Integrating computer technology in teacher education

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Abstract:

The paper highlights some of the concerns among developing countries to introduce computer technology in teacher education and the nations' classrooms in particular. The arguments in favour hinge on improving quality of education through improvement in quality of teaching and learning processes through the use of computer technology. The paper discusses the use of computer technology in exploring the constructivist dimensions of the content of science and mathematics curricula and helping the development of new curricula with a constructivist or social constructivist orientation.

The reader is introduced to the efficacy of integrated learning systems (ILS) in providing feedback and the need for remedial action to learners who can monitor their performance. The 'microworld' learning environment created by LOGO, and the application of Microsoft Paint programmes in the primary school science and mathematics curricula are discussed. The paper also highlights the role of the World Wide Web (WWW) in developing global curricula for science and mathematics. The emergence of Web-based learning environment (WBLE), a confluence of digital technologies of computer, Internet and the World Wide Web, is creating new opportunities in the academia for e-learning and online education – both in-campus and off-campus.

The paper emphasizes on the need for teachers and student learning to promote the acquisition of 'technological disposition' if our educational system were to integrate technology in teaching. The new learning environment scenario, created by emerging technologies, needs a re-conceptualization of the role of teachers and learners entering the information age. The route to technology integration in teaching passes through teacher development in technology education which should be regarded as a major discipline in pre-service preparation and in-service teacher development programs.

In conclusion, the paper describes the Mauritian government's concern to invest in computer technology in order to provide the necessary technological infrastructure to propel schools into the information age, thus bringing about instructional reforms at all level of schools. The reforms have also engendered massive teacher training and re-

training, continuous professional development (CPD) programmes for instructors and teachers alike and eventual reform of primary and secondary curriculum.

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While the drive to provide computers in developed countries' classrooms is strong in favor of K-12 schools, the picture is quite different in developing countries. There is uncertainty and lack of consensus as to where to start, where to put computers, in which classrooms or in computer labs. Although financial implications of providing computers in schools may be one among many other reasons that may lead to lack of consensus, the element of uncertainty is often associated with understanding the provisions and implications of instructional technology in schools and classrooms. Most arguments in favor of computers in K-12 schools hinge on improving quality of education through improvements in skills, variety in content knowledge and pedagogy. Generally, the arguments in favor of computer use in schools is to improve the quality of teaching and learning processes through application of integrated learning systems (ILS), using computers in integrated curricula, exploration in microworlds, explorations of concepts, and re-defining new roles for teachers in computer-enriched classrooms.

Integrated learning systems (ILS) are basically prepackaged computer-based systems for delivery of reading, math, and science curricula using the Individually Prescribed Instruction (IPI) mode of learning. The system has gained popularity over the past decade, a popularity evidenced by the appearance of numerous systems in educational software catalogues. A popular ILS is SuccessMaker (marketed in the UK by Research Machines (RM)) which is aimed at ages 5-14 (Baker, 1977). Though evidence abound in the efficacy of such systems in significantly improving performance of students, criticisms have lately been leveled against the design of packets within the courseware component of the system as lacking effective integration of learning experiences. Cassidy & Smith (2005, p. 1), argue

> "(the) packets are often no more than unrelated activities clustered around a single topic and give little consideration to the development of larger concepts or goals… Real knowledge is much more than a group of unrelated segments; each section supports a particular function, and all are related to one another….True integration respects the interrelationships of the discipline – language, mathematics, science – as natural and necessary to achieving the goal of becoming educated about a particular topic."

However, ILS have positive operational features that contribute to significant learning gains in areas of reading, mathematics, and science. The system constantly allows students to monitor their self-appraisal and performance, provides immediate feedback and shows clear indication for remedial action whenever it may be needed. Its contribution as a course delivery system and a tool for concept exploration makes ILS a viable educative instrument to support learning in classrooms.

Integrated curricula provides additional context for application of computers in concept exploration and encourages students to use word processors (e.g. KID WORKS2 software) for composing and hearing their compositions read back. In contexts where mathematics features as a critical component embedded in interdisciplinary curricula, computer-based learning environments act as catalyst to make explicit the structure of mathematical knowledge as applied to the different areas of the curriculum. Most integrated curricula embed features of mathematical thinking processes with time-dependent processes and are amenable to computer processing.

