Characterization of ICT Activities in the Teaching/Learning Institutions and the role of ICMI.

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Abstract

Technology has occupied a prominent place in every forum organized under ICMI, including ICME, Topic Study Groups and ICMI Regional Conferences. This paper acknowledges the big contribution ICMI has made over the years and continues to make through research and publications in the area of Technology in Mathematics Education. In this paper, the author reflects on the UNESCO models for ICT development in schools, and uses Uganda as an example. The paper argues that for research in the use of technology in mathematics learning to be realistic, the teachers should have moved from the discovery stage to the transforming and specializing stages in the use of ICT tools. The continued role of ICMI, through its many organs, in promoting the sharing of research findings and improving documentation capacities of mathematics teachers, especially in classroom-based research in and with technology is underscored.

1. BACKGROUND

Information and communication Technology (ICT) has become one of the basic building blocks of modern society. Mastering basic skills and concepts of ICT is becoming part of the core of education, together with reading, writing and numeracy.The role of ICMI in promoting research and publication in the use of technology in teaching and learning has been very prominent over the years. This is achieved through many fora organized and supported by ICMI. For example at the 9th International Congress on Mathematical Education (ICME 9), held in Tokyo in 2000a number of research reports on educational technology were presented ([2], [4], [5], [7], [8]).An earlier study [1] reports on the student interaction with a computer, used as a proxy to get information on their problem solving strategies. The authors in their conclusion mention limitation in the type of records obtained and point out the necessity for the records to be complemented with interviews and written protocols. Over the years, through ICME conferences [2] and ICMI study groups, the sharing of research among the mathematics education community has been possible across boundaries. There are however a large volume of research findings on the use of technology in the teaching and learning of mathematics which is apparently not fully shared. This is partly because the mathematics and mathematics education community may not be fully aware of the technological needs of their peers elsewhere, which makes the sharing of research cumbersome. This work reflects on the possible cause of lack of participation in research by reviewing the UNESCO models of ICT development [8]. The continued role of ICMI, through its many organs, in promoting the sharing of research findings and improving documentation capacities of mathematics teachers, especially in classroom-based research in and with technology is recommended.

2. THE MODELS OF ICT DEVELOPMENT

Two models are reviewed here. These are *a continuum of approaches to ICT development* and *stages of teaching and learning with and through ICT*. The two models provide a framework for an ICT curriculum in a school.

2.1 A continuum of approaches

A continuum of approaches comprises of four broad approaches by which educational institutions and schools may proceed in their use of ICT. The four approaches are **emerging**, **applying**, infusing, and **transforming**. Figure 2.1

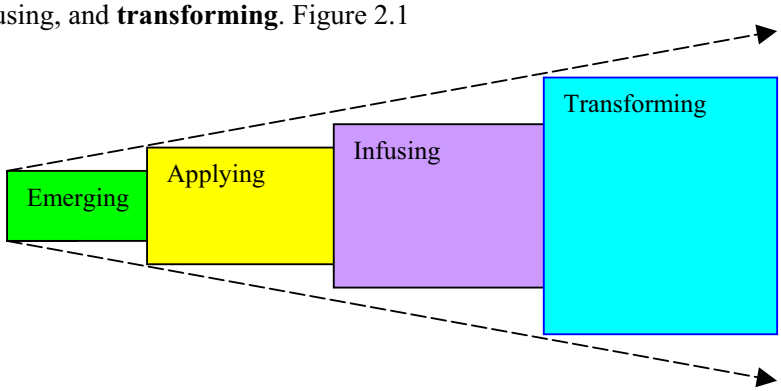

Figure 2.1.Model showing a continuum of approaches to ICT development in schools, adapted from (UNESCO, 2002, p.15).

(i) The merging approach

This is the beginning stages of ICT development characterized by institutions purchasing or acquiring donated computing equipment and software. In this stage administrators and teachers are only beginning to explore the possibilities and consequences of ICT usage in management and curriculum. In Uganda this stage is typical in over 80% of the schools in the country. Computer curriculum has been designed by the national curriculum centre to be used by schools, but its operation in the schools is still optional due to uneven or non availability of ICT equipment in the schools.

