teachers' educational practices. Educational Technology Research and Development, 55(6), 627- 646. Retrieved July, 2013 from http://www.jstor.org
6. Kunkel, K. R. (2004). A research note assessing the benefit of presentation software in two different lecture courses. Teaching Sociology 32(2), 188-196. Retrieved June, 2013 from http://www.jstor.org
7. Lindstrom, R. (1998). Presentation intelligence. Sales and Marketing Management, October 1998, 1-11.
8. Liu, D. and Beamer, L. (1997). Multimedia as a teaching tool in business communication course delivery. Business Communication Quarterly, June 1997, 51-56.
9. Maxwell, A. (2007). Ban the bullet-point! Content-based PowerPoint for historians. The History Teacher, 41(1), 39-54. Retrieved June, 2013 from http://www.jstor.org
10. Niederhauser, D. S. and Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. Teaching and Teacher Education, 17, 15-31.
11. Northwest Educational Technology Consortium [NETC]. (1997). The Northwest Regional Profile: Integration of Technology in Pre-service Teacher Education Programs.
12. Office of Technology Assessment IOTA]. (1995). Teachers and technology: Making the connection. Washington, DC: U.S. Government Printing Office. 1995.
13. Pippert, T. D. and Moore, H. A. (1999). Multiple perspectives on Multimedia in large lecture. Teaching Sociology 27, 92-109.
14. Rankin, E. L. and Hoaas, D. J. (2001). Teaching notes: Does the use of Computer-generated slide presentations in the classroom affect student performance and interest? Eastern Economic Journal, 27(3), 355-366. Retrieved June, 2013 from http://www.jstor.org

15. Russell, M., Bebell, D., O'Dwyer, I. and O'Connor, K. (2003). Examining teacher technology use: Implications for pre-service and in-service teacher preparation. Journal of Teacher Education, 54(4), 297-310.

16. Saylor, T. Creating an effective PowerPoint presentation

17. Smith, S. (2001). Teacher education associate editor column: Technology 101: Integration beyond a technology foundations course [On-line]. Journal of Special Education Technology, E Journal, 16(1).

18. Whetstone, L. and Carr-Chellman, A. A. (2001). Preparing pre-service teachers to use technology: Survey results. Tech Trends, 46(4), 11-17.

19. Yildirim, S. (2000). Effects of an educational computing course on pre-service and in-service teachers: A discussion and analysis of attitudes and use. Journal of Research on Computing in Education, 32(4), 479-495.

29

ICT in Innovative Teaching-Learning

Brinda Bazeley K Rymbai

Abstract

Information and Communication Technology (ICT) plays an important role in the field of education. It provides the prospects and trends of integrating ICT into the educational sphere. ICT has been developing very rapidly and thereby bringing about a lot of new innovative techniques in the field of education. The learning activities can be reorganized as per the student needs through innovative means. Innovative ideas can emerge through the use of ICT. This paper will look at the impact of using Information and Communication Technology on teaching and learning and the extent to which ICT is being used to promote education in the twenty first century learning skills.

Key Words: *ICT, innovation, teaching- learning*

Introduction

Science and technology play an important role in the growth and development of the society. Science is the foundation of innovative culture and acts as a core of significant decisions that we take every day. The basic objective is to communicate scientific literacy to all and to cultivate scientific temper in the society. We need to update ourselves to emerging technologies. Many researchers have shown that people are interested in receiving useful information on happenings in the field of science and technology, latest news on inventions and discoveries etc. Advancements in science and technology have paved for new Information Communication Technology innovations.

Today, from the time we awaken in the morning to the time before we sleep, we are surrounded by media, such as newspapers, radio, television, and computers. Sometimes we are not even aware that we are surrounded by these media. All these media come under the overall umbrella of what are known as today's ICTs. Knowing and using ICTs is important in today's fast changing knowledge society.

Technology is endowed with an immense potential to innovate education (Blandow & Dyrenfurth, 1994; Ruiz i Tarrago, 1993). However teachers need to modify their teaching methods to accommodate the changed interaction and behaviour patterns. The effective use of new technologies require innovative teaching skills. When students are not provided with an adequate understanding of the capabilities of technologies, there is a high probability that they will replicate familiar forms and ideas using the new tools, as opposed to using the new tools to explore new connections and different ways of fashioning (Loveless, 2008). A study conducted in primary schools to examine how students used online tools to communicate and participate in online communities highlights the same point (Turvey, 2006). Despite relative autonomy in virtual spaces, most children did not attempt to experiment the potential of the tools but rather followed predictable patterns of behaviour. This shows that provision of creative spaces and freedom for exploration does not necessarily lead to *creative learning*. In order for innovative teaching to take place, teachers need to be aware of the available resources and how such resources may be useful. Teachers, who are not conversant with the use of technology in their teaching, may not feel comfortable showing their lack of expertise in front of their students. As Shaffer (2006) argues, if a teacher cannot read, it would be difficult to identify whether a book is bad or whether their reading is inadequate to judge the book. When it comes to technology, similar behaviour is noted.

Information and Communications Technology or (ICT)

ICT is often used as an extended synonym for information technology but is a more specific term that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary storage devices, and audio-visual systems, which enable users to access- store- transmit.

Information and Communication Technologies are defined as all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital which can be deployed for realising the goals of teaching learning, enhancing access to and reach for resources, building of capacities, as well as management of the educational system. These will not only include hardware devices connected to computers, and software applications, but also interactive digital content, internet and other satellite communication devices, radio and television services, web based content repositories, interactive forums, learning management systems, and management information systems. These will also include processes for digitisation, deployment and management of content, development and deployment of platforms and processes for capacity development, and creation of forums for interaction and exchange.

Today's World is Highly Technology Driven

All organizations in various sectors: business, education, healthcare, banking, finance and others are influenced by the rapid pace of technological developments and innovations. This technology presents itself in various forms, ranging from using instructional technologies inside the classroom to running the whole course away from the classroom thus giving students the chance to having access to higher education regardless of place, time and constraint. New technologies like web based PC, mobile phones, satellites and wireless technologies, internet etc are tremendously used among the student communities and the teaching group so as to gather and disseminate information which is normally not possible through any other means. These new technologies have been accepted for faster development and growth due to global competition.

World's Technological Capacity

The world's technological capacity to store information grew from 2.6 (optimally compressed) Exabyte's in 1986 to 15.8 in 1993, over 54.5 in 2000, and to 295 (optimally compressed) Exabyte's in 2007. This is the informational equivalent to 404 billion CD-ROM in 2007. Piling them up would create a stack from the earth to the moon and a quarter of this distance beyond (with 1.2 mm thickness per CD). (The Exabyte is a multiple of the unit byte for digital information. The unit symbol for the Exabyte is EB.1 EB = 1000000000000000000B = 10^{18}bytes = 1000 petabytes).

ICT Development Index

The ICT Development Index (IDI) is an index published by the International Telecommunication Union based on internationally agreed Information and telecommunication technologies (ICT) indicators. The ICT Development Index is based on 11 ICT indicators, grouped in three clusters: access, use and skills.

Table 29.1 30 Countries as Ranked by the ICT Development Index in 2010

Rank	Country	Score	Rank	Country	Score
1	South Korea	8.40	16	Austria	7.17
2	Sweden	8.23	17	United States	7.09
3	Iceland	8.06	18	France	7.09
4	Denmark	7.97	19	Singapore	7.08
5	Finland	7.87	20	Israel	6.87
6	Hong Kong	7.79	21	Macao	6.84
7	Luxembourg	7.78	22	Belgium	6.83
8	Switzerland	7.67	23	Ireland	6.78
9	Netherlands	7.61	24	Slovenia	6.75
10	United Kingdom	7.60	25	Spain	6.73
11	Norway	7.60	26	Canada	6.69
12	New Zealand	7.43	27	Portugal	6.64
13	Japan	7.42	28	Italy	6.57
14	Australia	7.36	29	Malta	6.43
15	Germany	7.27	30	Greece	6.28

Information Technology Act

Under the IT amendment Act-2008 many regulatory and advisory committees were set up from 2008-2011.The National Policy on Education 1986, as modified in 1992, stressed upon employing educational technology to improve the quality of education. The policy statement led to two major centrally sponsored schemes, namely, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS) paving the way for a more comprehensive centrally sponsored scheme – Information and Communication Technology @ Schools in 2004. Educational technology also found a significant place in another scheme on upgradation of science education. The significant role of ICT in school education has been highlighted in the National Curriculum Framework 2005 (NCF) 2005. Use of ICT for quality improvement also figures in Government of India's flagship programme on education, Sarva Shiksha Abhiyan (SSA). ICT figured comprehensively in the norm of schooling recommended by Central Advisory Board of Education (CABE), in its report on Universal Secondary Education in 2005.

With the convergence of technologies it has become imperative to take a comprehensive look at all possible information and communication technologies for improving school education in the country. The comprehensive choice of ICT for holistic development of education can be built only on a sound policy. The initiative of ICT Policy in School Education is inspired by the tremendous potential of ICT for enhancing outreach and improving quality of education. This policy endeavours to provide guidelines to assist the States in optimizing the use of ICT in school education within a national policy framework.

Vision

The ICT Policy in School Education aims at preparing youth to participate creatively in the establishment, sustenance and growth of a knowledge society leading to all round socio- economic development of the nation and global competitiveness.

Mission

To devise, catalyse, support and sustain ICT and ICT enabled activities and processes in order to improve access, quality and efficiency in the school system.

Policy Goals

To achieve the above, the ICT Policy in School Education will endeavour to create:-

- An environment to develop an ICT knowledgeable community. An ICT literate community, who can deploy, utilise, benefit from ICT and contribute to nation building.
- An environment of collaboration, cooperation and sharing, conducive to the creation of a demand for optimal utilisation of and optimum returns on the potentials of ICT in education.

ICT in Higher Education

In the higher education sector, application of ICTs in the form of e- learning is already changing teaching and learning processes. There are many pedagogical and socio-economic factors that have driven higher learning institutions to adopt e-learning. These include greater information access; greater communication via electronic facilities; synchronous learning; increased cooperation and collaboration, cost-effectiveness (e.g. by reaching different students and in greater numbers) and pedagogical improvement through simulations, virtual experiences, and graphic representations.

Both teachers and learners can choose more appropriate applications which are flexible in time, in place, personalized, reusable, adapted to specific domains and more cost-efficient (Fisser, 2001; Pelliccione, 2001). This includes developing course material; delivering content and sharing content; communication between learners, teachers and the outside world; creation and delivery of presentations and lectures; academic research; administrative support, student enrolment.

Though there are many ICT innovations in Higher Education, we shall discuss certain recent interventions-

1. Web based technology;
2. Cloud computing;
3. Avatar;
4. Sixth sense (gadget).

Web based Technology

Tele communication technology combined with web enabled technologies (internet, online learning) have created a new technology based focus called Web based teaching and learning in higher education.

Web based teaching technology can be utilized to enhance the teaching and learning environment. World Wide Web (WWW) being the most successful educational tool combines and integrates text, audio and video. The use of web based communication technology has created interactive, network based services and tutoring support having the essential elements of e-learning. The World Wide Web has emerged as the most successful educational tool which can be used in an independent platform. Here a simple transfer takes place from a normal traditional teaching to the medium of web. In online learning, students complete their assignments on the internet, meet their instructors and peers in the chat rooms.

Cloud Computing

Cloud computing is the use of computing resources (hardware and software) which are available in a remote location and accessible over a network (typically the Internet). The name comes from the common use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation. This means you can deliver applications to your end users faster than ever, without investing in new infrastructure, training new personnel, or licensing new software.

How can Cloud Computing Benefit Educational Institutions?

Although colleges and universities have been using "cloud-based" applications for years (e.g. email), the cloud computing trend is quickly evolving into a premium model for data storage and exchange. According to technology research company Gartner, more than 50 percent of Global 1000 companies are predicted to store confidential data in the public cloud by the end of 2016. The cloud is proving itself as being a techno-trend which is here to stay.

Higher educational institutions recognize that adopting the latest technologies and solutions is essential to staying competitive and retaining students. Cloud computing can actually help institutions reduce high expenditures on hardware, software and IT maintenance. Cloud computing provides businesses with a centralized, virtual data center that is accessible to faculty and admissions personnel, for example, at any time and any location.

The Cloud Can Help Colleges and Universities

- Accommodate the rapid increase in mobile device dependency.
- Store expansive amounts of sensitive data and information that's easily accessible.
- Stay current (e.g. provides students with digital campus storage for class notes, papers and projects).
- Acquire and implement the latest software and application updates.
- Streamline enrollment and admissions processes that are costly and time-consuming.
- Turn to subscriptions that are scalable and provide options.

When it comes to private student information and confidential university data, security challenges and concerns are inevitable; however, according to Tech Journal's infographic on schools the cloud computing spending is expected to increase by more than 30 percent as of May 2011. Boston College, New York University and Maryland Institute College of Art are higher educational institutions leading the industry into cloud-based applications. The institutions rely on FolderWave, Google Apps and Fischer International Identity for admissions, financial aid, collaboration tools and system management.

Ed Tech Magazine and Cult of Mac surveyed colleges and found:

- 6 percent maintain cloud-based technologies.
- 28 percent are implementing cloud computing.
- 29 percent are planning to adopt the cloud.
- 32 percent are discovering cloud computing.

A Pew Internet/Elon University survey reports that of 1,021 participants, including Internet research experts and users, by 2020 higher education will strongly focus on–

- Teleconferencing
- Distance learning
- Hybrid classes (i.e. online and off-campus learning)

For 2013, cloud computing is a rapidly growing, evolving model that offers significant advantages, yet there are potential fallacies as well. It is no debate, however, that cloud computing has positioned itself as a technology information deployment system that is not going anywhere. From small businesses and major enterprises to elite universities and online colleges, cloud computing seems to be worth exploring.

Sixth Sense Technology

The Sixth Sense technology contains a pocket projector, a mirror and a camera contained in a pendant-like, wearable device. Both the projector the camera and sensors are connected to a mobile computing device in the user's pocket. Projector projects visual information enabling surfaces, walls and physical objects around us to be used as interfaces; the camera recognizes and tracks users' hand gestures and physical objects using computer-vision based techniques. The software program processes the video stream data captured by the camera and tracks the locations of the coloured markers (visual tracking fiducials) at the tips of the user's fingers. The movements and arrangements of these fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces. Sixth Sense supports multi-touch and multi-user interaction. This is basically living in the virtual world.

Avatar

The word 'Avatar' is derived from the Sanskrit word *Avatara* which means descend into mortal realms for special purposes. In Hindu Mythology, it is the temporary physical incarnation of a god who is visiting the earth. In context of web technology, Avatar describes a player's onscreen identity. AVATAR- Advanced Video Attribute Terminal Assembler and Re-creator. Avatars are online manifestations of self in a virtual world- allowing them to enhance interaction in virtual space. Avatars work on Artificial Intelligence (AI) and Natural Language Processing (NLP) for human-computer interactions and conversational agents.AI strives to create machines that use reasoning and intelligence like humans. NLP is related to artificial intelligence with regards to the cognitive functionality-focuses in the way information is received and conveyed through languages.

Components of Avatars

A typical Avatar consists of 4 basic components-

- Virtual environment
- Virtual reality devices-stereo glasses (3 D images), gloves (finger control), position sensors, data acquisition and data distribution unit (card)
- Virtual reality modelling-algorithms, graphics
- Virtual reality control software-signal processing, communication

Avatars are user controlled and can display emotional responses such as happiness through gestures and actions during real time interaction with other users. These graphical entities can traverse virtual space with the active world environment through mouse clicks or through the use of keyboards. It can also be used to create an appearance. Example - teacher presence in virtual world.

Avatar in Higher Education

With Avatar, a programme character may appear onscreen, point to objects and speak to learners. This can definitely enhance a learning experience. It can guide students through course ware, explain and demonstrate techniques, offer hints and feedback. It can give an experience of an almost human element that can be more consistent, efficient and economical.

Benefits

- Virtual world give users the ability or tasks that could be difficult for them to carry out in the real world.
- Virtual worlds allow for continuing and growing social interactions
- Virtual worlds can adapt and grow to meet user needs.
- Using Avatar technology effectively can provide virtual teaching environment in which students can assess a 3 D multi-users educational environment.

3G Mobile Learning-Innovation in Education

According to International Telecommunication Union (2011), there were 6 billion mobile subscribers which is equivalent to 87% of the world population and 6.9 billion by the end of 2013.The mobile penetration in the developing world is now 79%. The number of active mobile subscription in India in September 2012 was 698.96 million. Mobile connection per 100 people in India was 74.49. Mobile Tele density in urban area was 154.64 compared with 39.52 in rural areas. (Om Prakash Sharma, university news, vol.51 No.7 February 18-24, 2013). Because of its value added functions and wide spread utility, the mobile has potential for teaching learning purpose. Mobile enabled learning potentially moves learning outside classrooms and into students' environments, both real and virtual, thus making learning as personal, situational, collaborative and lifelong.

International mobile telecommunications-2000, better known as 3G or 3rd generation, is a generation of standard for mobile phones and mobile telecommunication services fulfilling specifications by the International Telecommunications Union. Here applications include wide area wireless voice telephone, mobile internet access, video calls and mobile TV, all in a mobile environment. Japan was the first country to introduce3G on a large commercial scale.

The main features are-

1. It is a mobile phone technology with faster access to web.
2. The 3rd generation wireless format is high efficiency data and voice format follows 1G and 2G.
3. Here mobile phones are to have broad band connections.
4. 3G system is the latest system and has the highest data rates for all the generation systems, meaning, one can access fast internet, use video calling, video streaming and access great gaming.

How will 3G Services help in the Field of Education?

