Beginning Change: Incorporating Information Communication Technologies into Secondary-level Biology Education in Bangladesh

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Abstract:- **Using a self-study methodology as a basis of investigation, this paper explores theincorporation ofinformation communication technology (ICT) into secondary-level Biologyeducation in Bangladesh.Given that the traditional secondary-level learning environment in Bangladesh isoften unequipped for preparing students to function beyond its own society, the encroachment of globalism renders pedagogical progress (in the form of incorporated ICT) both vital and inevitable. Using ICT in a learning environment is commonplace in developed nations, yet developing countries, such as Bangladesh, are still considering whetherICT is even an appropriate application, yet there is scant understandingor substantive research upon which to base future policy change. This paper examines the role that ICTmay play in supporting face-to-face teaching and learning in thesecondary-level Biology classroom, at the same time as improving knowledge-retention, and dealing with special-needs students. This paper also discusses possible ICT education needs in Bangladesh and suggests futurepolicy direction.The result of this research is an important tool for educators, students, politicians, development practitioners, researchers, and many other freelance knowledge educators.**

Key words: - **Information Communication Technology, ICT, Secondary Education, Self-study, Biology, Bangladesh**

I. INTRODUCTION

Using ICT in class learning is a global movement (Bagui, 1998; Bell and Bell, 2003; Clarke, 2007; Bringimals, 2009). The developed countries as well as numerous developing countries are adopting appropriate policies in order to incorporate ICT in secondary-level education. In Western schools, the use of computers began in the early 1980s, and various academics argue that ICT will be a significant tool for the delivery of education into the 21st-century (Bringimals, 2009). Agreat deal of rigorous research has been undertaken in this area, Lefebvre et al. (2006) state that modern technology is offering an enormous enhancement of teaching and learning. These new technologies have immense possibilities in the support of teaching and learning across the curriculum. Dawes (2001) argues that ICT provides scope for effective communication between students and teachers which is impossible in the traditional learning environmentsuch as clarification of ideas through visual medium as well as placing and answering the queries online. Several studies argue that the use of ICT in classroom is essential for providing opportunities for students to learn to 'operate' in the information age. For example, Bringimals (2009) argues that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of contemporary societies.

This is supported by various researchers. According to Taylor (1980, 2003) computers may hold three essential roles in the classroom: Tutor, Tool, and Knowledge-repository. Sorgo et al (2010) found that successful use of ICT in Biology classes not only increased the level and density of knowledge among the students, but alsoactively changed the attitudes of students towards the subject matter. Similar observations were reported by Haunsel and Hill (1989), Kubiatko and Halakova (2009) after a successful research on relationship between microcomputer and student achievement in Biology. While new technologies mayencourage teachers to enhance their pedagogical practices, they can also assist students in their learning (Bringimals, 2009). According to Grabe and Grabe (2007), ICT can play a key role in developing student skills, motivation, and communication. Grabe and Grabe further claim that ICT can be used to present information to student in a manner designed to assist them complete complex learning tasks.

Becta (2003) has argued that successfully integrating ICT into education varies from curriculum to curriculum, place to place, and class-to-class, depending on the way in which it is applied. In science education, and specifically Biology, there are several areas where ICT has been shown to have a clear and constructive impact. Kubiatko and Haláková (2008) found that students were highly satisfied with the use of ICT in theirBiology classes after experimenting with both ICT and non-ICT dependent lessons for the same group of students in two different cities in Slovakia. Their observation was interesting as they realised that the same student group performed differently in ICT, non-ICT based lessons, and students responded in a more positive manner when ICT was used within the lesson. Jeronen et al (2008) discuss a similar result in their case study. They found a very positive attitude of students towards computers and ICT, stating that almost

86% of the surveyed students stated they were very confident in using ICT and only 14% feltless than competent when using ICT. Their conclusion was that students are increasingly positive towards ICT with a high confidence of using computers as a learning tool. According to Gaytan and Pasaro (2009), teacher opinion is a little different, in that those educators who were surveyed agreed that ICT was useful in the classroom and keyin connecting with students who preferred to use ICT. Additionally, there was consensus that using ICT in Biologyeducation is an improvement over traditional classroom methods. However, Gaytan and Pasaro also emphasised the necessary modification of teaching methods and strategies in teaching and learning, before attempting the integration of ICT, commenting on teachers' occasionally negative attitudes towards ICT as a teaching methodology. Their conclusion was that a number of teachers experienced fear about using ICT, a significantobstacle to any implementation of ICT in the education sector. This not only suggests a major area of competency-training for the teaching staff, but also future research in the specific field of professional software for educators.