In its simplest form, microworlds are learning environments created by LOGO programming language. Although microworlds exist independently in other spheres of human learning, computer-generated microworlds are the most powerful learning environments that bridge the gap between abstract learning and hands-on experience. It allows children to interact, play and discover concepts and cause-effect relationship in a natural way in a language close to ordinary conversation (natural language). LOGO has an 80% task time and a 20% learning curve, making it the easiest language to master within the shortest time. Because it is result-oriented and provides immediate visual feedback make LOGO particularly suitable as the first programming language for teachers and children.

Computers offer a unique way of exploring fundamental concepts in science and mathematics. The tool-set in-built within Microsoft Paint programs consist of a variety of instruments that have been used to articulate processes relating to basic mathematical and science concepts. By way of illustration, Paint is being used to simulate elementary transactional processes of drawing, folding, tracing, shading and colouring in the study of line and rotational symmetries, while the software provides deeper insight by engaging learners in exploring fundamental concepts of degrees, areas, powers (indices), and solving word problems.

Resources on the Web may help curriculum writers to develop global curricula to complement the learning gains. Unlike textbooks that contain static materials, resources

on the Web can create better dynamics to enrich classroom teaching. One example is the subject of tessellation. The World Wide Web (WWW) abounds with information on instructional materials and content to the extent that a single 'yahoo.com' search (27 May 2006) for 'tessellation' yielded as a many as 76,800 hits.

WBLE

The convergence of digital technologies of computers, the Internet, and the World Wide Web (WWW) have made possible the emergence of a new and rich learning environment, the Web-based learning environment (WBLE). As the name implies, WBLE is becoming a viable, interactive option for teaching and learning. The system can be regarded as being present in two complimentary modes: one **in-campus,** for traditional students; and the other **off-campus**, for non-traditional students.

The **off-campus** mode of Web-based learning environments (WBLE) can be viewed as an extension of distance education or as a variant of classroom activity (Pringle, 2002). In this mode, it has become an ubiquitous open Web of interconnected, global computer networks allowing extensive interaction and collaboration among learning communities. This development has further led to the concept of building "communities of learners." Pringle (2002, p. 218) argues that

> "such communities are built on principles of coparticipation while challenging traditional modes of teacher-student relationship. Here, coparticipation implies the presence of a shared language that becomes accessed by all as they engage in the activities of the community with a goal of facilitating meaningful learning. In effect, the teachers are no longer the bearers of information, but partners in conversation that seek to construct knowledge. This construction occurs through negotiation and consensus building, allowing the viability of such knowledge to be tested against what has been established and accepted as 'truth'."

The new learning environment created by emerging technologies needs a re-conceptualization of the role teachers entering the information age. Far from being the purveyors of content, teachers need to be educated professionally to develop a 'technological disposition' in integrating technology in teaching. There is general consensus that instructional goals in technology education should be directed toward student learning that promote the acquisition of a 'technological disposition' rather than a set of isolated skills and competencies. The notion of 'technological disposition' encompasses the acquisition of competencies and skills in applying computer technology to competent learning and problem solving through application of technology. These involve the ability to acquire domain-specific knowledge, heuristic methods,

metacognitive kowledge, understanding and skills, and affective components like rational, beliefs, motivation and emotion, together with the ability to develop skills and competences through the application of these categories interactively and comprensibly.

The Information Age and conception of postmodernism offer a systemic approach for re-conceptualization of professional development of teachers beyond the modernist view that focuses on the delivery of education as the additive sum of teaching strategies, learning skills, curriculum, modes of assessment, pedagogical content knowledge, and propositional knowledge related to the specification and definition of standard knowledge. The postmodernist view holds that professional development as currently conceived – one week seminar, a day workshop, an occasional in-house training, complemented with hand-outs – is inherently lacking in conception and misleading in approach because it does not frame up with teachers' needs in the context of emerging school reforms and the newer roles of teachers in the twenty-first century. The futility of the impact on teachers of such approaches is widely known. Darling-Hammond (1999, p. 221) argues that 'schools must become dramatically more successful with a wide range of learners if many more citizens are to acquire the sophisticated skills they need to participate in a knowledge-based society.' The fact is that the knowledge and skills of the modernist era have produced citizens that need continual re-training in the sophisticated skills accruing from emerging technologies of the last two decades. With respect to the teaching profession, for too long, teachers have been viewed as professionals with plug-and-play capabilities who could enter the profession for a lifetime career span in schools. It is now felt that professional development should engage teachers in continuous and life-long learning processes for self-development and for growth in their profession.