(ii) The applying approach

Schools which have appreciated the contribution of ICT to learning enter into this phase. Teachers use ICT for routine tasks in the school. Teachers adapt the curriculum to increase the use of ICT in mathematics teaching and learning. Teachers however still dominate the learning process. In Uganda, those schools which have acquired computers use them primarily for editorial purposes, not as a teaching and research tool. Acquisition of basic computer skills is the major activity.

(iii) Infusing approach

At this stage a range of computer based technologies are employed in laboratories, classrooms. Teachers explore new ways of in which ICT will change their productivity and professional practice. The curriculum begins to merge subject areas to reflect real world applications.
Some ICT infusion is visible at higher levels (university) in Uganda. Examples are use of multimedia in teaching, and use of specialized software in solving mathematical problems.
At school level, this stage is not yet achieved.

(iv) The transforming approach

This is stage where ICT becomes an integral though invisible part of daily personal productivity and professional practice. The focus of the curriculum is learner-centered and integrates mathematics teaching and learning in real applications. In Uganda, this not yet achieved because the curriculum design and also the limitation on facilities and equipment in the schools.

2.2 Stages of teaching and learning

UNESCO (2002) studies point to four broad stages in the way students and teachers learn about and gain confidence in the use of ICT: These are **discovering**, **learning how**, **understanding how and when**, and **specializing in the use of ICT tools**.

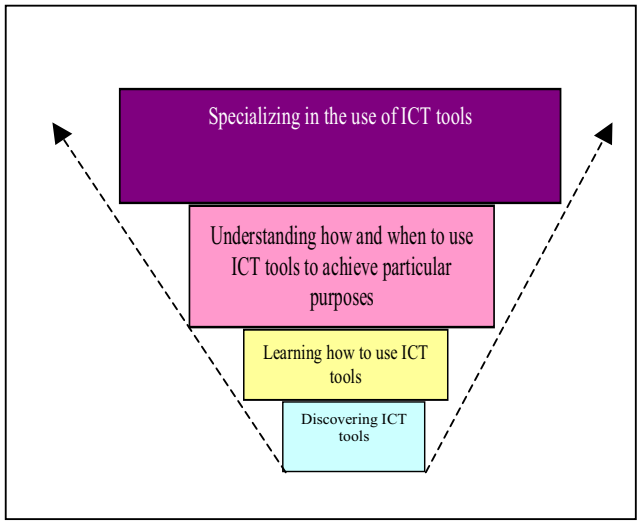

Figure 2.2.Model of stages of teaching and learning with and through ICT adapted from (UNESCO, 2002, p.17).

The intensity of use of ICT increases from the discovery stage toward specialization in the use of ICT tools.

(i) Discovering ICT tools

In this stage teachers and learners are discovering ICT tools and their general functions and uses. At this stage, emphasis is on ICT literacy and basic skills. This stage of discovering ICT tools is linked to the emerging approach in ICT development (Fig.2.1). In Uganda over 80% of schools are still found in this category. Limited use of scientific calculators is visible in urban schools but the impact on teaching and learning mathematics has not been quantified. The implication is that technology is still not fully explored and hence no research in the use of technology in the classroom is being done.

(ii) Learning how to use ICT tools

This is a stage where learners and teachers begin to make use of ICT tools in different disciplines and is linked to the applying approach in the ICT development (Fig.2.1).A number of secondary schools in Uganda are in this category but the percentage is still small (less than 10%).Tertiary institutions including universities in Uganda are generally at this stage. Common application of ICT in tertiary institutions includes editorial work and internet. Actual research on how students learn mathematics with technology is not available. Given the limited coverage, research output in mathematics education with respect to technology is still minimal.

(iii) Understanding how and when to use ICT tools to achieve particular purposes

This stage implies the ability to recognize situations where ICT will be helpful, choosing the most appropriate tool for a particular task , and using these tools in combination to solve real problems. For example using Excel by students to plot graphs of statistical data generated from a classroom exercise. Another example again, is use of excel by a teacher to process grades obtained from a class test. This stage is linked with the infusing and transforming approaches in the ICT development.