Bagui (1998) and Levy and Murmane (2001) have all reported significant improvements to learning outcomes when ICT is harnessed into content delivery. Likewise, Bell and Bell (2003) and Clarke (2007) opined that use of ICT in the learning process creates a more positive attitude among students in how they approach their learning. Dark and Perrett (2007) described how ICT can remove the chronological boundaries within a learning environment and help pupils to work in-group beyond geographical boundaries, a useful point to consider for schools which may have mixed cohorts. DiCarlo (2009) found that use of ICT as a learning tool helps students to engage more fully, and Šorgo (2010) identified a 6-step model of ICT use in Biology classes of student of15-18 years, detailing the students' higher grades and improved outcomes.

II. METHODOLOGY

Self-study is the process of personal inquiry and reflectionopen to public critique. In the early 1990s, Guilfoyle et al.recognized self-study as an important tool of education research (Loughran, 2004; Lassonde, Galman, and Kosnik, 2009).According to Lassonde et al. (2009), Guilfoyle, Hamilton, Pinnegar and Placier were designated as the leaders of self-study theory and pioneered their work through the American Educational Research Association (AERA) in 1992. This researchtook the first steps in development of self-studyas a formal branch of education research. Research [by the individual educator]through self-study entailsboth openness and susceptibility, because it focuses on the self and it is designed to lead to the reframing and re-conceptualizing of the role of the teacher. (Loughran, 2004).The following paperwill demonstrate the effective application of self-study theory through a discussion of the problem of integrating ICT in secondary education in a developing country.

Research in the area of reflection and reflective practice has had a strong influence on the process of self-study. The movement towards developing reflective practitioners led to a body of research that focused on the teacher as researcher of his or her own practice (Cochran-Smith and Lytle, 1993). It was discovered that teachers could examine and problematize their teaching by reflecting on their practice and by becoming reflective practitioners (Schön, 1987; Zeichner and Liston, 1996).Teachers studying their own teaching methods spurred research that incorporated a number of qualitative research approaches,such as teacher inquiry and reflective practices. University researchers in the USA began to use biographical forms of inquiry as well as personal histories, life history approach, and narrative inquiry tounderstand their practice (Bullough and Gitlin, 1995). These research approaches provided a foundation for teachers and teacher-educators to enable the incorporation of similar methodologiesin their own practice. As teachers critically considered their practice, they questioned pedagogical methodology and participated consciously in their own growth and development (Zeichner, 1999). Many self-study researchers were influenced by the area of reflective practice, particularly Schön's (1983, 1987) and Dewey's (1933) work in reflection.

Action research has also had a strong influence on self-study and has been referred to as a "useful tool for self-study" because it provides a method by which to "conduct systematic inquiry into one's teaching practices" (Feldman, Paugh, and Mills, 2004, p. 970). Introduced by Carr and Kemmis (1986), action research involves a systematic approach to problem solving. Teachers and teacher educators engage in action research (Mills, 2000) to examine their teaching and their students' learning as a basis for making changes, especially in the absence of more quantitative data. It is for these reasons that a self-study methodology was chosen as the basis of this investigation.

Although teacher-educators have written about, discussed, and promoted the use of reflection and action research in their education courses in the 1980s, it was not until the early 1990s that teacher educators began doing what they encouraged pre service and in service teachers to do: that is, reflect on, inquire into, and study their practice (Loughran, 2004; Mills, 2000). The shift in the focus of educational research was characterized by research questions that delved into the complexities of teaching and learning. An important result of this shift in research focus was that the role of teachers and teacher educators changed as they began to investigate and question their practice. Teaching was viewed as highly contextualized, and the research began to focus on the complex and dynamic interactions between the teacher and the students. Research on teaching and schooling became more inclusive, and the knowledge generated about teaching came from the teachers' questions and wonderings.