Faster connectivity, internet TV, video on demand, audio- video calls and high speed data exchange became reality in the field of education. The 3 major areas of mobile learning that promises huge benefits are synchronous video, asynchronous multimedia and real time collaboration. It may be pointed out that when the network provides large pipes of data, any sort of content in the internet becomes instantly accessible regardless of time and location, interactive experience, handy connection that be taken even to the remote village, easy peer-to-peer sharing, instant communication. This also gives access to many educational references, support innovative teaching practices, provide flexibility, provide better teaching and learning environment. SMS is one of the most common wireless applications used with mobile phones to support teaching learning. MMS can also deliver information through text messages, sound images and video messages. To a large extent, application in education is through mini tutorials, video on demand, video conferencing etc.

Major Advantages

- portability
- faster learning
- collaborative learning
- flexibility
- high comfort level
- freedom of location and space
- ncrease efficiency and effectiveness

Major Disadvantages

- High cost
- limited storage capacities
- lack of well developed Meta cognitive skills in some

- short battery life
- huge capital requirement to build infrastructure for 3G services

Therefore the development of 3G mobile technology is the ability to incorporate transportable devices in the learning process.

Akash 2 Tablet-Innovative Teaching-Learning

Akash is an android based touch screen PC tablet designed specially to fulfil the educational requirements and needs of the students at extremely low cost. Akash is the first in a series of android based tablet computers produced by British Company Data Wind. It is manufactured by India based company Quad, at Hyderabad. The tablet was officially launched in New-Delhi on 5th October, 2011.The Akash tablet PC was a proposal by MHRD when it was headed by Mr. Kapil Sibal.

The vision and ideology of this tablet computer firstly, is to enable the Indian students to get the best in technology and facilitate e-learning modules so as to keep the Indian education system abreast with the education patterns abroad. Secondly, this will enable the students to keep in touch with modern day technology. The Akash II tablet can improve the standard of education in the following way-

- Easy use by teachers both inside and outside the classrooms
- interest in studies increases, by bringing new experience to students
- Paper free campus, it also works as note books.
- Various presentation styles supported by PDF,PPT, word files, video files etc.
- power in palm , with just 350gm weight, 7 inch of big touch screen displaying 800x400 pixels resolutions makes it very convenient and can be put in the pocket.
- Storing data. The tablet has 256 MB RAM and 2GB Flash Drive of internal memory expandable up to 32 GB. It is enough to hold 45 movies.
- compatible with smart phone
- e book and e-examination, Students now have an advantage of reading e-books and making presentations and submitting them while doing the necessary research online.
- integrative device, pre loaded applications like internet browser, calculator, calendar, clock, contacts, data wind, package manager, email, messaging, music, notepad makes it easy for the students.

Advantages

Low-cost, gives education to all category of students, compact, teaching learning easier, all in one device, supports various document formats like PDF,DOC,PPT,MS WORD etc.

Disadvantages

Technical problems– Non availability of inbuilt webcam and blue tooth, defects of display and touch experience, Non availability of devices in India, especially in the rural areas.

It is seen that National Mission on Education through ICT is supporting the project. There are many methods to spread education; this would prove to be an innovative way of imparting teaching learning.

Conclusion

Therefore, access to new Information and communication technologies (ICT) and e-learning will have a strong impact on the methodologies pertaining to teaching learning process. It is a medium of fast connectivity and development. The Government of India has launched policies and programmes for smooth transition of ICT at Grass root level, so that awareness can be generated at educational, social, economical and political domains.

References

1. http://www.'edudemic.com/2013/02/higher-education-and-cloud-computing/
2. Jibin VK, Naseema C-"3G mobile learning-innovation in education" University News vol.49,No.6 February-07-13,2011,pp 28-31
3. Prakash, Reddy "Information and Communication Technologies in ODL: Contextualising the Framework" University News vol51, No. 21, May 27-June-02, 2013, pp 3-7
4. Singh M.S- *Education in emerging global society,* 2007 Adhiyayan Publishers and Distributors, New Delhi-110002.

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Skill Based Education – Job Prospects for Students

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Abstract

Skill-based and vocational education is becoming more important today, with many employers expecting new employees to have all the practical skills they need to start work. Vocational courses are typically more practical and skills-based than academic degrees, they are often taught at universities as well as colleges and technical institutes. Skill based training programmes, provide a clear idea of what a student's career will involve. Professional universities, colleges and institutes that specialises in particular fields provide such courses, and has teachers with recent experience in the industry.

Inclusion of Industry Based Learning (IBL) into our degree programmes will give the students an opportunity to put theory into practice working with a host organisation. In the process they develop relevant industry skills and knowledge, confidence and self-discipline. Successful completion of IBL course may also lead to rapid employment, as some organisations have offered permanent positions to students they worked with through the programme.

The industry must play a key role in designing the curriculum, training methodologies and setting up facilities for training the trainers in the skill-based education sector, said Rajesh Tope, state minister for higher and technical education while addressing the inaugural session of 'SkillCon 2013', a two-day conference to promote skill development education in the state. Need-based and industry demand-driven skill education is in demand today. It provides students with the opportunity to undertake a paid, relevant work placement as part of their university degree. This paper will focus in the new interventions of diversified education which is skill based and industry based for future job prospects of the students.

Key words: *Skill based, Industry, Job Prospects, Students*

Introduction

India being a vast and diverse country, the Indian youth is slowly going through a cultural transition in their outlook due to globalization, communication and media. Education is expected to contribute to the empowerment of learners so that they can make well versed choices, manage issues that concern them and ultimately the quality of their lives. The power of literacy can well be the signs of development. Literacy is best derived from the experience of developing life skills. Life skills provide a solid establishment for poverty reduction and sustainable growth in pursuit of an independent and firm society. However, the Indian Education System at present with the advent of globalization has integrated degrees with the rest of the world.

The mobility of skilled manpower increased with globalization. The constituents of generally defined life skills include the abilities necessary to apply the conceptual thinking and reflection in concrete situations. They should imply capacities to be involved in effective interaction with the environment and provide an appropriate motivational attitude. Psychological pre-requisites for successful performance, such as problem solving capacities, self confidence, skills for critical thinking etc. provide skill based education to students and help to develop knowledge, attitudes and skills together for future employment.

Various studies have shown that the students would want a course that would suit their aptitudes and also meet their future needs, positive response is seen for skill based and industry based learning. Literature available also shows that general, technical and vocational education and training provided in India in many ways is inadequate to meet the changing skills needed for the firms.

The changing skills needs are increasingly becoming complex and are often decided by international forces. Thus, the transition from the world of education and the world of work has to be supplemented by firms providing training to its employees as per the requirements of the global labour standards. The skills that the labour market requires are all human related skills and not learnable through computers. Opportunities are to be given with an industry based curriculum.

Skill based education according to UNICEF concentrates on the following areas-

1. Empathy
2. Interpersonal relationship skills

3. Communication
4. Critical thinking
5. Creative thinking
6. Decision making
7. Problem solving
8. Coping with stress
9. Coping with emotions

Knowledge and skills have increasingly become the primary determinants of economic growth and social development. According to the International Labour Organization, "Skill Development is of key importance in stimulating a sustainable development process and can make a contribution in facilitating the transition from an informal to formal economy. It is also essential to address the opportunities and challenges to meet new demands for changing economies and new technologies in context of globalization".

Skill development brings about quality and relevance of education and training for women and men, innovation, investment, technological change, enterprise development, economic diversification and competitiveness that economies need to accelerate the creation of more jobs.

Vocational, or skills-based education is becoming more important today, with many employers expecting new employees to have all the practical skills they need to start work. Vocational courses are typically more practical and skills-based than academic degrees, and are often taught at universities as well as colleges and technical institutes. If you know exactly what you want to do in your career and that it requires practical skills, then vocational learning is important. It could be hospitality and tourism, retail management, software development or interior design. There are literally thousands of skills based training options.

Industry Based Learning (IBL)

Industry-Based Learning Programme is an apprcach to learning from an industry perspective. With traditional technical teaching methodologies in educational environments, the conventional pathway is to build the foundation of learning through subject-based teaching independently. Subjects based on the knowledge required for the discipline usually follow on from this. The problem with this traditional methodology of learning is that there is no close relationship with industry requirements. Industrial oriented methodology is an approach to learning from an industry perspective. Here, undergraduate students are given the opportunity to do a full-time paid placement in a particular industry, usually for 6 to 12 months, in an area that is relevant to their studies.

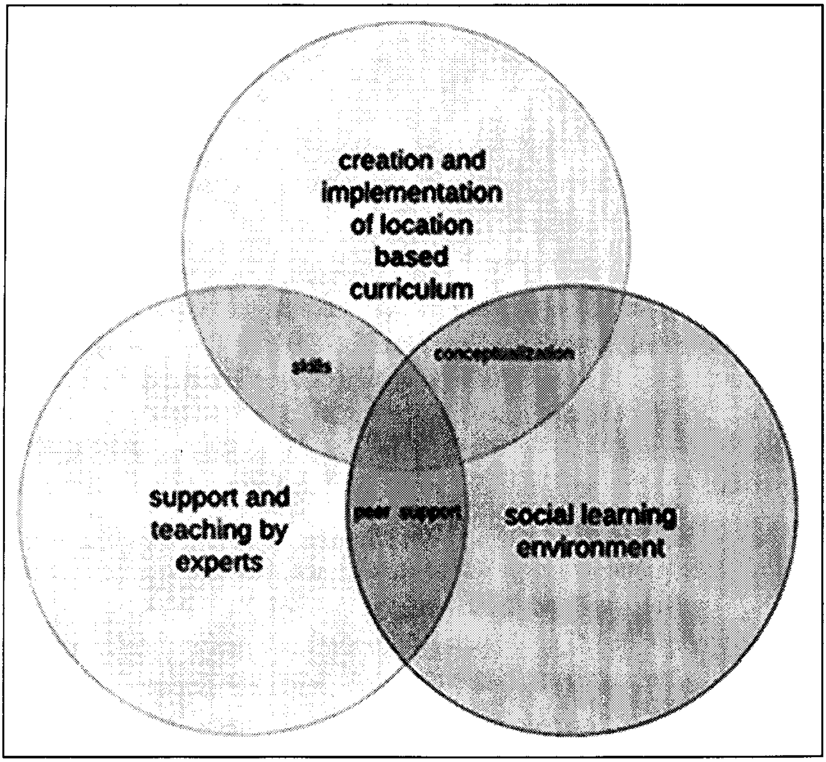

Fig. 30.1 Components of Teaching-Learning Programmes

Successful completion of Industry-Based Learning Programme course may also lead to rapid employment, as some organizations have offered permanent positions to students they worked with through the program.

Industry-Based Learning Programme allows one to apply one's academic skills in or for a professional organization. So, one gets a competitive edge while still based in a supportive learning environment. With leading global and Indian Companies as our clients, Industry Based Program can offer outstanding placement opportunities and scholarships. IBL also gives one access to exclusive graduate recruitment programmes as all the industry work is assessed and credited towards one's degree.

The Industry Experience programme allows one to develop a system for a real life client within a small student group. The student will be part of delivering a first class information system, while learning essential project management skills. Career progressive programs like Industry Based Learning and Industry Experience are just two of the reasons why one becomes a professional before one enters the workforce.

IBL gives students the opportunity to put theory into practice while working with a host organisation. In the process, they develop relevant industry skills and knowledge, confidence and self-discipline. It ensures students add value to the organisations they work in. A key element of this commitment is the inclusion of Industry Based Learning (IBL) into our degree programmes. Industry-Based Learning (IBL) is a new discipline of study for undergraduate students from all areas.

It provides students with the opportunity to undertake a paid, relevant work placement as part of their university degree. Successful completion of the IBL course may also lead to rapid employment, as some organisations have offered permanent positions to students they worked with through the programme. This cooperative education programme gives students the opportunity to unleash the skills they have learned in the classroom in the corporate world. During their industry placements, students gain invaluable professional and business experience – giving them a competitive edge in the employment market. Students also receive scholarship during internship.

Their industry work is assessed and credited towards their degree. Students also participate in a number of industry-assisted activities, such as:

1. field trips to partner companies
2. an industry seminar series
3. a career start program
4. Access to an exclusive graduate recruitment program.

University students can also gain valuable hands-on experience as part of their studies by working in the industry they are interested in. There are different names attached to the kind of work experience programmes one can do while one is at the university. Sometimes it is known as:

1. Work placement
2. Work experience
3. Internship
4. Co-op year (or Cooperative Education)
5. Learning to Learn
6. 3 Rs (Reading, Writing, Computation)
7. Communication: Listening and Oral Communication
8. Creative Thinking/Problem Solving
9. Self-Esteem/Goal-Setting and Motivation/Employability and Career Development
10. Interpersonal/Negotiation/Teamwork
11. Organizational Effectiveness/Leadership

Need for an Industry based Curriculum

Knowledge alone is not important. What matters is how one applies it. Keeping in mind that Education is an ever evolving field, the curricula has to suit the needs of the industry. The industry driven course structure helps students to become industry ready and thus make the transition to the workplace smooth. The curriculum encourages students to apply theoretical learning to real-life scenarios in the form of case studies, research, events and live projects. The research driven environment will ensure that the students are exposed to current developments as they happen and are able to understand the concepts. Innovative pedagogy, industry oriented curricula, world class infrastructure, high-tech environment, constantly evolving pedagogy and curricula to meet the needs of the industry. Students can benefit from learning through broad, contextual experiences. In fact, many individuals become more engaged in contextualized learning, thereby improving their preparation for future studies and entry into the work world.

All the courses aim to equip students with a curiosity – driven and deep understanding of their subject, a critical approach and skills relevant to their future career. The curriculum for each individual course has to be designed by a perfect blend of inputs from renowned academicians and industry leaders. In liaison with academicians, professionals and industry experts, we develop courses that make one attractive to future employers. The involvement of industry is not limited to the designing of the curriculum. Experts from various industry sectors are continually involved in the professional grooming of every student through the delivery and assessment of courses, judging of presentations and providing feedback on students' performances at internships.

The specialized courses offered produce exceptional graduates with the perfect education, **industry oriented skills** and attributes necessary to succeed in the changing work environments across the globe. For many courses, a placement year or short-term work internships are available to give students a first-hand experience of the work cultures in top corporates and brands. Most of the courses have a strong vocational focus and carry full or partial professional accreditation or recognition. The main purpose is to make every graduating student academically excellent and professionally groomed to assume leadership roles in every sector of the industry and economy.

Some of the courses include

1. Accounting and finance
2. Architecture
3. Communication studies
4. Computing and information technology
5. Design and visual arts

6. Landscape architecture
7. Management and marketing
8. Textile designing
9. Building Technology
10. Civil Engineering
11. Construction
12. Electro technology
13. Plumbing & Gas fitting
14. Transport Technology
15. Short term courses like –Enterprise creativity, design & innovation

This industry based course provides students with enhanced capability to examine innovation, creativity, design theory and practice within several themes. These themes include: leadership, structured processes for new product development, industry, national, and cultural factors, knowledge and ideas management; environmental responsibility and green design, financing, and intellectual property rights management. Enterprise Creativity, Design and Innovation is an example of a postgraduate level course. The course can be taken as a stand-alone short course. Industry based learning is the in thing now a days. Many lucrative courses are being offered by a number of higher education institutes in India so as to satisfy the needs of the industry and generate employment for the youths. The curriculum is framed as per the needs in employment. Skill based learning have enhanced employment opportunities.

The Courses attempt the following:

Evaluate the strengths and weaknesses of structured processes for developing new products. Critiques the impact of industry, national, cultural and global issues on the context of an organization's innovation strategy.

Design an effective strategy for introducing an innovation into a specific organisational context. Implement and evaluate a pilot intervention of an innovation introduced to a specific organisation. Evaluate contemporary consultancy, facilitation and team work skills in the context of leading an innovation intervention. An experiential learning approach is used in which students engage in designing and delivering a practical innovation realised as a new process, service, or product.

Assessment is based on a significant project in which each student:

1. Visits a client organisation to identify opportunities for an innovation intervention
2. Selects and presents an innovation intervention as a proposal to the client organisation

3. Designs and facilitates the implementation of an innovation intervention accepted for pursuit by the client organisation
4. Evaluates the lessons from their experience for their future professional leadership practice.
5. Finding an IBL course
6. Most universities have an IBL coordinator who can help the student to find an option that is right for a student.

IBL gives one a chance to learn firsthand what it is like to work in one's chosen field and industry. One may probably get some recognition from the placement. One may also get further part-time work out of it while one finishes studies. One might even end up with a promise of full-time work when he/she graduates. Some graduate recruitment programs prefer graduates who have done an IBL course.

Grameen Yuva Rozgaar provides skill based training to youth of Rural India who are class 10 graduates, and then ensures a 100% placement to these youth. Life Skills Livelihood Programme for Women, gives training to women in Tailoring, Beautician courses etc, so that they can earn and provide financial support to their families in the future.

Working in a trade has the potential to earn the kind of money one probably only ever dreamt about. It is definitely better than working behind a desk all day, and no two jobs are ever the same. Whether you are a builder, mechanic, electrician or plumber, you constantly get to meet new people, discover new challenges, and pick up a new skill or two. Likewise, being a civil engineer, surveyor and boat designer or construction manager can give you transferable, tangible skills.

Benefits

Some possible benefits include:

1. In-depth exposure to a broad field of interest and a wide range of occupations.
2. Opportunities to learn through more contextualized and authentic learning experiences.
3. Exposure to linkages between school-based learning and work-based learning.
4. Greater potential to prepare for both higher education and employment.
5. Opportunities for teachers to work together on self-directed teams.
6. Opportunities for counsellors and administrators to influence students' career development and school experiences.
7. Industry/university linkage
8. Competency development

9. Curriculum integration
10. Teaching/research cooperation
11. Technical service
12. Industry-oriented technology development
13. School-University/industry partnership or alliances
14. Customer (employer &employee) satisfaction
15. Employment rate
16. Job performance
17. University enrollment
18. Career development
19. An insight into a career
20. New professional networks
21. An income while learning through working
22. Added motivation, confidence and maturity
23. The opportunity to contribute to an organization
24. A head start in the competitive graduate job market
25. Valuable industry experience and professional skills
26. The opportunity to increase your professional communication and interpersonal skills.