The route to technology integration in teaching passes through teacher development in technology education as part of pre-service and in-service teacher education provision. Technology Education is regarded as a major subject discipline in pre-service preparation and in-service teacher development programs. It serves as an inclusive strategy to encourage technology integration in teaching and as well as using multimedia technology in education. Technology education is intended to foster project-based learning (PBL) with focus on integrating multimedia technology into curriculum, using computer technology for teaching, software evaluation in education, and use of educational software as support system to teaching-learning processes.

To upgrade and bring up-to-date practicing teachers, both in primary and secondary schools, in integrating technology into teaching, teacher training institutions should provide tailor-made upgrade programs in Technology Education through application of

distributed and open learning systems and use of immersive, synthetic Web-based learning environments (WBLEs). The scale of this project necessitates collaboration of stakeholders in drawing up a blueprint for its design, development, implementation and evaluation. A project of this magnitude would embrace all schools and teaching personnel at the national level, and needs setting up a steering committee to consider its implications in terms of availability of human and computer resources.

Bringing computer technology into a traditional teacher education setting based on face-to-face, didactic method of instruction is regarded more a challenge to established norms of classroom practice than a will to restructure teacher education through technological innovation. Experimenting with the process of teaching and learning through the medium of Information and Communications Technology (ICT) is regarded as instructional innovation and has established itself in its role of influencing education and contributing to the enhancement of teaching and learning. The literature abounds with research into the effects of using ICT in education, more particularly the Internet and the WWW and their effects on learners. At the baseline it is important to see how well an innovation can make its way into the learning lives of instructors and students, at home and in the classroom. The 'education systems and their teachers are supposed to prepare the next generation for the future. Yet no sector of society seems more conservative and chained to the past than the education sector' (Victor Ordoriez, Director of UNESCO, Bangkok). Teachers and instructors continue to rely on traditional methods of instructions.

Trends in education in a changing social context

It is common knowledge to regard investment in computer technology as being related to productivity. Mauritius has been no exception to this perception. In its objective to implement the Master Plan, the Action Plan, the Obeegadoo Plan, and the Educational Reform of 2005, there has recently been massive investment in equipping schools with computers with the aim of bringing instructional reforms at the level of schools. The micro-economic focus is getting narrower and sharper on education with the result that pressure on educational institutions to use new technologies in classrooms is mounting. This is leading to massive teacher training, continuous professional development (CPD) for instructors and teachers alike and an eventual reform of primary and secondary education curricula. Funding bodies like the World Bank no more adhere to the idea of building new classrooms; training more teachers will be the solution to accommodating the increasing number in the student population (Wolfensohn, 1996).

Mark & Stanway (2006)) argue that ICT are not likely to be helpful to teachers unless they can relate to teacher's work, have relatively low opportunity costs in relation to other forms of information access (such as library books or the teacher's filing cabinet containing plenty of previously used materials), and have a fairly short learning curve so that the initial investment in learning results in useful material for instructions. A fact to be reckoned with is that in most countries access to Internet and its resources are now on the increase in practically every area of education and training. Computers and Internet facilities are being made available in almost every teaching and learning institution and the trend is that the facilities offered are on the increase each year. Negroponte (Being Digital, 1995, p.6) pointed out "The population of the Internet is now increasing at 10 percent per month. If this rate of growth were to continue (quite impossibly), the total number of Internet users would exceed the population of the world by 2003".

With the advent of the wider availability of the Internet, there has emerged a belief that the Internet promotes pro-active teaching and learning (Joo, 1999). Opening the classroom to the Internet and using it in education and training are believed to change the role of both teachers and learners. The 'paradigm shift' invoked in these roles benefit both parties as one take more responsibility for his/her own learning while the other is relieved of being the source of all knowledge. However, its adoption in the classroom by no means implies that technology is either well used or well understood. Its judicious use and acceptance depends in a large measure on teachers and students and the caution with which they explore some unfamiliar sites.

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