Cole and Knowles (1998) argue that there are multiple reasons why people practice self-study and those purposes are typically integrated and not mutually exclusive. Although the purposes may be layered and multifaceted, researchers often focus on one aspect of professional practice. At the same time, the purpose may extend beyond the self towards educational reform. Kosnik, Beck, Freese and Samaras (2006) identified three purposes for practicing self-study: 1) personal renewal, 2) self-study where teachers explore and begin to identify who they are as teachers for self-knowing and 3) forming, and reforming a professional identity (Samaras, Hicks, and Garvey Berger, 2004). Another example is self-study action research whereby classroom teachers conduct a manageable professional inquiry that enables them to study their classroom strategies and actions for change, and who they are as teacher professionals (Samaras, Beck, Freese, and Kosnik, 2005). Regardless of purpose or method, the self-study scholar questions practice with the support of colleagues, and frames, assesses, and reframes his/her practice within the context of broader educational aims.Bullough and Pinnegar (2001) and Whitehead (2004) argue that self-study scholars must have a deep commitment to checking data and interpretations with colleagues to broaden possibilities and challenge perspectives to increase the credibility and self-study validity. Whereas validity in conventional research involves empirical evidence, generalizability, and professional critique, self-study is validated through collaboration including testing, sharing and challenging exemplars of teaching practices (LaBoskey, 2006, p. 252). Multiple perspectives provide ways of validating the findings (Loughran and Northfield, 1998).

Having mapped the foundation and development of self-study as viable research method, we now turn to the application of such a methodology as it relates to the incorporation of ICT into biology education in Bangladesh.The Bangladesh governmenthas put recent emphasis on the introduction of laptops and projectors in higher secondary schoolsand other sucheducational ICT as well as developing an ICT oriented training module for the teachersin order to achieve the goal of "Digital Bangladesh" (Bangladesh Government 2011), and appears comfortable with the notion thatthe use of ICT is one of the better ways to face the challenges of education in a global environment. Data fromthe Ministry of Expatriates' Welfare and Overseas Employment (MEWOE)indicates that Bangladeshi workers are facing unsurmountablelabour market competition with the neighbouring countries ofIndia and Sri Lanka,due to their lack of ICT knowledge (UNDP 2011). Effective knowledge of ICT therefore is both essential to develop an efficient workforce, and to enhance the momentum of national development. The Government of Bangladesh has identified the education sector as one of the most important areas within which to promote the use of ICT (Bangladesh Government 2011). Under the project 'Access to Information' (A2I) and with the collaboration of UNDP, the Bangladesh Government has taken an initiative in teachers' training and building the infrastructural support among the secondary schools in Bangladesh (Akash 2011).

The [Bangladesh] National Academy for Educational Management (NAEM)appears to beplacing tremendous importance on the incorporation of ICT into the design of the training curricula for secondary-level teachers. ICT is planned to bea major component of the training activities in order to motivate usage in the classroom. After formal training, a teacher of a year 12 Biology class,was able to participate in the trial ofa multimedia methodology in addition to the traditional white board-marker lecture system.During the self-study experiment, it was clearly demonstrated that teaching Biology using ICT rather than simply relying on the unvariedlecture method,created better learning outcomes for the students. Using colourful, animated videos of the blood circulatory system of birds and different glands in the human body made the class more interactive and generated increased student engagement.The difference between the traditional classroom environment and what a technology-assisted environment was immediately obvious. Bangladeshi science teachers weremore used to 'chalk-and-talk' as a way of teaching andconventional communication was not as effective for learning outcomes as an environment which embraced a more varied delivery set.