Conclusion

Can education be changed? If students continue to be mass produced, will today's graduates be adequately prepared for life and living? Will they be able to compete in the world class workplace? If educators hope to prepare graduates who can compete head-to-head with graduates from other nations, "product" quality must greatly improve. Efforts have to be focused on three areas:

(1) Identifying curriculum practices and processes that emphasize "all aspects" in the long term;

(2) preparing a document that describes these long term curriculum practices and processes and ways they may be designed; and

(3) Assisting educators at selected institutes with their curriculum implementation.

Therefore, there is a need to situate industry in the curriculum development and teaching pedagogy. Skill developments must suit the requirements of the industry and ultimately to generate employment for our youth.

References

1. Singh R.P-"Educational finance and the planning challenge",1997Kanishka publishers, distributors, New Delhi-110002
2. Muthukrishnan .S- "Some Issues in Skill Development in Higher Education", University News vol.49, No.01 January 03-09,2011
3. Ansari Hamid M- ''Entrepreneurship and Innovation - The two tenets for productive advancement – 'Convocation Address' - University News, vol. 48, No.35 pp. 52-54
4. Saluja, Patil, Tank-''Endowing life skills for Employment", University News, vol.48,No.26 June 28-July 04,2010 pp10-19
5. Swamy N.R-" Life skills Education: Ruby in the Crown of Human Development" University News,vol.49 No.12 March 21-27,2011
6. Selvam SKP-"Higher Education and Entrepreneurship in India" University News, vol.50 NO.44, October 29-November 04,2012
7. www.google.com

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Teaching Strategies in Physics by Using both technological Aids and Lost cost Teaching Aids

Elarinanoris Dkhar

Abstract

The study of Physics is becoming difficult not only due to conceptually difficult content but also due to our formal and didactic approach to teaching science. This process of teaching and learning of Science does not fascinate the students and hence learning of science becomes only a tool to get a descent or a white colour job. To make Physics understandable, perceivable and enjoyable we have to make use of technology. My paper explains the basic concepts of the phenomenon and its application in daily life with the help of PowerPoint Presentation and the Teaching Aids. Slides can be prepared with the help of animation to explain the phenomenon and its application. For making the concepts of Physics understandable to students the teaching aids available should be used by teachers to explain the different phenomenon of the subject thereby enabling them to enjoy the subject and find it interesting. Hence teaching Physics should go beyond the boundary of classroom and it should be practical in its approach.

Keywords: Power point presentation, animations, teaching-aids, Practical application.

Introduction

Science plays an ever increasing role in the modern civilization. It is our primary duty to see that every individual should have at least an elementary knowledge of the scientific principles involved in everyday life.

Importance of Experimental Work: Demonstration and Activities

The National Policy on Education, 1986 has given due emphasis on child centered education and inculcation of scientific temper in students. A Scientific temper in pupils is inculcated by experimental work in science. They get an opportunity to handle scientific apparatus/equipment skilfully and understand principle/concepts/processes of science. The learning through demonstration also provides first hand direct experience and can arouse curiosity and interest in children. As the Chinese proverb say:

"I read, I forget it.

I see, I remember it.

But when I do things, I understand."

The philosophy underlying the learning of science through fun is directed towards a greater participation of children in active learning experiences in the classroom and outside. Discovery, purposeful activity and environment are the three basic elements of new teaching method. Activity should be developed utilizing local resources in such way that children perform the experiment themselves.

New Approach to Teaching Science

Science courses are becoming difficult not only due to conceptually difficult content but also due to our formal and didactic approach of teaching science. Therefore science teaching should be:

- Through understanding.
- Life oriented.
- Lectured-cum-demonstration and activity oriented.
- Made interesting through use of local resources.

Science can thus also help in giving pupils the social education. Thus for flexible science teaching aid is essential to:

- Involve pupils in science.
- Help them to think about science.
- Stimulate their participation.

Science and in particular Physics, is being taught since years and decades only through chalk and talk. Science education has reduced to transferring some formulae, equations and statements from the teacher's lecture notes to the student's notebooks via the blackboard without affecting either of the brains. This process of teaching and learning of Science does not fascinate the students and hence learning of science becomes only a tool to get a descent looking job.

To make Physics understandable, perceivable and enjoyable, I am trying to bring in innovations in teaching such as demonstrations, experiments during the classroom teaching by designing low cost teaching aids and by using computer (Media) as technological aids. Making teaching aids is an emotionally, intellectually, aesthetically and professionally rewarding experience .It is an act of creation. It is an affirmation-an affirmation that I as a teacher care about the pupils and believe that, with the help of these learning aids they can learn. It is an act of love.

Teaching aids provide a stimulus for exploration and thinking. With the added input of verbal, personal communication with an adult interaction and discussion arise.... And these are crucial to real, activity based learning. Adults and older children, help younger ones to interpret sensory and language experiences to clarify them and relate them to their previous understandings. We must remember that children, who learn by blending language with experiences, learn to think better.

For maximum mental growth and personality development, a child's life needs to be filled with stimulating, encouraging experiences. Appropriate learning materials (teaching aids) help children to develop their innate abilities.

A classroom consists of heterogeneous ground, where they differ in their intellectual ability to abstract, generalize, reason and remember. In that sense, every child is unique and has unique ways of learning. As a result, a teacher has to adapt different methodology in order to create understanding among all children in a class.

As teachers, we have a wealth of information from which to choose for our classrooms. We can now bring history into the classroom through pictures, music and other visuals to a degree never before possible. We can communicate with students from other countries, and we can take classes from teachers we have never met in places we have never been. We can apply the Physics from classroom to simulations available to us through the internet, and we can develop projects across grade levels and campuses. Students are no longer limited by the walls of a classroom or the knowledge of a single text book. The world is available to most classrooms, even when students do not have their own computers.

We can bring media into the classroom through visuals, sounds, smells and tastes. Because our brains rely heavily on stimulus from the outside for learning, this is just one of the reasons that teaching with media is brain friendly. In addition, we should bring technology to the classroom because

- Technology is not limited by the classroom walls.
- Technology does not know or care what the student's socio-economic status may be, and thus helps to level the playing field for these students.
- Technology provides an equal opportunity for everyone to learn.
- Technology is more in tune with the way our students learn today.

- Technology is so much a part of the real world that to limit its use in the classroom is to limit our student's ability to compete in the world.

Why Media is Brain Friendly

Most researchers define brain compatible learning as learning that occurs:

- Using modalities that are most comfortable for the learner. For example, most learners are either visual or kinesthetic, thus a brain-friendly environment will lean heavily on teaching methods that include visuals, models, or hand-on-activities.
- In an environment that is positive and friendly and incorporates high expectations for everyone.
- In a classroom that utilizes research-based methods for teaching and learning.
- In a classroom that provides a variety of opportunities for learning.
- In a classroom that is flexible in terms of time, resources and structures. For example, if something is not working, the problem is identified, diagnosed and fixed rather than just moving on. If students need more time to learn, more time is given rather than sticking to a fixed timetable, regardless of the quality of the learning.
- In a classroom where quality is important and students are given rubrics or matrices that tell them in advance what is expected.
- In a classroom where standards are used and where students know the expectations. The students are provided opportunities to review their work in terms of given standards so that they know at all times where they stand.
- When specific feedback is given consistently and frequently. Just saying "Good job" is not enough.

We are being encouraged to use brain based strategies in our classrooms: one of the best ways to do so is through the use of media in the teaching/learning processes.

The Effect of Media on Student Modalities

About 98% of all incoming information to the brain comes through the senses. Add to that the fact that over 87% of the learners in the classroom prefer to learn by visual and tactile means and you have a recipe for failure if the primary methods of teaching are auditory. In Growing up Digital (1998), Don Tap Scott said that this generation prefers to be active participants in all that they do.

The Effect of Media on Motivation

According to Jensen (1997), interactive abstract learning that includes the use of various media such as CD-ROMs, the internet, distance learning, or virtual reality utilizes the categorical memory and requires little intrinsic motivation. Although traditional forms of education receive the greatest amount of the education dollars, they require a great deal of intrinsic motivation to be effective. Students must struggle to make the traditional type of learning work, since it is outside the context of its meaning.

The Effect of Media on Behaviour Management

We know that most of the discipline problems in the classroom are caused by such factors as boredom, not understanding the relevance of the information, and incorrect modalities for learning.

We also know that over 87% of the students in any given classroom are visual learners. Students who enter our classrooms have been a part of a multimedia world since birth. Students today are able to insert videos or DVDs of children's programs into the appropriate devices for viewing them from the time they were three years old .If they want to know something, they search the internet. It should not be surprising to us that these same students have difficulty sitting all day in classrooms that rely on low technology, such as overheads, whiteboards, lectures and note taking, as the major sources of information gathering. For the majority of students, who are visual, just hearing the information is not enough, they need to see it and to experience it. We lament the fact that students do so poorly in Mathematics and yet we teach this subject primarily by lecture and homework (i.e. drill and practice). If we can find ways to help these students see how the math works and how it is applied to the real world, we are more likely to have better math students. Media can help us get there quickly.

The Effect of Media on Reaching Higher Levels of Thought

There are so many great websites that encourage and teach higher level thinking and we must keep it in mind that we are doing injustice to our students if we do not lead them there. Using media is the key to moving students to higher –level thinking. Our students are already familiar with the Internet and many of the software programs required reaching such higher-level thinking skills as creativity, problem- solving, comparison and contrast and evaluation. We need to lead them to the best of the best in terms of media and to provide feedback as they work. Real world applications, such as the Physics software that explores how to design amusement park rides utilising g-forces without damaging the body, are exciting and fun, but they also lead students into problem solving and decision making.

To make Physics understandable, perceivable and enjoyable, we should be delivering our lessons by using technology also, in the form of power point slide show or by using the internet. We should incorporate technology in our day to day teaching process to create a conducive pro-technology environment in the class. At last I also want to share my experience with you. While teaching with technological aided lesson, I found that the students were very attentively listening and observing the lesson. Their face, were smiling with satisfaction. So, teaching through technology is indeed an effective method to engage the classroom as they relate to it with interest.

References & Acknowledgements

1. "Low- cost, No-cost Teaching Aids" by Mary Ann Das Gupta, National Book Trust (1997), ISBN: 9788123720548.
2. "What every teacher should know about Media and Technology" by Donna Walker, Corwin Press, (2003), ISBN: 1452239576, 9781452239576.

Message

On The High Road to Excellence!

Care more than others think is wise.

Risk more than others think is wise.

Dream more than others think is practical.

Expect more than others think is possible.

Work more than others think is necessary.

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Changing the Mindset and Reversing the Trend Back to Basic Sciences

Amrita Roy
Deborah L. Buam

Abstract

The financial lure of careers in information technology and management often takes away the best and the brightest and indeed the current trend of diminished attraction among the meritorious students for basic sciences is an issue of great concern. It has been observed that many adolescents after passing out from schools seem to be probing to know their aptitudes and skills. More often than not, it is for the reason that they are not able to know where they are good at, they may become good doctors or engineers or architects but at times parents know little but just push them into what they feel will lead to a lucrative career and job later in life. Not only parents but teachers or peers sometimes push them into careers which they do not have interest or aptitude for. In their perception, it has to be any degree that would fetch them one day a well-paid job be it in marketing or management while overlooking the skills and aptitudes that the students have. Several interrelated factors have contributed to this and as mentioned, the one important reason is the perception of careers and opportunities in science among students, teachers, parents and general public. Thus, there is a need for promoting a culture of science in the country with special emphasis on inculcating scientific behavior in students and teachers alike. This paper attempts to emphasize the fact that it is imperative to reverse this trend and retain talented young students in careers of science.

Keywords: *Basic sciences, Careers in Science, Scientific behavior*

Introduction

We live at a time when we had witnessed the charm of taking science as a career option in the past few years, where students took up science and had the ultimate aim to be a doctor or engineer; but we also witness now that somewhere along the way, science as a career seems to have lost the charm and not much of a passion for many. The declining enrolment in basic science courses today, whether in the Secondary or even in the Higher Secondary level has been observed not only in our country but elsewhere and it has become urgent to change the mindset in the young minds. As we all know, today's changing world brings new radical implications that the conventional teaching learning methodologies need to be upgraded so as to motivate the students to be able to think outside the box, the teachers therefore need to provide the optimum conditions in order to maximize the learning process. Academic and research careers in science, once highly regarded are no longer valued. Poor image of undergraduate science education in colleges and universities sometimes demoralizes even the motivated students to pursue a science career. The paper tends to highlight the reasons for the declining rate, strategies to meet challenges and the need to inculcate scientific behavior.

Reasons for the Declining Rate of Students Pursuing Science Courses

There seems to be big challenges at this juncture when the trend to basic science seems to have faded along the way for reasons that are known to many; the need of the hour is to revive again and change the mindset to reverse the trend back to the basic science courses.

The reasons are well known to all of us, in many cases, we observed that

- ➢ Students at times are carried away with some kind of phobia when it comes to taking up Science courses, even the young minds who have high aspirations and interest, and bright as they may be, yet are overcome by that phobia that it is such a tough course which they may or may not be able to pursue.
- ➢ Students are attracted to the management courses that seem to capture the young minds with talents in science to pursue courses that would fetch them money and power as because in this growing consumerist culture, prestige attaches to careers fetching more money.
- ➢ Other reasons which add to it are lack of basic infrastructure, especially the educational institutions in the rural areas where poor infrastructure is one of the main reasons that led to the poor enrolment of students.
- ➢ Bureaucratization and lack of independence both in government and private institutions and the way science is taught in schools and colleges in our country.

- Lack of information about the various schemes and avenues open to students in a career of science ultimately puts off students from taking up science.
- Another important reason could be that the underprivileged or disadvantaged group of students with a passion for science often drift away from taking a career in science for high fee-structure, like in an institution where many students come from rural areas.

Strategies to meet the Challenges

- Often students show keen interest in learning science in schools but the interest wane as they reach higher secondary level. According to several findings the number of students taking up science is going down drastically. One needs to have strategies in order to meet the challenges and some strategies may be mentioned as
- The awareness of basic science courses and options is important as it would enhance knowledge of the surroundings and there is a need to popularize careers in science through various channels and media.
- There is a need for common effort to address the challenges and find out means to attract the youth to careers in science by conveying a sense of excitement and creating suitable employment opportunities for them.
- The government needs to supplement its help through financial aids for the meritorious students who are in financial need.
- There should be widespread emphasis on encouraging students to take up basic science courses from the school level in order to create sustained interest in the minds of students. The basic objective should be to communicate to the youth the excitements of creative pursuits of science from an early age to be able to experience the joy of innovation.
- Science teaching in schools should be more scientific and science projects more interesting. The teaching faculty and management should take the responsibility to inculcate an awareness of science for the advancement of the nation.
- Science should be taught in a way that it is a pleasure and not a burden for the students, more experiments and practical illustrations should be the norm which would help to catch and tap the young minds faster.
- Finally there is a need for curricular reforms with emphasis on improvement of textbooks which should be made more

comprehensible and thereby reduce the load on students.

- Some kind of reform movement should be started where teachers become part of it; teachers need to inculcate scientific behavior in students with an eye for creativity that goes outside the confines of formal school disciplines.
- An increase in number of scholarships and good investment in science education is necessary to encourage and help the talented students especially these from disadvantaged groups.
- Since many students and parents are unaware of careers and opportunities in science, it requires wide publicity; also colleges should have close association with leading scientific research institutions to take advantage of existing research ambience, more collaboration and networking between colleges and science institutions would be an asset. Adequate assistance should be given by the government to establish world-class science centers.

Inculcating a Scientific Behavior

Science education today needs to intersect with the society in many ways, and as the students of this generation live in an age of exponential leap in scientific knowledge and application, there is a great demand that higher education system has to satisfy to make the required changes in courses and curricula. The curriculum does not really mean just inclusion of subjects to be taught but the totality of experience to be provided to the students through the various educational activities like career counseling, classroom experience, field trips, study tours, group discussions, project work etc. Teachers have a unique role to not just maximize the learning process but also to shape the students to become effective citizens in the society and to be able to reach the competitive edge in the job market. However, the most important message is that we as a nation in general, and particularly the youth need to develop a scientific culture and attitude from an early age. Taking up Science courses should no longer be a phobia but a passion. Science is one of the foundations of economic growth of a country and indeed it is one of the cultural indicators of a civilized society.

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Values in Science Education

M. Kharkongor
R. Nongrum

Abstract

Value and Education are like the two sides of the same coin, where education without value is meaningless and value with no education cannot be achieved and brought about in a desired manner. With the onset of Globalization and liberation, all nations of the world are striving utmost to bring into the lives of their people the marvels of Science and Technology. Materialism has become part and parcel of Human lives leading to the degradation of the moral values especially among students. This has become evident from the fact that there is a wide spread of conflict, misery, lawlessness, corruption, extortion, hypocrisy, falsehood, etc. surrounding us. Science Education plays a vital role in enhancing awareness and sensitivity to moral aspects of major issues and concern of modern life and also to develop in students the ability to reflect with an open mind on the moral dimension of social events and incidents of everyday occurrence.

Keywords: *Personal Code of Conduct, Value Education, Indian Education Commission, Environment and Health, Teaching Mathematics*

Introduction

The Oxford dictionary defines Values as "principles or standards of personal code of conduct where the fundamental truth or law is the basis of reasoning or action; or one's judgment of what is important in life." Values are the beliefs by which people steer themselves through life- they are the basis of our decisions and choices because they are born out of the craving for happiness that lies deep within every human heart. "Education, on the other hand, is to acquire the knowledge, skill and values, personal and social, deemed appropriate for the society". It aims to bring an all round development of an individual- physical, mental, intellectual, moral and spiritual. In other words, education aims to reach the cognitive, affective and psychomotor domains of an individual. Although the affective domain was clearly important, the role of the psychomotor domain was not well understood and education tended to stress the cognitive domain only. Today, education components are more likely to cover intellectual, communicative, social and moral, personal and physical, and aesthetic attitudes (Hong Kong Curriculum Development Institute, 1993). However, by noting that communicative and aesthetic qualities are linked to the individual, whereas social and moral are more societal aspects, it is suggested that the sub-division can be more conveniently expressed as Cognitive, Personal and Social domains. While the cognitive domain is still stressed, there is a clear recognition of the need to educate the individual and to develop social attributes towards creating responsible citizens.