In Uganda, this stage is mainly accomplished in well established research institutions and Universities. Training and ICT infrastructure development are key factors being addressed at all levels in the country. To that extent there is now a full ministry of ICT in the country, a position which has not been there before.

(iv) Specializing in the use of ICT tools

This stage involves specializing in ICT. In this stage students study ICT as a subject to become specialists. After their study, they become professionals as opposed to the general knowledge in the use of ICT.

In Uganda undergraduate mathematics teachers to be, take their teaching subjects together with basic ICT course at the University. This training does not make them to become ICT specialists but basic users of ICT tools. Students in the computer science departments in Universities in Uganda are the ones who specialize in ICT. For the teachers to explore technology in the teaching and learning of mathematics, more exposure in classroom based research skills is necessary.

3. IMPLICATIONS

3.1 Introduction

In section 2, two models of ICT development adapted from UNESCO are reviewed. These are *a continuum of approaches to ICT development* and *stages of teaching and learning with and through ICT*. The two models are closely related and do provide a framework for an ICT curriculum. In this section some implications of the two models are discussed based on the examples from Uganda:

(i) Limited research output in the use of technology in the classroom

There is limited research output because the majority of schools (over 80%) are still at the ICT discovery stage in Uganda. In this stage, emphasis is more on the familiarity with ICT tools with the application confined to routine tasks. Even in cases where facilities such as internet exists, research documentation of its impact on the teaching and learning of mathematics is hard to come by.

(ii) Research capacities of teachers

Graduate teachers leaving Universities without practical research skills in the use of technology in the classroom. Basic knowledge in the use of ICT tools is not sufficient if a teacher is not exposed to research methods in the use of ICT in the teaching and learning of mathematics. Training of mathematics teachers will make them help students know when and where they need to use technology, and also to be confident with their solutions. This point is illustrated in a simple random experiment with nine junior secondary school students from Kyambogo College School.

(iii) Potential of and limitation technology

The author asked a group of nine junior secondary school students what strategy they would apply to solve a routine problem such (24x25).The responses varied as follows: calculator (5),pencil and paper (8),Number patterns(0).The reasons for using the calculator mentioned variously by the students were: ”takes long to get the answer without calculator”, ”you can easily get confused”, ”makes work easy”, “saves time”, and “one cannot get confused”. The author again challenged to tell him how they would know that the calculator gave them an incorrect answer. This took them time to offer an answer. Only one student was able to offer a response:” First try it on smaller figures which can be checked without the need for a calculator. If it works, then it should work for other bigger figures”. Another strategy was use division to check the multiplication or vice version.

4. RECOMMENDATIONS

Basing on the examples and experience from Uganda, the two models of ICT development reviewed in this paper, namely, *a continuum of approaches to ICT development* and *stages of teaching and learning with and through ICT* call for increased exchange of research in the use of technology in teaching and learning of mathematics. Greater strides are only possible in this particular area if new research findings are documented and shared by a wider mathematics audience, especially in regions and countries where facilities pose a challenge to independent research. In this regard ICMI and its many organs such as ICME, ICMI Topic study groups, ICMI regional conferences, and professional associations continue to play a key role in sharing the volume of research that are being generated, especially in the use of technology in mathematics education.

Where feasible new regional research dissemination portals should be created where they do not exist, or where they do exist, strengthened, to make the dissemination of research in teaching and learning mathematics with and through technology easy and affordable.

5. SUMMARY

This paper has reviewed and adapted two UNESCO models of ICT development
These are *a continuum of approaches to ICT development* and *stages of teaching and learning with and through ICT*. Some implications of the two models are discussed, based on practical examples from Uganda. The importance of research based knowledge in teaching mathematics with technology is emphasized. The continued role of ICMI, through its organs and affiliations in sharing research information, as well training of teachers is recommended. Strengthening regional portals or contacts is suggested to widen the scope and coverage of ICMI activities in countries such as Uganda and the neighboring regions. Where feasible new regional research dissemination portals should be created where they do not exist, or where they do exist, strengthened, to make the dissemination of research in teaching and learning mathematics with and through technology easy and affordable in the mathematics and mathematics education global community.

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