The use of long-established methods of teaching failed to move students beyond their own anticipated outcomes, or eventransmit complete and clear information in a Biology class in a way which made it engaging. From the personal perspective of a Biology-teacher involved in this experiment, the implementation of ICT in Biologymay be deemed both effective and essential in contemporary education. Additionally, due to the conventionally complex nature of the science and the often-pedestrianmanner of communicating the materials in class, students had previously been visibly reluctant to take Biology in their year 12 class, and would frequently seek an alternative subject. Thetwo-term trial of ICT attracted students to study Biology, first by novelty, then through authentic engagement. Moreover, incorporating ICT into the Biology classroom promoted, for the first time, the active involvement of learners, permitting a new flexibility in teaching delivery and access to modern technology and the internet.The flexibility offered by web-based platforms also increases personal contact, instant feedback and improved communication among students, as well as creating a basis for pedagogical progress. According to Akash (2011, p. 2),use of ICT in the classroommay create"a striking and tangible presentation"for the student. Akash further argued thatpermitting access to additional online sources such as the National Geographic magazine to download imagesof models such as photosynthesis, offers the Biology student a physical/visual connection to deep-learning rather than the superficiality of rote-learning (Akash, 2011, p. 2). Furthermore, significantliterature supports the inculcation of ICT in Biologyeducation in order to provide students with a variety of learning styles including visual, auditory and

experiential as well as teachers' personal contact with students in classroom.Therefore, realising the necessity of ICT in education, the Bangladesh government has begun to create well-equipped computer labs in the teachers' training institutions for extending the teachers' delivery 'repertoire' (UNDP 2011).

III. RESULT AND DISCUSSION

Thisself-study has critically investigated the plausible entry of ICT as a medium of instruction in secondary-level Biologyeducation in Bangladesh, though it poses a number of issues surrounding the perception of learning and teaching, as well as government policy debate. It is clear from the contemporary initiatives of the Bangladeshi governmentthat there is a development priority on the ICT-in-educationissue; however, to date no substantial action has taken place. Some minor, paper- based policy drafts have been produced, but there have been no further recorded field-related trials, and existing applied (experience-oriented) research is insufficientto instigate real change (UNDP, 2010). As a result, anyICTinitiatives are still vulnerable and open to a hijacking of funding as newer projects gain prominence. Furthermore, historical data suggests that Bangladeshi government initiatives are highly subject to change through the volatility ofpolitical administration and is often influenced by the opposing political beliefs of the various political parties, many of whom hold stakes in capital expenditure arrangements (Salman,2009). To ensure the ICT initiative actually reaches fruition, adequate and appropriate funding must be earmarked according to designated implementation plans. In order to define both funding requirements and its distribution, a clear understanding is needed of *what* and *where* ICT may be encompassed, in not only secondary-education, but also, and more specifically, in Biology education.

It seems logical then, that the followinginformation be researched to identify the best and most equitable solutions:

i) *Ascertaining student need*. How do the students feel about having ICT in Biology lectures? The subject data of biology are sometimes intangible and beyond the understanding of the student. For example, the process of photosynthesis in the chlorophyll should this read chloroplast?of plant leaves is a very sophisticated scientific chain of reactions. The understanding of growth, using sunlight and other chemicals stored in leaves,demands a conceptual leap from the student. Students who are used to the rote-memorisation of materials for examination (summative education) are more conversant with superficial learning rather than deeper understanding. If a complex chain of reactions can be visualized by using animated pictures and video, entire scientific tropes may bevisualised through a simple program. It is assumed that students will become more comfortable with ICTas use increases, and will ask questionsas critical thinking follows. Clarifying the

feelings of students towards using ICT in class would be one of the major components of any future research.

ii) *What are the possibilities of using ICT in teaching Biology?*Usage possibilities depend on several factors. The most important ones are school (infrastructure) support;the educator's experience; the leadership attitudes towards ICT in general; the student's orientation to technology and available technology.

iii) *How do the uses of ICT affect the learning process of the student?* Students' results and learning outcomes are the important indicators of the successful utilization of ICT in class. Student satisfaction and interest is very important in determining how effectively ICT was used in class. Assessment of ICT inclusion will be paramount.

iv) *What are the constraints in using ICT from the educator's perspective?*A teacher's level of comfort with ICT is crucialin the successful implementation of technology in the classroom, and removal of all possibleobstacles hampering ICT use will need consideration.

v) *How should ICT be included in a 1ˢᵗ year class?*Determination of the computer literacy of new students and the proper measures needed to make an homogenous computer skilled class is very important and will reflect the overall success of ICT utilization.

vi) *How to change the existing curriculum?* Changing curriculum is a policy-based decision and depends almost entirely on political will and ease/cost of change.

vii) *How will the change be sustainable?* Sustainability of ICT use is an issue of overall success. Defining ways to make such radical change sustainable requires involvement ofall key stakeholders such as parents andthe local community.