Value Education

Value Education forms an integral part of the education process at all stages and it is one of the potent factors most likely to influence and modify one's conduct. Value education fosters right attitude, habits and also establishes a sense of personal and social responsibility in an individual. In the present world, we are going through a crisis in our social and political life as the value of idealism, altruism, selflessness and service to fellow human beings are vanishing because materialism has become part and parcel of human lives, leading to the degradation of these values. In all aspect, of life, crime, violence, cruelty, greed and apathy to human suffering is on the rise due to the disregard shown to basic values like honesty, tolerance, patience etc. Education conducted in its true spirit leads to the development of the human personality in all its richness- intellectual, physical, social, moral, etc. and enables a person to think in terms of right or wrong, true or false, reasonable or unreasonable. Therefore, every cultured society has developed some educational system to operate within its socio-economic and political system. Hence, there is a need to incorporate value education in the educational system to inculcate a sense of humanism and a deep concern for the well being of others and the nation.

The Indian Education Commission 1964-66 recommends that 'conscious and organized attempts be made for imparting education in social, moral and spiritual value'. The report of the Committee of members of parliament on the National Policy on Education 1967 emphasizes the need for 'cultivation and formation of right attitude and value among students. There has been an imbalance between scientific values and moral values throughout the world. Nehru emphasized the need to combine the progress of science and technology with the progress of mind and spirit. The Indian Education Commission 1964-66 writes 'we believe that India should strive to bring science and values of spirit together in harmony'. It further adds that we can 'harness science to support rather than weaken our basic commitment to cultural and spiritual value'. The National Policy on Education (1986) expressed concern over the erosion of essential values and an increasing cynicism in society and thereby stressed the need for readjustment in the curriculum in order to make education a forceful tool for the cultivation of social and moral values. It also emphasized the combative role of value education in helping to eliminate obscurantism, religious fanatism, violence, superstitions and fatalisms. It was also recommended that primary emphasis was to be laid on the inculcation of the positive content based on our heritage, national and universal goals and perceptions.

UN Declaration

The United Nation declared 2005-2014 as the United Nation Decade for Sustainable Development, laying emphasis on the development of skills and values like moral, cultural, gender sensitivity, participatory democracy, collaboration, unity and peace. Our values and attitudes determine our behaviour towards other people and all the activities in the environment, thereby influencing the prospects of achievement of a sustainable future. However, in the process of discussing sustainable future with the students, sometimes one may encounter issues that reflect contrasting values. It is important that these issues be tackled in a congenial and conducive manner by adopting a positive and optimistic approach and the use of critical thinking skills. This viewpoint is most clearly expressed in the European Commission White Paper on Education and Training (European Commission, 1995) which argues that: "Democracy functions by majority decision on major issues which, because of their complexity, require an increasing amount of background knowledge. ... At the moment, decisions in this area are all too often based on subjective and emotional criteria, the majority lacking the general knowledge to make an informed choice. Clearly, this does not mean turning everyone into a scientific expert, but enabling them to fulfill an enlightened role in making choices which affect their environment and to understand in broad terms, the social implications of debates between experts. There is similarly a need to make everyone capable of making considered decisions as consumers."

It is necessary to integrate value messages in the teaching of science and make the teaching- learning process not only cognitive but also affective. According to J. Osborne, 'any science education consists of four elements:

1. The *conceptual* that builds students understanding of the knowledge and ideas of science.

2. The *cognitive* which attempts to develop students' ability to reason critically in a scientific manner.
3. *'Ideas-about science'* which is an attempt to develop students understanding of the epistemic and the process, values and implications of scientific knowledge and
4. *'social and affective* which attempts to develop students' ability to work collaboratively to offer an engaging and stimulating experience.'

Science Education

Integrating values into science education is a challenging task for the educator and different strategies has to be developed and explored to achieve the desired target. It is important to recognise that the selection of the subject matter and its presentations should highlight a particular value which will have a powerful impact relating to the matter of the science topic presented. The extent and direction of portraying this influence will depend on the teacher's awareness of values ascribed to the particular discipline. It has been expressed by Edward Rugumayo (1984) in discussing science education and the needs of developing countries as follows "......the challenge is thrown at science educators to carry out innovations into new methods of science education, taking into account work done elsewhere in the world, and incorporating this into their own home produced approaches. But for them to be successful, science educators in developing countries have to make their science relevant, practical, and problem-oriented, and in the process produce persons who have the creativity to apply acquired knowledge to new situations, the competence to get things done, the curiosity to discover and understand the world around them; and the compassion to put science education to humane needs".

Studies have shown that a socio-scientific approach towards the teaching of Science have proven to be very effective, whereby the main objectives of learning as well as awareness of the social values are achieved. In a science classroom, personal and moral values like responsibility, co-operation, unity, respect for others viewpoint, etc. can be inculcated through group activities and experiments. These values can be taught by addressing the "why" and not just the "what" of the subject thereby developing the student's mental structure and also help instructors to recognize and deal with particular widespread and deeply ingrained misconceptions.

The various Environment and Health issues have important values, whereby to understand the various social, moral problem faced today, basic knowledge is required which is provided from science Education especially Biology which is the science that extends our knowledge and understanding of the natural world including ourselves. Living organisms including plants and animals have inspired us in many ways for instance in literature and particularly in art. Julain Huxley, a famous scientist, and also the first Director General of UNESCO wrote: 'The witnessing of wild life on a grand scale can give a sense not only of privilege but also of wonder and deep emotion. To see large animals going about their natural business in their own natural way, assured and unafraid, is one of the most exciting and moving experiences in the world.' (UNESCO, 1973). The object of conservation is to ensure Earth's capacity to sustain development and to support all life'. The World Conservation Strategy embodies Huxley's feeling for the natural world together with a 'scientific' analysis of man's impact. 'Human beings in their quest for economic development and enjoyment of the riches of nature, must come to terms with the reality of resource limitation and the carrying capacities of ecosystems, and must take account of the needs of future generations'. Traditional areas of Biology such as nutrition and feeding behaviour, breeding and genetics, territorial and social behaviour can be studied through pet animals. The skills of observation, hypothesizing and inferring, as well as encouraging communication through group work can be developed by a visit to the zoo or natural reserves.

Chemistry plays an important role in enhancing the learning process in the cognitive, personal and social domains. Different topics in Chemistry can be correlated with the personal values. For example, while discussing the periodic table, the uniqueness and the importance of each element could be related to the different nature of people, the state of mind of a person could be compared to the various reactions taking place under different optimized conditions. Also to make Chemistry affective, it is important to co-relate the issues in society with the conceptual chemistry and thereby incorporate the making of rational decisions.

V.M. Talisayon, in discussing the role of Physics to promote gender sensitivity, stressed on the equal participation of both girls and boys in all group activities and also highlighted the encouragement of girls in the handling of electrical and electronic devices.

Value education in the teaching of Mathematics favours rationalism in the ideological dimension which helps to inculcate the belief in reasons as a guiding principle in life. In the sociological and sentimental dimensions, Mathematics teaches openness and empiricism where knowledge is derived from sense of experience. In short, it can be summed up as " Mathematical literacy is an individual's capacity to identify and understand the role that Mathematics plays in the world, to well founded judgments and to use and engage with Mathematics in ways that meet the needs of individual's life as a constructive, concerned and reflective citizen" (OECD, PISA, 2003).

Conclusion

In conclusion, Science education should enable the future citizen to live and act with reasonable comfort and confidence in a society that is deeply influenced and shaped by the artifacts ideals and values. In the words of Lin Zikai, "If every teacher is equipped with such a value system and can infuse values in every lesson, values-centric education will become integrated in their lives and not as a separate subject." For long, explicit teaching of values in science is rare. Values have been perceived as a nuisance because they prevent inquiry. Nevertheless, science education can be transformed to be value laden by making scientific approaches more objective, accurate and precise in the pursuing of truth; to respect human significance through intellectual and academic honesty; to make curious scientific enquiry fair and just with courage, humility, integrity and open-mindedness. The goal of science education is not only to produce scientists but also to prepare well rounded, clear thinking and scientifically literate citizens; thereby, helping young people acquire the knowledge, skills and values they will need as productive adults in an increasing technological society.

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Value Education – The Need of the Hour

S. Khyriemmujat
M. B. Lynser
A. B. Basaiawmoit

Abstract

The present day crisis of moral and social values that is witnessed in India and all over the world points to the facts that value education continue to remaine a neglected dimension in the scenario of higher education. The aim of education is mainly to cater to the needs and problems of humanity wherein value education forms an integral part in the educational process. Value education refers to the social, moral, aesthetic and spiritual side of man's personality that contribute to the well being not only of man himself but that of others and society at large. However, loss in the values of society in the present day, clearly highlight that the system of education have not been able to meet the changing demands and needs of society. For instance, inequalities in social strata, cultural crises, environmental degradation and others are posing serious threats to the quality of life. Therefore, this paper attempts to highlights the issues and problems that is related to the neglect of value education in the present day educational scenario.

Keywords: *Educated Unemployed, Role of Education, Cultural Preservation, Social Attitude, Environmental conservation*

Introduction

Education is a lifelong process which involves imparting survival skills, developing the individuals 'innate potentialities', physical, mental emotional, social and spiritual, and making the individual fit for his/her environment. It includes all knowledge, experiences, skills and attitudes and also involves socializing the individual. Therefore, through education, a man can become a worthy citizen where we can hope for a more human and humane nature and a more harmonious and inclusive society.

Education in its true sense should heighten a person's awareness of oneself and one's relationship with the outside world of nature and other human beings and not only about providing employment as many people seem to have understood. The role of education is to inculcate knowledge and skills to make the person more equipped to face the future. But as of today, education has degenerated into a process of information transmission with the primary objective of producing examination results.

A. K. Nongkynrih (2002: 62) in his paper "The Educated Unemployed: Its fall out in the Society" noted "It is also absurd to think that education provides employment. It is not the role of education to provide jobs. Its role is to inculcate knowledge and skills to make the person more equipped to face the future". While job oriented and career linked education has to be given the weightage it deserves, this should not compromise the fundamental principles of higher education that seeks to develop a man into a complete human being. Therefore, the educational aims of the society have to be shaped in such a manner so that the process of education can cater to the problems and needs of humanity.

Role of Education

In this context, as stakeholders in the educational system are we not to ask ourselves why are we educating or being educated? Is it not true that education is about character building, shaping lives, learning to live as a citizen with rights and responsibilities? Yes, education aims at imparting information and skills that will eventually help us in acquiring jobs but through education, a person also acquires codes of conduct and moral values. By being educated, a person is able to analyze, learn and decide rationally for him or herself. It is in this context that value education in the curriculum plays an important role.

Meaning of Value Education

Value education refers to a planned educational action aimed at the development of proper attitudes, values, emotions and character in the learners. The phrase has very wide connotations and covers all aspects of personality development-intellectual, social, moral, aesthetics and spiritual. The question of the content of value education can only be approached from two angles-the individual and the social. Viewed in this light, the actual values that education is to promote should be derived from our nationalistic aspirations and universal perception keeping in focus our commitment to a democratic, socialistic, secular, social order. They should also enjoy universal acceptance by the different sections of our people cutting across diversities. These values are democracy, equality, social justice, scientific outlook, secularism and other values that are related to preservation and transmission of our cultural heritage, conservation of environment, promotion of social cohesion and national unity and at the same time ensuring a reasonable quality of life for all in the context of exploding population.

This paper draws attention to the neglected dimensions of the present day educational system where value, education should be an integral part of the educational curriculum whereby it is a means of cultural preservation, and a medium of building the right social attitudes and creating consciousness towards the environment as a whole. The intended interventions could be attempted through regular curricular and co-curricular activities of the educational institutions. It is not a matter of absolute necessity that there should be a separate course but rather it should integrate with and enrich the entire curriculum.

Education in Cultural Preservation

Edward Tylor has defined culture as "that complex whole which includes knowledge, belief art, morals, law custom and any other capabilities acquired by man as a member of society". (Ogburn, W, F. and Meyer, N. F. 1972: 29). So, culture is a growing whole and there can be no break in the continuity of culture. However, the forces of globalization, telecommunication revolution and the emergence of the market economy in a qualitatively new form has led to the establishment of "popular culture" or "mass culture" in both the rural and urban settings of our society. This has also sharpened the consciousness of social inequality and raised the level of aspiration which has led to the one dimensional approach of education without an educate value-based option.

In this context, the renowned sociologist, Emile Durkheim sees education as the socialization of the younger generation. It is a continuous effort to impose on the child ways of seeing, feeling and acting which he could not have arrived at spontaneously (Sarangi 2011:252). Therefore, education has as one of its fundamental goals the imparting of culture from generation to generation. These cultural elements which refer to a set of beliefs, skills, arts, literature, philosophy, religion, music etc. which must be learned, are passed on through the agents like family, school and other association.

The social vision shaping school curriculum in India as of today is of a culturally and economically unequal society and not a just and egalitarian one. The department of education of Groups with Special Need, NCERT, in its background paper (Consultative Workshop) on Development of guidelines for addressing the S/C, S/T and Minority concern reflected in the NCF 2005 and NFG paper noted that, the school curriculum fails to take account of tribal cultures as autonomous knowledge systems with their own epistemology, transmission, innovation, and power. Not only are the knowledge and linguistic and/or cognitive abilities that

ST children possess ignored – for example, the capacity to compose and sing spontaneously, to think in riddles and metaphors, and their intimate knowledge of their environment – but schooling also actively encourages a sense of inferiority about ST culture.

"Value Education" was has merely introduced as a subject in schools in the 20th century from the primary to the secondary level based on imbibing values which are expected of the individuals by the society but it could not fulfill this goal. Further, in this value education system, there is also a danger that the student will learn nothing that will help him become a unique individual as he or she will not be able to indulge one's creative impulses but instead they will be forced to follow a seemingly stagnant course.

Therefore, education then clearly has to do a lot in order to bring about a social and cultural change within a society that desperately needs to grow from the stagnant marshes where our society is currently waddling, into the dynamic of social cultural and economic development that it needs to be. Focusing on education, both formal and informal, the curriculum of an institution, its extra-curricular activities and the informal relationships among students and teachers must be such that they should communicate social skills and values. Through various activities, schools can impart values such as cooperation, creativity, obedience, discipline etc. Education, thus, acts as an integrating force in the society by communicating values that unite different sections of society and at the same time encourage creativity. In other words, education teaches skills to the children which not only preserves culture but at the same time help them later to integrate with in the culture of the society.

Education in Building Social Attitudes

For man to be socially acceptable in society, he must build the right social attitudes. But, man is a social animal and this modern society in which he lives grooms or develops his attitudes towards life and society in general. When we talk of social attitudes as parents or teachers, we wish our children to be co-operative, creative, kind, tolerant etc. We think that these attitudes towards people and things in their lives can be groomed and nurtured in their 'second home' – the educational institution. However, the false belief that education is nothing but a means to acquiring material riches and success is the root cause to many tensions and anxieties in our society. Thus, in this aspect it is important for us to realize that however valuable education may prove to be vocationally, it may nevertheless be inadequate if it fails to impart a sense of social responsibility.

Therefore, though policy makers have implemented the Right to Education in India, it is seen that poverty is still one of the fundamental deterrents to educational access and attainment. The 1990 World Conference on Education aimed at eradicating extreme poverty and improving the welfare of their people by the year 2015 and the second goal is to achieve education for all. Education builds what Amartya Sen (1999) calls "Human Capabilities" since it has been felt that investment in human resources will directly contribute to economic development and growth by promoting the knowledge and application of Science and Technology to production process, training workers in different skills and building up the right type of attitudes, values and interest conducive to higher output.

The idea of pursuing education for most of the people is tempered by actual economic possibilities and do not look at it as an opportunity for 'self' expression, 'self' realization or personality development through which the self can contribute to society. Further, looking at the current existing situation from a different angle, we find that the ideologies, to which our nation has declared its commitment, have come under severe strain. Forces of social and national disintegration have become active, putting our democratic society to the test because of the concern of the self with myself and my kind. The rise in population has indirectly affected the quality of life of the masses and has caused social tensions and unrest as this age is an age of survival of the fittest. Crime, violence and indifference to human sufferings have spread to all walks of life and these problems cannot be tackled effectively unless education or more rightly, value education changes the very outlook of man and his values. In fact, education or rather in particular, value education when integrated with the entire learning process can nurture these innate and inborn human values which are essential for making every human 'a real human being'.

In other words, to meet the needs of the society, 'education' has to play a significant role to build the social attitudes among the people, to prove useful 'input' for the nation. Education should not merely lay stress on subject centered "Curriculum" and communicate textual information, but should make them aware of their obligations towards society. This creation of awareness of an individual's obligation towards society is the building of social attitudes and these attitudes can be imbibed through the curricular and co-curricular activities in educational institutions which would help the students change their outlook from 'the self' to 'the society'. In turn, this change of outlook would usher in growth and development of society and the country as a whole. Therefore, this is the solution of the main social and educational problems of transforming 'output into inputs', to serve people and to meet the requirements of society.

Education in Environmental Conservation

Today, ecological challenges are growing in every part of the earth, whether regions are developed or developing in industrialization and modernization. Our physical environment – rivers, mountains, forests, plants and animals life, is getting increasingly polluted and depleted of its resources and this has posed a serious threat to the quality of life of our people. Current priorities in terms of economic growth with no concern for aspects such as sustainability or equitable use of resources are one of the causes of environmental degradation. In addition to this, lack of adequate education often results in mindset with improper thinking towards the environment. Therefore, it is extremely important to imbue in learners an environmental consciousness through education. Only when today's youth are made aware and knowledgeable about the environmental disasters facing the earth, will they be motivated to conserve nature and find solutions to the problems, both local and global that loom on in the horizon. The pre-eminence of the natural environment in our everyday life and culture makes it all the more important that environmental education be given a high importance and place in educational reform and innovation.

A study by Howe (2009) emphasized the importance of education as a useful tool for environmental conservation and sustainable development. Education, both through formal and non-formal processes, must be planned in a way that environmental concerns and values are inculcated in students throughout their lives. One of its main aims should be to impart an understanding on environmental, natural and cultural values, social justice, human heritage, equitable use of resources, managing common property resources and the causes of ecological degradation. Essentially, environmental values cannot be taught. They are inculcated through a complex process of appreciating our environmental assets and experiencing the problems caused due to the destruction of our environment. Values in environment education is expected to bring about a better humanity, one in which we can live healthy, productive and happy in harmony with nature.

Environmental consciousness deserves to be propagated for all ages and all sections of the society beginning with the child. In 1991, the Supreme Court of India issued directives to make all curricular environmental oriented, so as to create environmental awareness among all its citizens. Hence after, Environmental Studies was made mandatory for undergraduates and Environmental Education was introduced as a subject for students of Class 1 to 12. The proposed syllabus for this subject by NCERT at the Secondary and Higher Secondary Stage and by UGC at the under-graduation level has been developed with the aim to instill sound environmental ethics in the society. Despite this step, environmental education problems are still far from over. The question still being examined is whether environment should be taught as a separate subject or it should be infused with other subjects or be integrated in the entire education process. Further, the current structure of curricular, not only lacks an exposure to outdoor activities but also is found to be wanting in developing creativity of thought and ideas and innovation as it is more grade based approach, a reason why the students seek only better grades, not better understanding or engagement with the issue. If the target is to address issues and develop innovation to solve the current problems, there should be a paradigm shift in the way we and our society approach and envision education. And this shift should not just be restricted to the 'environment' part of the education system. But the sole focus, after analyzing the current system and education curricular, seems to make the students 'aware' and 'informed' about the issues and concepts alone. While this is important, it should be followed with a plan of action on how to get the students 'engaged' with the issues, otherwise our efforts will yield only half-baked results. It has also been noticed that local environmental issues are not given importance in the syllabus, making the students unaware of what is really happening. Therefore, consideration should be given to the types of educational programmes that can meet the requirements for creating environmental consciousness amongst its learners. Students should be taught things which they can see around them and activity based approach should be integrated into the learning process to achieve the true goal of 'education'.

Conclusion

Therefore, in conclusion we would like to reiterate Swami Vivekananda's definition of education which is "the manifestation of the perfection already in man". This so called perfection can be manifested in the life of man only if the disciplines integrate value education be it moral, social or environment so as to awaken the innate and inborn human values and transforms him or her into a true human being-one who realizes his obligation to society. None the less, worldly education is necessary but value education is the need of the hour. We, as stake holders in the education system, should strive for both, for to be a true human being in the real sense, requires qualities of both the head and the heart.

Referrences

1. Annonymous, 2008. Background paper by the Department of Education of Groups with Special Need, NCERT, (Consultative Workshop) on *Development of guidelines for addressing the S/C, S/T and Minority concern reflected in the NCF 2005 and NFG* organized by Dept. of Education of Groups of Special Needs, NCERT, New Delhi at Shillong from 17th to 19th December, 2008.
2. Brubacher, J. S. 1950. *Modern Philosophies of Education*. Mc Graw-Hill Book, New York.
3. Howe, C. 2009. *The Role of Education as a Tool for Environmental Conservation and Sustainable Development*. A Ph. D. Thesis, Imperial College London, United Kingdom.
4. Nongkynrih, A. K. 2002. The Educated Unemployed: Its Fall Out in the Society in *5th Annual General Conference of the Meghalaya College Teachers Association-Souvenir*. St Anthony's College, Shillong.
5. Ogburn, W. F. and Meyer, N. F. 1972. *A handbook of Sociology*. 2nd ed. Eurecia Publishing House, New Delhi.

6. Sarangi, A. 2011. *Foundations of Sociology.* Damini Garg for Murari Lal & Sons, New Delhi.
7. Shah, B.V. *Education and Social Change among Tribals in India* in P. M. Challo (ed), *Tribal Communities and Social Change*. Sage Publication, New Delhi.
8. Singh, Y. 2006. *Culture change in India Identity and Globalization.* Rawat Publication, Jaipur.

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Innovative Learning Environment

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Abstract

Contemporary learning environment is not sustained by working in isolation but in-stead need to be more exposed and creative to make teaching and learning interesting and more effective. The alternate way is to create creative classrooms which are innovative learning environment. In its widest sense, includes all types of learning environments, for-mal and informal settings. New methods and ideas which are creative and effective were delivered and shared to meet the students need and expectations. This paper tries to share some of the methods and ideas to modernise the learning and teaching techniques in our state, Meghalaya.

Keywords: *Learning, formal, Informal, Classrooms.*

Introduction

Contemporary learning will not be sustained by working in isolation but instead needs to be more exposed and creative, to make teaching and learning interesting and more effective. Creative Classrooms (CCR) are innovative learning environments that innovate and modernise learning and teaching practices. In its widest sense includes all types of learning environments in formal and informal settings. In CCR, open education principles (Liyoshi & Kumar, 2008) are fully implemented in practice at all levels. Curriculum and content are open, providing learners with concrete opportunities for developing 21st century skills, such as problem solving, inquiry, collaboration and communication (Stefania Bocconi et al, 2012). The CCR concept is based on innovative teaching and creative learning practices (Personalised learning, collaborative learning, entrepreneurship, etc) as document in the literature (Cachia, et al, 2010, Ferari, Cachia and Punie, 2009 b, Microsoft, 2011). In CCR, the learning process is not rigid, it is able to change easily depending on the different conditions and circumstances that may occur, to meet the needs and expectations of the learner. In CCR, learners not only have to take responsibility for their own learning progress, but also have to support each other in jointly creating the learning content and context. The role of CCR is to support more engaging and playful approaches to learning and should encourage collaboration and peer learning. The learning process should make use of different sensory channels, provide new formats for creative expression and encourage learners to experiment with different innovative ways of articulating their thoughts and ideas (Bocconi & Trentin, 2012, Redeeker, et al, 2009). In CCR the teachers play an effective role as mentors and facilitators of learning and act as role models of creativity and innovation. Therefore, the skill sets of professional teachers should shift from subject knowledge towards expertise in pedagogy (Hannon, 2009) in order to effectively foster creative learning and innovation attitudes in learners.

Keeping the above information in mind, this paper tries to high light the need to make learning environment more friendly, creative and interesting to the learners. The following are some of the parameters needed to be dealt with seriously in the present day and age to innovate and modernise the learning and teaching techniques.

Emotional Intelligence

Emotional intelligence should be valued in CCR as it is a key factor for creative learning .The role of CCR teachers is to help the learners learn how to control their emotions, to have a positive outlook and to learn to tackle the situations in the present day and age, to have a self control and empathy for others. Research reveals (Domitrovish, Cortes and Greenberg, 2007) that after exposure to the Promoting Alternative Thinking Strategies Curriculum –PATHS for nine months, young learners had higher emotional knowledge skills and were rated by parents and teachers as more socially competent compared to peers from a control group.

Learners Thinking Ability

The duty of the CCR teachers is to motivate learners to develop and expose their talents and creativity in any field of their interest to the fullest extent. The learners should apply their prior knowledge and exercise their independent thinking ability in order to enhance both soft and hard skills.

Learners Interest and Preferences

To motivate creative learning to the learners ,the CCR teachers should take into account their backgrounds, cultures, interests, goals, skills and prior knowledge (Stefania Bocconi, et al, 2012) and then guide them according to their interest and preferences (e.g. through social net works).

Fostering Soft Skills

In CCR ,a great variety of activities should address transversal soft skills, such as problem solving, collaboration and cultural awareness, in order to facilitate the learning of the equally important and complementary hard subject – specific skills such as online collaboration, problem solving and cultural awareness (Stefania and Bocconi et al,2012).

Equity

Learners coming from different classes or backgrounds should be given equal chances to participate, display their creativity and to expose their talents. This will help them build up their confidence, become socially stable and reduce dropouts and failures.

Innovative Time Tables

Innovative, flexible (Csikszentmihalyi, 1996) and tailor made time tables should be used for providing teachers and learners with more opportunities and time to engage in creative learning in CCR.

Infrastructure

All basic facilities in CCR should be equipped to enable the teachers and the learners to have an access to multimedia rich contents and online services which offers great opportunities for innovating learning and teaching practices. Recent research (Johnson, et al, 2011; Redecker & Punie 2010) shows that infrastructures such as broadband networks, web applications, smart phones and tablets, offer great opportunities for innovating learning and teaching practices (i.e. online learning).

Physical Scale

The physical CCR space should take advantage of colors, lights, sound, materials etc in order to provide a flexible, aesthetically appealing and inspiring environment for innovative teaching and creative learning (Burke, 2007).

Exploratory Learning

CCR teachers should motivate the learners to explore complex concepts by making use of whatever resources available. e.g. online learning (audio, video), online access to remote laboratories with advanced equipments.

Creative Learning

CCR should involve the learners in many related activities that will help them generate and develop their own methods and ideas which are of their imagination and nurture their creativity. Students can demonstrate their creative imagination and innovative ideas like designing, video making etc e.g., stop motion animation is among the techniques used in many schools worldwide for learning by creating.

Play-way Method

Learning by playing in CCR, will enhance the learning ability of the learners as both physical and mental powers are involved in the process of learning. Learning through a variety of digital games will help them improve their literacy and numeracy skills and confidence.

Peer to Peer Collaborations

As learning is a social process rather than an individual one, CCR should constantly encourage peer collaborations. This fosters learner's ability to think both independently and with others, and enable learners to consider a plurality of points of view that helps creative thinking. Such peer collaborations across networks are likely to increase creative learning, both in formal and informal settings (Stefania Bocconi, et al, 2012).

Informal Learning

The learning experiences delivered in an informal environment can spark student's interest and provide opportunities to broaden and deepen student's engagements, concepts and practices. e.g., fieldtrips, seminars, group discussions etc.

Social Networks

In CCR, social networks should be used in order to increase interaction opportunities within the school community, opening up and modernizing internal processes.(Ala-Mutka,2010).Evidence shows that social computing(blogs, twitter, LinkedIn etc)supports the interaction and collaboration among the learners, as well as among teachers, enabling collaboration across borders, cultures, language barrier and institutional walls(Selwyn,2011).

Assessment

Assessment should incorporate creative tasks in order to engage and motivate learners, while assessing complex skills, such as collaboration and problem solving developed inside and outside school, which cannot be measured with conventional assessment tools (Stefania Bocconi, et al, 2012). Evidence based research reveals that it is possible to assess creative learning in order to promote it (Ellis,2009).One of the most promising methods for assessing creative learning would involve the review of learners portfolios of creative works. CCR should embed a plurality of methods and tools for formative self and peer-assessment (OECD/CERI,2010a).These methods and tools should provide a record of learners thinking and reasoning-assessing competences rather than factual knowledge- in a form that is accessible to the teachers for monitoring and feedback purposes.

Discussion

The vast diversity of the course content in any course of study is over taxing the learners. As such, it has been found (Authors own observation) that they lose the interest to learn more or dropout from the course. The only way to overcome this problem is to make the learning environment more attractive in several ways i.e., by making teaching and learning process more flexible and creative. Learners should be at the center of any learning process. Accordingly, curricula and methods are continuously sensitively adjusted to respond to individual learners' needs in order to foster their intrinsic motivation and allow for self expression (Redecker,et al, 2011). By empowering learners with self regulation skills in order to help them to take control of their learning process, promoting self directed learning skills(Hattie,2009).Encouraging learners to apply their prior knowledge, inquiry and independent thinking in order to enhance both soft and hard skills(Stefania Bocconi et al, 2012). Personalization, collaboration and informal ways of learning are at the core of creative learning practices (Ott & Pozzi, 2010, Redecker, et al, 2011).

The parameters discussed above cover both formal and informal ways of learning. It is hoped that the suggested parameters might bring about significant changes in the learning process, where learners can express their own skills, interests, preferences and develop their creative potentials in many ways. It might also help to provide educational policy makers with thorough understanding of key elements that need to be addressed in order to innovate and modernize education.

References

1. Ala-Mukta, K. (2010). Learning in informal Online Networks and Communities (JRC scientific and Technical Reports No. EUR 24149 EN). Seville: European Commission-Joint Research Centre Institute for prospective Tecnological Studies. http://ipts.jrc.ec.europa.eu/publications/pub.cfm/id=3059.
2. Bocconi, S. and Trentin, G. (2012). Wikis supporting formal and informal learning. New York, Ny: Nova Science Publishers.
3. Burke, C. (2007). Inspiring spaces: creating creative classrooms. Curriculum Briefing, 5 (2): 35-39.
4. Cachia, R., Ferrari, A., Ala-Mukta, K. and Punie, Y. (2010). Creative Learning and Innovative Teaching: Final Report on the study on Creavity and Innovation in

Education in Eu Member States. Seville: European Commission-Joint Research Center-Institute for prospective Tecnological Studies. EUR 24675 En. http://ipts.jrc.ec.europa.eu/publications/pub.cfm/id=3900.

5. Csikszentmihalyi, M. (1996). Creavity: flow and the psychology of discovery and invention . 1st (edn.). New York: Harper Collins Publishers.

6. Domitrovich, C.E., Cortes, R.C. and Greenberg, M.T. (2007). Improving your children's social and emotional competence: A randomized trial of the preschool 'PATHS' curriculum. *The Journal of Primary Prevention*, 28(2)" 67-91.

7. Ellis, S, (2009). Creative Learning Assessment (CLA): a framework for developing and assessing childrens's creative learning. In: Measure Creavity: Proceedings for the conference " Can creavity be measured?" Brussels. Villalba, E. (edn.). Kuxembourg: Publications Office of the European Union. Pp 315-325.

8. Hannon, V. (2009). 'Only Connect': A new paradigm for learning innovation in the 21st century.

9. Hattie, J. (2009). Visible learning: a synthesis of over 800 meta-analyses relating to achievement. London; New York: Routledge.

10. Iiyoshi, T. and Kumar, M.S.V. (2008). Opening up education: the collective advancement of education through open technology, open content, and open knowledge. Cambrigde, MA:MIT Press.

11. Johnson, L., Smith, R., Willis, H., Levine, A. and Haywood, K. (2011). The 2011 Horizon Report. Austin, Texas: The New Media Consortium.

12. OECD/CERI (2010). Inspired by Technology, Driven by Pedagogy: A systemic Approach to Technology-Based School Innovations. Educational Research and Innovation. OECD Publishing. DOI: 10.1787/9789264130852-en.

13. Ott, M. and Pozzi, F. (2010). Getting ready for the "School of the Future": Key Questions and tentative Answers. In: Technology Enhanced Learning. Quality of teaching and Educational Reform. Lytras, M.D. *et al.*, (edn.). Springer Berlin Heidelberg, 73: 495-502.

14. Redecker, C., Ala-Mukta, K., Bacigalupo, M., Ferrari, A. and Punie, Y. (2009). Learning 2.0: The Impact of Web 2.0 Innovations on Education and Training in Europe. Final Report (No. EUR 24103 EN). Seville: European Commission-Joint Research Center-Institute for Prospective Technological Studies. http://ipts.jrc.ec.europa.eu/publications/pub.cfm/id=2899.

15. Redecker, C., Leis, m., Leendertse, M., Punie, Y., Gijsbers, G, Kirschner, P., et at. (2011). The Future of Learning: Preparing for Change. Seville: European Commission-Joint Research Center-Institute for Prospective Technological Studies. http://ipts.jrc.ec.europa.eu/publications/pub.cfm/id=4719.

16. Redecker, C. and Punie, Y. (2010). Learning 2.0 Promoting Innovation in formal Education and training in Europe. ECTEL'10 Proceedings of the 5th European conference on Technology enhanced learning conference on Sustaining TEL: from innovation to learning and practice. Pp 308-325.

17. Selwyn. N. (2011). Social media in Higher Education. http:/www.educationarena.com/pdf/sample/sample-essay-selwyn.pdf.

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Value Orientation in Science Education

I. Syiem

Abstract

Generally speaking science is regarded as value free knowledge and left to itself it insinuates materialism and sheer objectivity. With the rapid change in science and technology human life has advanced materially on the one hand and has failed in human character and virtues on the other. Therefore, there is a need to link science and ethical values and also science teachers to learn, improvise, develop and apply methods for teaching values in the form of social responsibility and ethics. Bloom had cautioned long ago that if affective educational objectives are not emphasised it will slowly erode from practice and make learners insensitive .The present paper will focus on the opinion of science teachers towards science as value free knowledge and the need of value orientation in science education.

Keywords: *Content of Science, Teaching Science, Teacher's Behaviour, Value Orientation.*

Introduction

Generally speaking, science is regarded as value free knowledge and left to itself it insinuates materialism and sheer objectivity. With the rapid change in science and technology, human life has advanced materially on the one hand and has failed in human character and virtues on the other. Therefore, there is a need to link science and ethical values and also science teachers to learn, improvise, develop and apply methods for teaching values in the form of social responsibility and ethics. Bloom had cautioned long ago that if affective educational objectives are not emphasised it will slowly erode from practice and make learners insensitive.

Objectives of the Study

1. To find out the opinion of teachers towards science as value free knowledge in relation to sex and school board.
2. To find out the opinion of teachers on the need of value orientation in science education today.
3. To provide suggestions wherever necessary.

Method

Sample

The sample of the study comprise of 60 teachers teaching science and mathematics randomly selected from the different schools belonging to varied school boards viz ICSE,CBSEand MBOSE from and around Shillong town.