3.1 The Significance of using ICT in Bangladesh

The synthesis of self-study and the reviewed literature suggests that students' response to the use of ICT in the lecture of a Biology class titled 'Life cycle of the Toad' would be dramatically reflective, and indeed, this was the case. Students were more enthusiastic than usualin their questioning, and more considered in their responses to questions. The short evaluation immediatelyfollowing a lecture demonstrated that the overall result/score of the students trended significantly upward. The students articulated their increased ability to offer comments and participate in a more interactive manner. The application of self-study adds importance to the reformation of existing practice (Loughran, 2004); especially after the observed results of the ICT trial was shared with other educators in order to reframe and re-conceptualization the idea. It was found that the majority of teachers involved in the discussion held very passionate views about the student feedback, and freely offered their own

reflective validity of the possible use of ICT in Biologyeducation. Students' interest and participation was one of the success factors of the research and was highly collaborative with the aim of the research. Similar observations are also reported by Sorgo et al. (2010) and Jeronen et al. (2008), who stated that the most important findings was that use of ICT helps the teacher save time in the class enabling them to give detailed responsesto specific queries from students. This also helps to give more attention to the student with special needs, all of which lead to improved learning outcomes.

This paper therefore proposessignificanttechnological change in secondary education in Bangladesh. The findings of both the trial ICT experiment and the self-study reflection of that trial by the author, suggest that the Government of Bangladesh consider altering the existing curriculum. There is a positive correlation between the use of ICT and student's level of understanding of the topic. Kubiatko and Haláková (2008) found that 85% of the students attending the ICT assisted Biology class agreed that the lesson fulfilled their desired expectations and expressed a high level of satisfaction with the teaching materials. Approximately 70% of the students who expressed an opinion, stated that the use of ICT in their Biology class wasmore engaging than writing on white board (Kubiatko and Haláková 2008). This requires change not only in the curriculum, but also in the relevant teacher training institutions, in order to foster necessarydevelopment of teacher training design, since, as the reviewed literaturehas shown, there is a distinct and positive correlation between training design and classroom performance of teachers (Bell and Bell, 2003; Sorgo et al. 2010). Yaman and Graf (2010) have shown that the participants of a recentBiology teacher-training program in Hacettepe University, Turkey,shows that 78% of trainee teachers were happy to use ICT. While the Bangladesh Government,with the collaboration of UNDP,has already begun initiatives to achieve the goal, under the project 'Access to Information (A2I)' Akash (2011), it is of the utmost importance that these initiatives take place and are implemented in a systematic and practicable manner. In order to bring Bangladesh into the same century as the rest of the world,significant change must take place in both the secondary learning environment and students' level of understanding through technology.

3.2 Recommendations:

The evaluation and analysis of the existing educational environment in Bangladesh generates the following recommendations:

1. The introduction of ICT in secondary-level education is in need of immediate government attention.
2. Extended research on this issue would greatly assist policy development.
3. The general curriculum should be updated to consider the benefits of ICT.

4. Biology education should be considered a priority for ICT inclusion.

IV. CONCLUSION

The result of this self-study carries a number of significant messages for the teacher-educator as well as for the government of Bangladesh. The weightiest lesson is that the traditional educational environment does not prepare today's learners to function or be productive in the workplace of contemporary societies. The result of the trial ICT Biology class reveals yet again that technology can play a vital part in supporting face-to-face teaching and learning in the classroom, as well as helping students to understand and retain an increased level of knowledge. The inclusion of ICT can reduce the amount of direct instruction given to individuals, thus catering for both larger (and mixed) classes, as well asenabling teachers to pay greater attention to students with particular learning needs. Moreover, it can help teachers enhance their pedagogical practice. For example, using ICT in a class appears to ensurethat communication freely travels both ways and the momentum of open discussionincreases spontaneity among the students involve in the discussion. This is the besttype of learning environment: holistic and effective. Further, the incorporation of ICTreduced the educator'spreparation time which again can be better utilized with the student having difficulties. It is crucial thatthe education policy of Bangladesh does not delay in the design and implementationof an inclusive ICT program.

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