Tool

The tool used for the study comprise of a self-made questionnaire. The questionnaire is divided into four components (1) content of science, (2) teaching of science as a subject, (3) behaviour of the teacher and (4) need of value orientation in science education.

Statistical Technique

Percentage has been used to find out the opinion of teachers towards science and the need of value orientation in science education today.

Major Findings

The findings of the study include the following.

Majority 58.82 % of the male teachers and 53.85% of female teachers opined that science deals with facts and not values, it is objective and values are not. Scientific theories do not presuppose or support any non cognitive intrinsic value judgements (moral & political) was opined by 64.71% and 61.54% of male and female teachers respectively. However, 61.76% and 69.23% male and female teachers respectively replied in the negative that science does not make any value judgements about the use of scientific knowledge.

With regards to the teaching of science in schools, 73.53 % and 50% opined that science is taught as a body of knowledge and a body of theories. Further, 82.35 % and 76.92% male and female teachers respectively were also of the opinion that science in school emphasises more on knowledge rather than on activity. Students are not taught to develop solution to problems using the knowledge of science has been opined by 64.71% and 76.92% male and female teachers respectively.

100% male and female teachers opined that the behaviour of the teacher is important aspect in teaching of values. The extent and direction of value influence is dependent upon the teachers awareness of values was expressed by majority 82.35%male and 76.92% female teachers. 82.35% male teachers and 69.23% female teachers replied in the affirmative about the need of teachers to improvise and apply methods for teaching values in their day to day lessons.

Regarding the three school boards viz. ICSE, CBSE and MBOSE, it was found that teachers from these boards had difference in opinion regarding the content of science. Only 40% ICSE teachers replied in the affirmative that science deal with facts and not values. However, a high percentage of 70% CBSE teachers and 90% MBOSE opined that science deals with facts and not values. 80% of ICSE and MBOSE teachers expressed that science does not support any non cognitive intrinsic value judgements and 55% of MBOSE teachers support the same opinion.

In the teaching of science in schools, majority 75% of the ICSE teachers, 50% MBOSE and CBSE teachers replied in the affirmative regarding the theoretical aspect of science teaching and absentia in practice. Besides a high majority 85%, MBOSE and ICSE teachers including 45% CBSE teachers opined that science teaching focuses only on getting grades and passing the subject. In addition 65% ICSE & CBSE teachers and 80% MBOSE teachers agree that on completion of teaching a lesson or concept, questions are asked only to test the knowledge of students and not on testing their values.

With regards to the behaviour of student's majority of the teachers85%, 65% and 80% respectively from all the boards agree that the behaviour of the teachers go a long way in influencing the values of students.

In answering to the second objective of the study majority 100% of the teachers from all the three boards have responded in the affirmative about the need to have an open classroom environment where students can explore his value system. Further, majority are of the opinion that there is a need to link science and ethical values in the lessons taught to students and finally good science education in schools is a vital preparation for scientific literacy in later life.

Suggestions and Conclusion

Science subjects at the Primary and Secondary level should be light on the content and should concentrate on values. School science should also emphasize activity (observing, experimentation, questioning, self-learning) and not knowledge. Conducting child centred classes and integration of values in learning a concept is very important. Further, demonstration should be an integral part of science class and opportunity to explore science and its application in their daily life is greatly recommended. Science projects on innovative topics must be encouraged in order to promote creativity and enable students to develop a scientific attitude.

In conclusion, it can be observed that science in schools is taught as a body of knowledge and theories. It is heavy on the content and do not concentrate on values. It emphasises more on knowledge rather than on activity. After understanding and learning a concept, questions are asked only to test the knowledge of students and not for testing the values. Finally, it has been expressed by all teachers that there is a great need to link science and values in the science lessons taught to students.

References

1. Kitcher, P. (1993) The Advancement of Science: science without legend, objectivity without illusions. New York: Oxford University Press.
2. Lacey, H. (1999a) Is Science Value Free? Values and scientific understanding. London: Routledge.
3. Poincaré, H. (1920/1958) The Value of Science. New York: Dover.

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Value Education – to Discover Real Needs and Grow in Life

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Abstract

A modern society is plagued by uncertainty, insecurity, confusion and internal chaos. One major characteristic feature of a modern society is a constant endeavour of man to prove himself to the outer world. This has led to all the chaos and confusion in our lives-a reverse journey- a regression process- we have chosen for ourselves. A man has various needs in his life. It is imperative to introspect and prioritise his real needs, fulfilment of which will be nourishing all the life forms in the world. These 'real' needs are the 'needs' of love, acceptance, cooperation and awareness, which have never been taught in any conventional educational institution. To understand real needs of mankind we need an education system where the focus is on the man and not on his success that is gauged by his amassment of wealth; after all wealth is for man and not vice-versa.

Key Words: *Modern Society, Education System, Wealth, Awareness, Internal Chaos, Love, Acceptance, Cooperation, Success*

Education – Definition and Concept

Swami Vivekananda has given us the best definition of education –education is the manifestation of the perfection already in man. We must have life building, man-making, character-making, assimilation of ideas. If you have assimilated five ideas and made them your life and character, you have more education than any man who has got by heart a whole library. He also has highlighted on what education is not. Education is not filling the mind with a lot of facts. It is neither book learning nor diverse knowledge. It is perfecting the instrument of mind and getting complete mastery over it. In other words education helps the power of concentration; the moment the mind is told to concentrate upon a point, it goes there, and the moment it is withdrawn, it is free again (Swami Vivekananda).

Value Education

"The education that you are receiving now in schools and colleges is only making you a race of dyspeptics. You are working like machines merely, and living a jelly-fish existence. The education which does not help the common mass of people to equip themselves for the struggle for life, which does not bring out strength of character, a spirit of philanthropy, and the courage of a lion- is it worth the name? If education were identical with information, the libraries would be the greatest sages in the world and encyclopaedias the Rishis (Saints)". These words may seem little harsh but were true to the core when Swamiji uttered those words during the British era, much before our independence. By then, we had lost our own education system, known as Gurukul – the forest universities (Nehru) of India, away from the hustle and bustle of urban centres where the Guru (teacher) imparted knowledge to his students on their duties (dharma) and responsibilities (karma) and also acted as Marg-darshak (one who shows the path). With the passage of time, various new developments incessantly changed the dynamics of Indian social fabric and Gurukul gave way to Buddhist Vihara and subsequently, the Muqtab and Madrasa during the Mughal era (Mehta, 2004). Finally, with the enactment of the education policy of the East India Company in 1813, the colonial origin of modern education system of India started spreading its root deep down on the Indian psyche slowly and steadily with a far reaching effect, the impact of which is still visible. In ancient India, Value education was actually a part of the education system as a whole which intended to prepare a student to become a complete man; it aimed at the overall development of man and not just mere sharpening of its intellect. Sharpening of the intellect without proper values has the risk of creating a 'Frankenstein' instead of 'Einstein' which has become a common phenomenon in today's society. As individuals and as an Society, we are plagued with the problem of militancy/insurgency which is not an isolated problem. The root of the problem lies deep down and it shows the gradual degeneration of our value system. Today, we need to talk and think seriously about value education as our present day education could not be washed off totally of its colonial flavour, which intended purely on investing on human capital to produce a bunch of clerks and the like who would be serving the British Raj faithfully. Even at the time of independence of our country, the educational situation was not encouraging. Due to a long colonial rule, the basic task was to restructure it radically and rapidly with a view to provide a system of national education suitable to our social needs. The thrust had to be on providing universal, free elementary education, reduction of adult illiteracy, adoption of Indian languages as media of instruction, a rational language policy for effective communication, restructuring secondary and higher education through vocationalisation and diversifications, making course contents socially relevant, modernisation of methods of teaching and examinations, promoting research facilities and putting special emphasis on the education of weaker sections of the society such as women, scheduled castes and tribes and other backward communities (kamat,1972). If we compare between the ancient and present education system even on a loose note, we find a basic difference between these two- a difference in attitude, a difference in purpose. Today, education has become a gateway to enter a livelihood; a ticket to a suitable profession-that which was dreamt of by the child or by his parents and that be the be all and end all in life. As by product, cut throat competition takes over and many a lives cannot bloom properly as they give in to the tremendous pressure of competition and escape life. They either enter into depression, or commit suicide or rebel against all the social norms and values. The rest lead a mediocre average (if I am allowed to repeat Swami Vivekananda) jelly-fish existence. Only a small fraction of our population is imbued with values, which are experiencing life as it is. This fraction has to go up.

Our education system is a mould which brings out skilled people equipped to take up different professions; the system adds value to the marketability of these people. 'Value' is understood in terms of exchange value. People are busy adding value to products and services in the outside world. Our whole focus is outside. We are desperately trying to prove ourselves to the outer world. In the process, we have forgotten our inner world from where the real values emerge. Real values are part of our consciousness. Value education is sometimes mistaken for moral Science which is like any other branch of knowledge that we acquire from outside. We acquire information, knowledge, and degrees in the process of educating ourselves. What about values? How do we acquire it- is it something we can get and acquire from outside i.e., outside-in or is it something which is innately/intrinsically inside us-waiting to be discovered and brought out i.e., inside-out? Does it require to be implemented? Lived with our lives? Are these some of our original innate qualities that we truly value and which require to be manifested in our day to day lives, in our relationships, in our very living? For example, let us take peace. Do we value peace? Is it not a part of our innate nature to be peaceful? Otherwise why are we constantly searching for it? Is it enough to say "let us be peaceful" and leave the rest to the forces of society? Or is it a value which needs to be cultivated right from our formative days, to be incorporated into our education system so that we grow with it and subsequently it becomes a part and parcel of our lives? For that we need to incorporate these values into our belief systems. A computer is a hardware which runs only with a software incorporated into the system, and the basic software is called an operating system. Similarly, this human system is a hardware which runs with the help of some software like ideas, concepts, thoughts etc which again arises from our deep rooted belief systems. Each set of belief system, generates its own ideas, concepts and thoughts. The clash of cultures and civilisations are in fact a clash of belief systems. Our values also arise from these belief systems. We need to inspect, investigate our belief systems and find out techniques, ways and means to change them so as to promote the right values, values which are meaningful and constructive and which go a long way in the evolution of mankind and society.

Modern Society and Real Need of Man

A modern society is characterised by some very prominent features, like tremendous progress in the field of science and technology, spread of education among the weaker section of society, a huge ocean of knowledge and information, fierce competition, high ambition, fear, insecurity and a sense of isolation. The situation has gone so far where husband and wife do not relate to each other, parents and children stay under the same roof like little known people, neighbours hardly know one another, teacher and student is a mechanical relation – no one feels connected to the other. This isolation is the biggest foe of today's mankind.

"The older I grow, the more everything seems to me to lie in manliness. This is my new gospel" (Swami Vivekananda). What is this manliness? Manliness is the manifestation of the qualities that define a man. These qualities are courage, truthfulness, knowledge, compassion, strength, forgiveness and happiness. The motto of a modern Society is the pursuit of happiness. The goal is perfect, but what about the means? A man needs many things to be happy. He needs a proper house for a comfortable stay, he needs good food to satisfy his body and mind as well, he needs proper education and a decent job not only to sustain himself and his family but to earn a status in the society, he needs a family and good health to enjoy his status and so on and so forth. When all these are provided for, still man is not happy; he is perplexed and he runs after more of these, thinking that the more, the better, and finally he will be happy. And still happiness eludes him. This sets the process of seeking-seeking the real needs of man, achieving that which sets him free and finally he is happy.

Real Needs of Man

Before we enlist the real needs of man, let us think of an imaginary situation where we see a mentally challenged child who clings to her mother and is not comfortable with anybody else. This girl is happy with her mother because she gets acceptance and love from her. So, it is clear that basically, we all need acceptance and love, irrespective of our diverse backgrounds and diverse conditioning that makes us different from each other. When we work together and receive help from one another we feel happy. Some of the real needs of man are therefore, acceptance, love and cooperation and awareness. The need for acceptance and love is more conspicuous among the youngsters who are always under peer pressure and are the most vulnerable section of any society today. We can help our youngsters by conceiving and creating an education system of which value education is a part and parcel.

A New Education System

It is time to have an overhauling of our education system which is producing skilled, unhappy people all around. The present education system in India lacks personality development lessons, moral and ethical teaching. The problem with our education system is that it fails to prepare a child for life; rather the focus is on excelling in the examination and grabbing an excellent grade. The present education system leaves behind millions of average children with incredible potential, who are paralysed by the fear of 'failures'. This defeats the whole purpose of education which is meant to build and not to destroy (Hussain, 2012). There has to be a basic shift in the very approach to education – the entire focus that was to the 'outer world' has to be shifted to a great extent to the 'inner world' as our outer world is an extension of our inner world. In the formative years when the child is taught the basic skills of arithmetic or arts, the child simultaneously needs to be taught how to take responsibility of everything that is happening to him. When he dashes against a table, he needs to know that the table is not to be blamed for his hurt but it is he who needs to be more careful next time. This will teach the child to be able to respond to every situation in his life in a more matured rather way than to blame others for every misery in his life. The child needs to know that if he has a feeling that nobody loves him, he has to see within and realise that it is he who does not love himself. The outer situation is only a reflection of the inner. If he can accept the way he is and love himself unconditionally, the world around him will spontaneously love him. In the future world order, education is expected to be more psychological than it was in the past where the focus would be on the soul, God and the world around him (Lucis trust). The child will discover himself as a global citizen, a part of the whole world. His tiny individuality will not restrict him to embrace the reality of Oneness – that the whole creation is one and that he is only a part of it. He will learn to accept variation as that which is natural and will experience the underlying unity in the apparent diversity that he finds all around him. Teachers need to perceive children as seeds to be nurtured and not as clay to be moulded. The teachers are expected to act as gardeners and not as potters (Hussain, 2012).

The new education system can be designed to help the child to have a vision of his own. Without a vision, life becomes ordinary. Without a vision, he lacks motivation and energy and becomes a slave to fear and hurt. A visionary is naturally progressive and derives great fulfilment in life. The new education system should be able to help him deal with his fear, uncertainty, conflict, and lead him towards success. Only a successful individual with a compassionate heart could be a complete human being (Sri Bhagavan, Oneness University). The new system may be devised so as to help the child in developing the faculty of (i) creative thinking: The children will be encouraged to give their opinion irrespective of whether it is right or wrong. Their grading may be not on whether they talked sense or not but on the basis of their participation. (ii) Sense of cooperation: Children need to be encouraged to work in a team. Grading may be based on the level of their helping attitude – to what extent they are eager and capable of helping their fellow beings. (iii) Learning to take decision: The child needs to learn how to respond in every situation spontaneously and should be encouraged to take part in decision making. Responsibility is defined as the ability to respond correctly in any situation. We as elders need to shun 'You are small, don't poke your nose in everything' type of attitude when it comes to help developing the personality of our youngsters. (iv) Awareness: The Child needs be told to be observant about his inner world- his feelings of joy, hatred, happiness, jealousy, compassion, fear; his thoughts, irrespective of quality-positive or negative, without being judgemental towards those. He will be taught to accept his truth – be it good, be it ugly; this inner integrity will help him to develop into a successful human being with a compassionate heart – the real heir to the new world order.

Growth in Life

We need to set our priorities right. What do we want in life? We need good health, good relationship, prosperity and success in life. What do we do to achieve those? We need to reform and redevelop our education system which will help us to set our thought patterns right. Since our childhood, we have been taught many different skills; it is time now that we teach our children the skill of right thinking, since we create our lives with our thoughts. Till now, for a majority of people, life was being created unconsciously as most of us do not know the art of thinking. Hence, there is so much of conflict, so much of uncertainty and so much of chaos in our lives. If we are to grow in life, the mind set has to be changed. For that, the ground work has already been started by various organisations – in our country and abroad as well. Oneness University in Andhra Pradesh (India) has been conducting classes which have become instrumental in changing thousands of people's attitudes and mind sets across the world. Humanity's Team (Oregon, U.S.A) an organisation on a worldwide basis, through all their activities, share this simple message with their world brethren: "There's another way" (Walsch, 2008).

Let there be a new value imbued education system in India that will clearly see the root cause of the present day crisis that humanity is facing today and try to solve it at that level. Let us not destroy but join hands to recreate.

References

1. Hussain, M.I. (2012), *The Education System: A critical Overview.* The Indian Express. New Delhi 12.3.2012.
2. Kamat, A.R. (1972), *The Education Situation.* Economic and Political Weekly, Vol VII, No.26, June.
3. Mehta, R. (2004), *Crisis in Higher Education Role Analysis of Teachers in a University.* Kalpaz Publications, Delhi
4. Swami Bodhasarananda. (1948), *Teachings of Swami Vivekananda.* Advaita Ashrama (Publication department), Kolkata.
5. The Oneness University. (2005), *Evenings with Sri Bhagavan.* Kosmic Publishers, Chennai
6. Walsch, N.D. (2008), *Conversations with God Book 3.* Jaico Publishing House, Mumbai.
7. Internet Access: (a) http:// www.onenessuniversity.org; (b) http://www.lucistrust.org

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Value Education Matching the Real Needs of Modern Society

Cornelia Mary Lyngdoh

Abstract

The fast changing scientific knowledge and technology alone cannot meet the deepest needs of the youth today if value education is kept in the shelf. At the level of our existence in this world, questions arise but these cannot be answered without having Nature as the ultimate frame of reference. This relates to what is right and wrong and what makes life meaningful etc. Nature has communicated to us the know-how of values through its Creations. Values are the basis of human behaviour and it is significantly related to the aims of life. Educational values play a vital role where they contribute immensely to the individual and to the society at large. It is said that values of life are declining day by day, consequently, the youth are passing through tremendous problems in the present era. There is an increase crime against women, drug addiction, suicide cases, hungry for power and money etc. Thus, value education is the very much need of the modern society. Parents and teachers can be agents of value education at home and in institutions respectively. It should be part and parcel of regular education and must be included in the curriculum. The fast changing high technology mindset of the youth should be bombarded, replaced by value education and believe in it.

Introduction

Many have agreed that "values are the greatest unifying force in life underlying the foundation of human behaviour". Values are gained through education and these values are broadly known as value education. Value education is closely related to our daily activities which are well cultured, cultivating good and noble deeds and useful to the society at large. Values change the attitudes of people in various ways. Values are defined as forces, principles, guiding factors or contents of personality. It can also be defined as truth, righteousness, love, peace and nonviolence. Some of the theories about value may be mentioned briefly here. In the Perfection theory, anything has value if it relates to the perfection of life for which a man endeavours in his life. In the Emotive theory-Man's emotions are expressed by his nature. These emotions change according to the circumstances. Thus by virtue of his emotion, man determines his values. The characteristics of values include subjectivity, objectivity, material or abstract and aim at perfection, self realization, satisfaction, development of integrity and unity etc. According to Reid, "Education is part of life and nearly our question about values and education are inseparable from larger question of values in life. Values are embodied in educational practice." Thus, education gives an important idea of good and bad. This idea of good and bad is based on educational values and these are tested in schools, colleges and institutions. Parents and teachers play an intelligent and important role to mould and groom the culture of the valuable child to achieve the goal of life. Parents are responsible for value education at home and teachers in the educational institutions. With the fast growing technology, value education is dramatically changing towards the positive as well as negative directions. With today's high technological revolution period, it is high time to rethink and to apply value education in our daily lives, otherwise the present world may end with uncountable crimes. Before it is too late, some strict rule should be implemented as early as possible to change the mind set of the younger generation.

Value Education

Value education can be discussed briefly as

Education and IT

Education is the backbone in every aspect of life. In the present information technological period, we do need to cultivate multiple literacies including media literacy, computer literacy and multimedia literacy to meet the challenges of the modern diverse multicultural society. Literacy involves the gaining of knowledge to read and interpret the text properly and also gaining various skills. After the multiple degrees in multiple disciplines, the youth should take part to develop the world in the proper way. The media culture should play a vital role in every aspect to apply value education in our daily lives. Technology has brought some changes in the teaching - learning process but it does not improve the teaching – learning. Indeed, it simply reduces the work load of the teachers. Having said this, it is necessary to introduce new technologies in educational institutions at the different levels so that the education is relevant to the demand of a multicultural society. It is necessary to restructure the education system to provide the competencies in every corner of the world.

Interaction via internet, face book, video conferencing etc. can play a very useful role in teaching-learning and can launch new channels of communication but these systems cannot replace the face to face interaction of students with teachers which must be at the foundation of the teaching-learning programmes. It is only through such interaction that we can hope to develop those qualities and abilities which are the values much needed in our daily lives. The transmission of such values is unlikely to be achieved without face to face interaction which is intervened by modern high technology.

There are some drawbacks of the new technology. For instance, our students have forgotten or do not understand some of the basic mathematics. They are so much dependent on the scientific calculator; consequently, their knowledge of mathematics is declining day by day. The course structure of the secondary and higher secondary schools should relook and necessary changes may be made immediately for the welfare of our children. If not so, our children may or may not be able to face the race of the IT world. Inculcation of IT values through education will help to check social relations, to encourage multicultural development, to enhance democratic qualities, to avoid injustice, to accelerate the work done etc.

Nature – Centered Educational Values

According to the Bible "All your children shall be taught of the Lord and great shall be the peace of your children" This verse expresses about education for all children. The spiritual and moral truth is taught through different levels of education. According to the Bible commentary, Timothy was trained by his mother and grandmother by teaching him on the Biblical and Jewish tradition. He was taught constantly and actively to understand the words of Wisdom right from childhood days.

Education can be discussed into two parts

i) Religious education and ii) Intellectual education.

Religious education is essential to our day to day life. Without this, life has no value or very little value. Religious education is directly related to the heart of on individual, which is the sacred quality of human being. But in today's modern education system, religious education has very little room. Indeed, one can say religious education is controlled by the intellectual education. In fact both should go hand in hand and should be dominated by religious education as religious education makes man good and is for life while intellectual education makes man great and is for temporary living. On the other hand, one can say that intellectual education leads to the worldly life while religious education leads to the eternal life. One should comprehend that the two should go hand in hand so that every person should have the characteristics of humnility, love, good and tender heart, truthful, compassionate etc. and finally makes a man great and good for the society. Proper education and literacy are important for personal growth, building a strong and healthy family, in service to Nature and also have significant contribution to the society at large. This means that education and literacy is a means to understand the things of Nature and the things of the world. Inculcation of these values through education is a necessity to ensure the integration of social relations, to strengthen social harmony, to encourage multicultural development, to introduce democratic qualities and to fight against the evils and injustice. Education and literacy is a process encouraged by understanding the laws of Nature. Our minds are created and designed in such a way that a child who grows to maturity should increase in knowledge, wisdom and diverse skills. Education should help us live in conformity with evolution of Nature. Today's world education system must become more Nature friendly instead being materialistic and consumerist. Education system should evolve such values so that students do not enter the path of the wicked or proceed in the way of evil men when seeking an education. It is necessary to understand that the educational values contribute to the individual and social life along with development of as healthy and balanced personality, ability to earn livelihood, development of professional competence, establishment of good citizenship, development of personal relationship, adjustment with the environment, fulfillment of the needs of man, development of personal character, development of national integration, ethics for leaders and skilled workers, endorsement of social efficiency, multicultural values etc. We may recollect here Joseph Smith's teaching "it is impossible for a man to be saved in ignorance". It is clear from his teaching that fulfilling our duty and responsibility to mankind, and learning whatever we can, will help us to contribute significantly to society. Therefore, it is necessary to understand that educational values play a significant role in the lives of men to lead their personal and social lives successfully.

Family and Education

Values are inculcated at different stages under different institutions such as family, neighbourhoods, schools, colleges and universities, peer groups, self, mass media etc. Family is one of the most important institutions where value education is taught. As the saying goes "Charity begins at home". So the character of values of an individual begins at a family level. It is in the family that the child learns to distinguish between right and wrong, good and bad. If the family is good, the individual person is good, the environment is good and ultimately the society is good. Culture plays an important role in socializing the individual. Every society has its own ethos, and this is communicated to the individual in various ways.

The child's cultural education begins at home, and it is in the family that he participates in the elements of culture and passes through the various stages of cultural development in his life. The parents and other members of the family educate the child in various areas of culture such as ethnicity, values, attitude, manners, discipline etc. Patterns of moral and religious behavior are also learnt in the family. Good behavior is assimilated from the behavior of adult members of the family. Schools in different countries educate the child according to their own cultures because through their textbooks, they seek to acquaint the child with their own values, ideas, customs etc. In general, thus family, text books and schools undertake the task of communicating the society's specific culture to the younger generation. Loss of cultural identity means loss of self respect for people. Any culture should be open to other culture without being overwhelmed by them. In today's world of competing value systems, there is tremendous opportunity to approach the challenges of our society from Biblical perspective. This is based on authentic motives and perspectives of people on Nature. It is very important to educate religious leaders, and teachers in particular, who will change the world and set good examples to the younger generation. Home is the first school for the children because this will help in introducing them to the things of Nature, creating a loving home and discipline them. According to the Holy Bible, Prov.29:11; "Discipline your children and they will give delight in your heart". In order to discipline children, parents should spend more time with them, this will help to acknowledge the children's feelings and any feeling that is not godly can be suppressed because the parents are around to observe their children. Parents should play a pivotal role for creative a better society and attain perfection for their children. Every child or pupil should be taught all the oral instructions from the first day in school to the last days of their higher degrees. The child who is taught the things of Nature from the beginning of his/her life will have a strong solid foundation in moral value. Higher the moral value, higher is the contribution to the society. In general, one's moral value will help the nation in all process of development. All these should be taught at home.

Role of Teacher

According to Aurobindo, moral education is the education of the heart, without which no individual can be completely human. Moral education cannot be imparted through lectures and textbooks because the foundation of this education is proper feelings, proper conduct and development of proper habits of thought, feelings and good action. In olden days, young boys and girls acquire education only by imitating his teacher. The present teacher, therefore, must also have the highest standards as the teacher provides value to the students which are useful and valuable to him. In addition, moral education takes place through moral conversation and behavior. The teacher's role may be defined in broader perspective as human rights education implementer and translator. Therefore, there is a need for strengthening knowledge, skills and attitudes of teachers. In the Academic Performance Indicator (API), it is necessary to add one column on moral value of the teacher. This will help them to indicate and test themselves where they stand.

Teachers should plan and carry out their teaching programmes, bearing in mind that they should attempt to develop in their students the qualities and abilities. This will characterize the ideal student an independent learning, creativity, team spirit, ability to express oneself clearly, identify the problem clearly and logically with the right potential and also develop leadership qualities. Teachers are the role models of the students. Teachers who are independent, self dependent workers and deep thinkers, who are creative, respectable, peace loving etc. make excellent role models. They transmit these values effectively through their personal example to the students. One cannot expect every teacher to be a perfect role model, however it is useful for the teacher community to be aware that the transmission of such qualities can be strengthened or weakened through our own personal behavior. Our attitudes and actions are continually on display and speak far more loudly and strongly to our students than any formal teaching can ever do. As members of academia, we hold a set of values where we expect scholars and researchers to uphold truth and honesty in the pursuit of knowledge. The manner in which teachers interact and deal with students will make a more lasting impression on them so that they can be responsible and useful citizens.

Any purpose education should go with value orientation. It has been given more importance at the primary and secondary school level but little enough in higher education in our country because teachers can mould the young students and shape them for their future. Values could be effectively imparted to the young minds particularly in the secondary and higher secondary levels rather than to the matured ones. These level students require direction and counselling very frequently with regards to their career and also for the society. Colleges and Universities are meant for a kind of specialization in some specific fields/areas of education. We the matured people particularly teachers are witness that in this generation, young people are exposed to various fields/areas which demand the intervention of the educationist for their betterment. Teachers should realize that the student's perception, understanding, knowledge, skills and philosophy on various life factors and events are getting shaped at this stage. Today's modern education aim at money making machines, institutions and power accumulation for individual benefits. Consequently, the moral values are getting eroded; social fabric is weakened day by day. Everywhere, people assume a job as a means of survival but lack the sense of responsibility, subsequently, the development is delayed everywhere.

The educational policy framed by higher authority is useless without value education. There is a big question on what is happening to the values in the educational institutions of our society in the present hour. Many people are facing innumerable problems; problems are increasing day by day and year by year. For example suicide cases, broken homes, misunderstanding, drug addiction, robbery, crime against girl children and women, youth unrest, family problems, dowry, torture of women in the work place, sexual harassment in the work place in the name of promotion, insatiable hunger for money and power etc. Problems are numerous but never saturated. Educational values, earlier considered essential by all sections of people have been eroded. The values have been forgotten due to worldly pleasure and it has given way to immoral practices. There is no peace of mind; consequently the youth are being Red to evil and wickedness. There is a saying that "honesty is the best policy". This is replaced by pride in the present hour. Worldly pleasure and money power has led some people to pride which is a bad moral value. Therefore, value education should and must be part and parcel of regular education and it must be included in the curriculum at all levels.

Conclusion

By Nature's grace and mercy, all of us can recapture Nature's original plan set for us in which, the role of parents, teachers, teaching methods and curriculum work together. All the required academic programmes must be set according to the knowledge needed by students so that after leaving school, college and Universities they can prepare themselves to occupy specific positions in different levels according to their capacities. The introduction of technologies like computers and other new technologies, particularly in the secondary and higher secondary levels without proper resources and teachers' training programmes will be highly confusing. Parents and teachers should play the most positive role for the betterment society and perfection of the valuable students. Multiple literacies are required to make education relevant to the needs of a multicultural modern society. The whole educational system needs to be rectified with a hope to bring back the real function of value education, counteracting the heavy inflation which science and technology have brought about in the world.

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Value Education – The Need of Modern Society

Aiborlang Dkhar
Mebanjopson Rynjah

Abstract

Education is a major aspect of any modern society. If there is a deficit of educated people, the society can't develop and will stop in its further progress. Now more and more people are realizing that education is the best investment, and the ever growing numbers of people are not satisfied with their fist basic education and try to get a second or even a third education to meet the demands of contemporary society. They sacrifice their time and money, and sometimes their health to raise their educational level because they know that, education is their passport to the future, for tomorrow belongs to the people who prepare for it today. The objective of education in a country like India, which has a glorious heritage and can boast of diversity in geography, culture, values and beliefs very rarely seen in this wide world, should be to educate a student of the value system which is indispensable to live a successful life. Looking at the present generation, it seems that society has failed, somewhere, in imparting non-formal and formal education to its masses. We might have developed materially but not mentally. Value education is ingrained in every tradition of Indian culture. Yet it is a matter of great regret that gradually, we are losing our values with the result that we tend to become bigoted and hypocrite. This trend must be checked urgently. Although the country has made rapid progress in various areas like scientific technology, economic infrastructure etc. its value system has been declining. Therefore, Education in general and value education in particular, occupies a prestigious place in the modern context of contemporary society. Parents, teachers and society at large are concerned about values and value education of children. We are witnessing tremendous value crisis throughout the world today. A lackadaisical attitude towards value and its institutions is pervasive in the world today. Value education has to be included in various aspects of education. Attention needs to be pay by higher authorities to spread the importance of value education in society. The present paper will focus on the Need for Value Education in Contemporary Society

Keywords: *Growth of Civilisation, Materialistic Value, Value Based Education, Living Guidance*

Introduction

Education remains a vital part of human life at all times but it has become very essential in the modern age. Everybody has to run with this modern life and without education it seems difficult and literally impossible. It has a great influence on the social, economic and moral activities of the people. It plays a stunning role in human thinking and in taking correct decisions. It has been said that man is a social animal but education makes him rational. If a person can not read or write, it means that many windows of knowledge, information, and opportunities are closed to him.

Today, education is viewed as a vital key to leading and having a successful life, and knowledge has become every individual's aim or concern. Each one of us is born in a different medium and of different social and cultural norms; however, most of us approve of education's positive effects on society. Therefore, 'Why do we need education?' and 'why do we think education is important?' is the issue to tackle. To get a better grip of this complex theme we have to distinguish three different types of education; there is the formal education like school education, the lifetime education obtained from learning through difficult situations, and the education by our parents. For any country to be successful, it has to have a high standard of education, so as to be able to impart the cultural heritage to the younger generations. Education develops a meaningful outlook on life.

Education serves as the means to bring about the desired change in a society, to develop a generation of virtuous individuals and thus contribute to the development of good human beings. The fundamental purpose of education is to gain knowledge, inculcate the forms of proper conduct and acquire technical competency. Education serves as the means to develop oneself physically, mentally and socially. Education can be seen in a society as the key ingredient to having a successful and extraordinary life, which is an undeniable fact that cannot be disputed. Some may argue that education can be given in different ways, some being radical while others being more conservative. Others see it as being biased towards a certain kind of social or ethnical group, and even gender groups, while another group might argue that it is equally fair for everyone. A specific group could say that some forms of education can be meaningless, while others possibly will interpret it in a wrong way, although a group of scholars might find a deeper meaning for it.

National Goal and Education

The development of a nation can be judged easily by its literacy rate. Economic development of a country depends upon its skilled and educated population. The developed countries of the world have highly educated human resource which is playing important roles to sustain the economic growth of their countries. These countries have many educational and training programs for their people to meet the new demands of the modern era. Their professionals have to follow many mandatory courses in order to know about the new developments in their respective fields. In this way, they are able to update themselves.

Due to the importance of education, many countries are planning to promote quality education for students' excellence. They are raising more and more funds for education. They are making polices to provide financial aids to a great number of students and have made strict policies for the proper distribution and monitoring of these funds. Higher education is also very necessary to have a wonderful career. There is a necessity for a person to get the right education in order get the right kind of job. There is more scope for promotion and higher pay, with incentives, if one is an educated professional. Many career advisors have been appointed in colleges and universities to guide the students for this purpose.

With a good education of the younger generation, the government takes care of the progress and the development of the country. But a good education is not just useful for the progress of the country; the aspiration for advancement lies in the nature of every human creature. People wake up every morning with the goal to scale new heights, to enhance their standards of living. Another factor in today's democratic society is the peoples' cravings for the latest information. People in modern societies do actually have the will to know what is going on in the world around them; they want to know what the government has been doing for the purpose of development, to understand what a new law is supposed to mean etc., and all this would be impossible without a good formal education.

More precisely, the perceived goal of education is to make the individual and the society 'better' in some qualitative sense. This however, seems to be missing in its current form. In our rush to get everybody educated, we do not consider it important to ask ourselves why we need education. An idealist notion about the necessity of education has been taken for granted. In fact, this notion has been so strongly developed that we are taught to overlook the shortcomings in the implementation of this activity. Both independent groups who have chosen to work in the field of education and expert committees have only suggested ways of improving the effectiveness of the present education system without addressing the more basic issues and the purpose of the entire activity. Such people often choose to ignore the disturbing trends mentioned above which are associated with the education system. When so much resources and the prime time of our children and youth being given over to the education system, we as a society need to find out the achievement of this system in real terms. However, in this evaluation, one must be prepared to dispense with the assumption that the modern education system is absolutely indispensable, for on close examination, this kind of education system itself appears to be at fault.

Modern Society and Education

In the present era of education assisted by ultramodern technology, we are inclined more lives towards knowledge and ranks in the examination than application of learning in our day-to-day. Theodore Roosevelt warns, "To educate a man in mind and not in morals is to educate a menace to the society." It is a lamentable fact that in the present scenario of education, the majority of the teachers as well as the taught have turned into grades-oriented and marks-oriented individuals, overlooking and undermining the superlative purpose of education i.e. refinement of ethics, purification of the soul and enlightenment of human intellect. More sadly, in the pursuit of degree-oriented education we have, wittingly or unwittingly, failed to incorporate the learning of moral and ethical values to our studies for the positive nourishment of our character. The degeneration in the present day life, the demoralization of public and private life and the utter disregard for values, are all traceable to the fact that moral, religious and spiritual education has not been given due place in the educational system. In a broader view, as the outcome of education, we are producing successful professionals obsessed with material pursuits, who fail as considerate, altruistic and humane individuals. Totally remiss of philanthropic and humanitarian elements, these professionals are content with the achievement of absolute luxury and authority as being the radical purpose of their studies. This kind of attitude is the result of the myopic vision and inadequate execution of the abilities of teachers and teacher-educators. Thereby, most of the existing students indulge themselves into anti-social and unethical dealings in their future endeavours. "Unfortunately, education is becoming more or less materialistic and the value traditions are being slowly given up" (Erwin, 1991). People seem to prefer their education based on what they could derive from it later in terms of monetary benefits. It is not how they could be useful to the society and to the people around them. Primarily, monetary considerations dictate the choosers of education today. It is the profit that is in the mind of the management as well as the learners. When such is the case, where is the place and value for value education? Students do not evaluate their potential capabilities, and their strengths and weaknesses before they take important decisions such as choosing their career- courses. This later become their entanglement for life.

Looking at the present growth of civilization, it seems that society has failed somewhere in imparting non-formal and formal education to its masses. We might have developed materially but not mentally and spiritually. Mental and spiritual development about life, death, happiness, sorrow, moral and our usefulness to society is lacking in the people. There is a great need to equip the present education that is being imparted to children with values of life in order to make them good human beings. The changing mindset of humanity towards materialistic approach at the cost of others is posing a grave concern for the survival of civilization. The present education system has groomed people for a legendary appetite for need-based knowledge and tuned us to feast on success. Today's education only plunges people enthusiastically into actions to create an image larger than life. Emphasis on materialistic value presents a distorted face of capitalism. Society is witnessing a loss of moral compass along with symptoms like growing cynicism, hatred towards others, moral decline in private and public life, increased isolation, increase of violence, greed, racism and many more. Education seems to have got totally divorced from ethical standards and even laws are unable to deter people from evil conduct. There is a crying need for value education in today's people and this has to start from the very beginning. Children, whose minds are like wet cement, must be impressed upon with moral values like personal hygiene, general cleanliness, community living, gender equality, sexual morality and social values like national integration, respect for elders, familial and societal responsibilities, respect for an individual's rights, the law and the Constitution and also the love for Mother Nature. As Mahatma Gandhi pointed out, education without character leads to criminality; educated persons have wider opportunities to indulge in crimes and that too committing them most efficiently and technically. Just look at the way organized crimes, financial frauds and terrorist violence is being perpetrated by some of the best minds gifted with the best of educational and technical accomplishments.

Recent cases of betting and spot fixing in the IPL has rocked the sacred institutions of cricket, and the millions of cricket loving fans of the country are left totally awestruck at the audacity with which this heinous crime is being perpetrated and of the persons involved in the entire scandal. They felt betrayed and their sentiments played with, by the very persons they idolized, loved, and trusted. Also, the kidnapping (for ransom) and subsequent murder of a 13 year old boy in Mumbai by his own cousin and an accomplice friend, both of whom are MBA's and successfully running their own business, after they lost several lacs over betting in the IPL; the recent spate of rape cases across the nation and even in our very own Ri Khasi State are some of the glaring examples of the complete degradation and erosion of moral and ethical values from the hearts and minds of the people.

Plan Value Education

The question that is of utmost importance today, therefore is, *isn't what we need today is value education?* Value Education refers to planned educational actions aimed at the development of proper attitudes, values, emotions and behavior patterns of the learners. Value Education is the education that is concerned with the transformation of an individual's personality.

The need for value education is central to all forms of education, from the primary to higher education. However, there are differences of opinion among educational administrators on how to organize it in the curriculum. The Central Policy on Education, 1984, explicitly states the need for value education and it even directed the Central Board for Secondary Education to frame a syllabus for value education which would then become part of textbooks of all school boards in the country. Even after almost three decades, we have not seen the efforts of the Policy bear any fruit in whatever way envisaged. This is a sad condition for a multicultural, multi-religious and multiethnic society like ours. We may interpret secularism to suit our point of view but one thing is for sure; there is no alternative to multi-cultures if India is to survive as a nation. This would mean that tolerance, as a value, must be imbibed in the personality of every individual whether he or she belongs to a majority or minority group.

The major problem in India is corruption and reluctance to work hard. India's image on tackling corruption has not improved with Transparency International's Corruption Perception Index (CPI) ranking it at 94th position out of 176 nations, this year. Though India was ranked at 95th position last year, the international watchdog said it has started evaluating the positions through a different formula beginning this year and hence this cannot be compared to last year's ranking. Unless the educated work force of the nation is not inculcated with values like national pride, integration, loyalty and respect for the Constitution, we may find it tough to scale the ladder.

Value education in the agenda of higher education should essentially extend to moral and ethical practices in individual and collective behavior. If corruption, deceit and violence prevail in public life today, the educational system in the country will have to own a share of responsibility for the malaise. If civil society has to grow and exercise a redeeming influence in social and national development, the educational system of the country has to take the lead and mobilize social action particularly among the youth through value education. Education without values is not beneficial to anyone. Education devoid of values may be detrimental to society in the long run. Values bring quality and meaning to life and give a person his identity and character. Children imbibe values all the time from their parents, teachers and peers. But it is also necessary that we deliberately teach them the right values right from their childhood. What they learn at this tender age stays with them all through their life. Hence importance should be given to imparting a value-based spiritual education. These values include the simple difference between right and wrong, a belief in God, the importance of hard work and self respect. Education is a continuous learning experience, learning from people, learning from success and failures, learning from leaders and followers and then growing up to be the person we are meant to be.

Planning pedagogical aspects of value education requires professional development of teachers, and their training and planning at both the school and teacher training level. It may not be so difficult but it definitely involves conscious planning. It may come with orientation, practice and continued focus. A system of education where teaching is restricted to instruction and learning to pass the examination will not deter the committed and inspiring teachers and school personnel to march ahead with force and enthusiasm to implement this important curriculum intervention for the cause of value oriented education.

Value based education is a three-fold development of any individual of any gender and age, but most importantly of a child. Education tries to develop three aspects: physique, mentality and character. Even though physique and mentality are important, they are menaces without the third because character is the greatest of these. Education plays a huge role in precisely this area. Value based education is a tool which not only provides us a profession which we can pursue but also a purpose in life. The purpose of our is undoubtedly to know lives and be ourselves. We cannot do it unless we learn to identify ourselves with all that lives. It is very aptly said that: "Know thyself" was written over the portals of the antique world.

Another important aspect and the most constructive factor in value education is its purpose which encourages the child to explore oneself while offering living guidance and setting appropriate limits to behavior. Value education is a norm designed that addresses the exceptional talents of each student and has a positive emotional experience as well as motivates the students in all respects. Value education evaluates natural talent, how the student learns, and also helps the student to understand and bring out his/her natural and God given talents, to be able to use them to their full potential.

Many great minds like Thomas Edison and Henry Ford never completed even their grade schools, but no one can deny that they were super success. When we look at the reason behind this phenomenon, we come to know that they succeeded because they knew how to research, collect information for a selected project and process knowledge. The typical class room environment is not research supporting and only focuses on the covering and cramming up of some text book topics, remaining exam focused. In this process, the innovative, creative, intuitive, and self motivating qualities of students becomes a victim of catastrophe. Lack of motivation is lack of knowledge processing skills. The usual college graduate will have a professional skill that supplies only life's basic needs. Even in modern society, education focuses only on academic needs of the student thereby producing graduates having good grades but futile for the society. Self-made millionaires are usually not "A" students in the classroom. The mode they process knowledge is in dissimilarity with classroom main teaching and concern. The self-made millionaire, like Bill Gates, Steve Jobs etc. has a vision; then he researches specific knowledge, applies intuitive ideas and process all essentials, searching for a workable way out. Finding unconventional conducts to do ordinary farm duties makes millionaires.

Conclusion

In conclusion we can say that, Value education is a process an individual's qualities viz., physical, mental, moral, and spiritual are called to mind, fostered and refined, so as to fashion out an ideal human individual, capable and willing to play his part for the betterment of the society at large. As Nelson Mandela always says, "You do not have to be phenomenal to do phenomenal things". What modern society needs is the right kind of education through *value education.*

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Non-Formal Education in Science

S. Khongwir
L. M. Jyrwa
D. N. Shabong

Abstract

The paper deals with the educational methods in science. Nowadays, there has been a great interest among scientists in activities outside the traditional school curriculum. However, little has been done to encourage non-formal education in our state. In this context, the main attention is devoted to the non-formal methods which would provide a satisfactory service to the young learners and the science society as a whole.

Introduction

The word science comes from the latin word "Scientia" which means knowledge or to know. It is the exploration for natural explanation for natural phenomena. It is an inspiring process of discovery that helps satisfy the natural curiosity with which we are all born. In this context, science education extends beyond what takes place within the four walls of the classroom. Therefore, students should come away from their classrooms with an appreciation of the natural world — fascinated by its intricacies and excited to learn more. They should view and value science as a multi-faceted, flexible process for a better understanding. Such views encourage life-long learning and foster critical thinking about everyday problems students face in their lives.

However, scientific literacy among our nation's students is at an all-time low. This trend needs to be reversed. Combining formal school experiences and non-formal science experiences for youth is critical to improving their scientific literacy. Contemporary research, places non-formal learning in a learning continuum between formal and informal learning, where an educational/learning activity can combine a range of features, of which some are more characteristic of formal learning settings than of non-formal or informal ones and vice versa (Chisholm *et al.*, 2006). Within an informal learning setting, such as a museum or zoo, learners control how they will learn but not what they will learn (Mocker and Spear, 1982). The present paper therefore, tries to fulfil the following aims and objectives.

Aims and Objectives

1. To broaden the scientific temper of the students.
2. To encourage students participation.
3. To give practical experience of how scientists make observations of the natural world, come up with hypotheses and do experiments to obtain evidence to support or disprove these hypotheses.
4. To encourage scientific thinking and observation power.
5. To develop awareness of the conclusions of important scientific theories in a concrete and accessible way.
6. To encourage independent research.
7. To develop training in scientific methods.
8. To apply scientific knowledge in their activities.
9. To develop a habit of co-operation.
10. To give pupils enough evidence-based knowledge to be able to make informed personal judgments in order to lead healthy, safe, comfortable and environmentally sustainable lives.

It is hoped that the above mentioned aims and objectives of non formal education can be imparted by science clubs, scientific excursions, science exhibitions, science museums, aquarium, botanical park, etc. Similar logic was also put forward by (Soni, 2004).

Science Club

A science club is the place where students get a chance to spend their free period in a profitable way. It gives students the opportunity to discuss and do science-related activities that they experience in the classroom. The club serves to promote the interests and activities of students, interested in the field of science. Activities of science clubs are usually areas of science not covered by the curriculum. Certain activities of the club that can be selected by the members include planning a science project, collection of specimens, organizing a seminar, debate or have a special scientific visitor, preparing models, visit to places of scientific interest, celebrating important science days etc.

Science Exhibition

The purpose of science exhibitions is to encourage students to make and take part in scientific displays. It is an opportunity for students to apply the scientific method independently. It also provides education through participation and helps in popularizing science among masses and creating an awareness regarding the role of science and technology in the society.

Museum

A museum is an institution that cares for (conserves) a collection of artifacts and other objects of scientific, artistic, cultural, or historical importance and makes them available for public viewing through exhibits that may be permanent or temporary (Alexander and Alexander, 2007-2009). A school or college must have a science museum since, museum provides a firsthand information to the students about the specimens on display. Similarly, students must be encouraged to collect specimens for the museum so that they will have an interest in the subject and will be inspired when their names and specimens collected by them are displayed in the museum.

Aquarium

An aquarium (plural aquariums or aquaria) is a *vivarium* consisting of at least one transparent side in which water-dwelling plants or animals are kept. Fish-keepers use aquaria to keep fish, invertebrates , amphibians, marine animals, turtles, and aquatic plants. The term combines the Latin root *aqua*, meaning water, with the suffix *-arium*, meaning "a place for relating to" (Merriam-Webster Online Dictionary). An aquarium however, can range from a small glass bowl to huge tank 'public aquaria'. Members of the science club can also work together to make a small aquarium for their institution. They can also encourage collecting specimens for the aquarium. Students can learn by themselves about the habit and behaviour of different aquatic animals kept in the aquarium.

Botanical Park

A botanical garden is an enclosed area with a wide variety of plants labelled with their botanical names. The following definition was produced by staff of the Liberty Hyde Bailey Hortorium of Cornell University in 1976. It covers in some detail the many functions and activities generally associated with botanical gardens (Bailey and Bailey, 1978). A botanical garden is a controlled and staffed institution for the maintenance of a living collection of plants under scientific management for purposes of education and research, together with such libraries, herbaria, laboratories, and museums as are essential to its particular undertakings. Each botanical garden naturally develops its own special field of interests depending on its personnel, location, extent, available funds, and the terms of its charter. It may include greenhouses, test grounds, an herbarium, an arboretum, and other departments. It maintains a scientific as well as a plant-growing staff, and publication is one of its major modes of expression. Students can visit botanical gardens to get a hands-on experience of what they have been taught in the classroom. Botanical gardens therefore are useful in improving students' understanding about different plant species, their habit and habitat in natural condition.

Field Trips

A field trip is a journey undertaken by a group of people to any place away from their homes. The aims and objectives of the field trip is usually for educational purposes or to provide students with experiences outside their everyday activities, so that they can observe the subject in its natural state. Field trips motivate the students, make the students co-operative and at the same time to be more independent in their thoughts and ideas. Charles Darwin is an important example of someone who has contributed to science through the use of field trips.

Conclusion

Learning is joyful. Informal science education opens up and brings joy and amazement to the students by unfolding the secrets of life on earth and beyond the universe. This type of learning and teaching needs to be continually encouraged because it has been shown to increase a youth's retention of facts when compared to rote memory (Novak and Gowin, 1984). Recent reports emphasize the important role of learning science in informal environments and provide clear evidence that these experiences can promote science learning and strengthen and enrich school science (Bevan *et al.*, 2010; Phillips *et al.*, 2007). These experiences may also provide important and unique opportunities to engage students who come from communities historically underrepresented in the sciences (Banks *et al.* 2007). Ward *et al.*, (1974) suggest the promise of non-formal education with regard to their professionals and leaders. Firstly, "... non-formal education promises to be a more effective approach to relating education to national development." Secondly, "...non-formal approaches offer education that is functional and practical, i.e., related to the life-needs of the people." Thirdly, "...non-formal education seeks to maintain a benefit/cost consciousness of what it does in order to provide the most effective and purposeful consequences with the most efficiency." Fourthly, "...non formal education is the inherent commitment to seek innovative means to achieve the goals." Fifthly, "...non-formal education offers a more eclectic, multidisciplinary approach to the problem of development in a country." Sixthly, "Non-formal education promises to produce short-term effects as well as long-term achievements." And last, but not least, the seventh promise: "...non-formal education assists in the decision-making of educational and development funding agencies on both a national and international level." Similarly, while out-of-school activities and informal learning provide a special enrichment value for the gifted and talented, they have an even greater significance for the average student. Informal environments—or out-of-school-time (OST) settings therefore play an important role in promoting science learning. It is hoped that these teaching methods can be implemented in our state and would provide a satisfying service to the learners.

References

1. Alexander, E.P. and Alexander, M. (2007-09). *Museums in motion: an introduction to the history and functions of museums*. Rowman & Littlefield, 2008.
2. Bailey, Liberty Hyde and Bailey, Ethel Z. (1978). *Hortus Third*. New York: Macmillan.
3. Chisholm, L., Hoskins, B., Søgaard-Sorensen, M., Moos, L. and Jensen, I. (2006). At the end is the beginning: training the trainers in the youth field. Advanced Training for Trainers in Europe. Volume 2 – External Evaluation. Strasbourg: Council of Europe Publishing.
4. Mocker, D. and Spear, G. (1982). *Lifelong Learning: Formal, Nonformal, Informal, and Self- Directed.* Information Series No. 241. Columbus, OH: ERIC (CE). (ERIC Document Reproduction Service Number 220723).
5. Soni, A. (2004). Teaching of Science. Tandon Publication, Ludhiana.
6. Novak, J. and Gowin, B. (1984). *Learning How to Learn*. New York: Cambridge Univ. Press.
7. Bevan, B. J., Dillon, G. E., Hein, M., Macdonald, V., Michalchik, D., Miller, D., Root, L. Rudder-Kilkenny, Xanthoudaki, M. and Yoon, S. (2010). *Making science matter: Collaborations between informal science education organizations and schools*. Washington, DC: Center for Advancement of Informal Science Education.
8. Phillips, M., Finkelstein, D. and Wever-Frerichs, S. (2007). School site to museum floor: How informal science institutions work with schools. *International Journal of Science Education*, 29 (12): 1489–1507.
9. Banks, J. A., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutiérrez, K. D. *et al*. (2007). *Learning in and out of school in diverse environments*. Seattle: The LIFE Center and the Center for Multicultural Education, University of Washington, Seattle.
10. Ward,T.W., Sawyer, F.D., McKinney, L. and Dettoni, J. (1974). Effective Learning: Lessons To Be Learned From Schooling. In Effective Learning in Non-Formal Education, org. T.W.Ward and W.A.Herzog Jr. East Lansing, Michigan State University, p.38.

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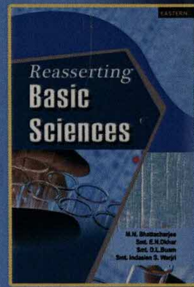
The Book



This book contains research papers depicting the emerging problems associated with studies and career in Basic Science, how to overcome them and how the studies can be made attractive and rewarding. It also takes care to establish a truly scientific progressive society devoted to human welfare and create a dialectical society.

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