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MATHEMATICS TEACHERS USING INFROMATION TECHNOLOGY

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Abstract

Teacher's education stands as critical among the various issues pertaining to the integration of Information Technology (IT) into mathematics education. Remarkable improvements have indeed taken place recently both with respect to the material aspects of (IT) (hardware, management, accessibility, maintenance) and the availability of high quality of the teachers and of their pedagogical agenda. Renewed and diversified roles confront teachers in an (IT) education environment. Pre-service and in-service teacher education must help all of them to modify their attitude and develop the new competencies in mathematics, informatics and the didactics essential for them to fulfill their pedagogical mission.

The last two decades have witnessed a wealth of attempts aiming at integrating (IT) into mathematics education. The advent of microcomputer technology and subsequent progress both in hardware and software development have given rise to very high expectations about the impact of informatics on the teaching and learning of mathematics. Teaching and learning are first and foremost human activities, involving the teacher and the pupils as well as the interactions between them and with knowledge. Information Technology comes into play to facilitate these interactions.

Keywords: Mathematics, in formation technology, education interaction.

Introduction

The pedagogical potentialities of the computer in mathematics [1,2] have evolved considerably since the days when it was used strictly in the context of numerically oriented languages. For instance, the availability of the programming language Logo with its underlying philosophy of exploring mathematics in specially designed micro worlds the development of symbolic mathematical systems like Maple or Mathematic capable of carrying out symbolic computations previously considered to exemplify a genuinely "human" ability, or the recent advent of geometry exploration software such as Cabrigeometre allowing users to manipulate and transform geometrical objects, have drastically modified the perception of the influence computers might have on the teaching and learning process in mathematics. Moreover the computer capability of handling multiple representations of information – numerical graphical and symbolic – and of moving from one form of representation to another has opened up the way to unprecedented applications in mathematics education.

The successful integration of IT requires a wide range of actions, numerous issues [3] such as : aims of education, expectations of society, curricular reform, material infrastructure of availability and maintenance of hardware, development of software, funding policies, human resources. The public debates that took place in the early years in many countries around the introduction of computers in schools and colleges more of a political than of a truly pedagogical nature and held in nearly feverish climate that could but hinder sensible decision making. Improving education with computers requires more than hardware and software. Students also need to work with skilled

people including teachers, parents, co-workers, and friends.

This paper concentrates on the teachers themselves, their competencies, their attitudes, perception multiple roles. Teacher education (both in pre-service and in-service context) is a channel of the utmost importance through which IT can create an impact in the mathematics classroom. This stand point matches the conclusions of the recent impact study [1] to the effect that the three main resources related factors influencing concrete use of IT are:

1. Access to computers;
2. Organization of IT in the class;
3. Teacher's skills and enthusiasm for using IT in curriculum.

While it is true that modern technology is affecting educational aims in general, the influence is particularly strong in the case of mathematics education, as reported in the Study of the International Commission on Mathematical Instruction ICMI [4]. This study states that mathematics itself and the way in which mathematicians work are being directly modified, the demands, expectations and employment patterns within society with respect to mathematics are changing, the educational goals and structure of entire curricula must be reappraise, and new pedagogical possibilities for teaching and learning mathematics are being opened up.

Our graduates are taught to do mathematics in ways that are very largely outmoded, with at least 80% of the curriculum time wasted on trying more or less successfully, to develop 'fluency in skill of now-limited value' [5]. Extraordinary demands are thus being made on the teacher towards a deeper use of IT in his mathematics classroom.

At least three types of competencies are necessary for teachers in order to adequately fulfill the new roles, which confront them in, and IT environment: competencies related to mathematics to informatics and to didactics. In no case can the technology replace the pedagogy [5]. All this results in a complex situation where the teacher is the one first and foremost responsible for elaborating a coherent teaching and learning context within which integration of IT can become effective. Successfull teaching experiments have been reported involving computer. These are often associated with enthusiastic teacher-pioneers and are very difficult to generalize or even to reproduce. One of the major difficulties in the integration of Information Technology in classrooms in thus to have all teachers become competent with this new environment, and not only those naturally inclined. This represents an outstanding challenge for both pre-service and in-service teacher education.

It has also been suggested [2] that successful integration of IT in teaching requires a new generation of teacher technology oriented teachers. But we cannot wait for today's teachers to have all been replaced by a future generation nor can we hope for such an evolution to happen by itself. Concrete actions thus need to be taken simultaneously both at the in-service level, because some of the teahcers actually in place will still be in their classrooms in years from now and at the pre-service level to allow future teachers a meaningful contact with the IT environment. Integration of new technologies in instituttions amounts first of all to integration in teacher education. It is not sufficient to inform teahcer about " how to use" IT, they must actually work with it. Effective use of IT in their own learning that teachers can go through the required change of attitudes perceives the computer pedagogical tool.

A Survey of Teachers Responses:

A survey of 54 teachers, Gower [7] provides the following responses. Teachers were asked about the benefits which accrue from the use of IT, are shown in Table 1 below:

Benefits of IT use	**% Respondents**
Low level cognitive skills	52
High level cognitive skills	33
Personal skills	30
Social skills	17

Table 1: % respondents indicating benefits of IT.

In one institution teachers were asked about the uses they saw for IT. Their responses were categorized and are shown in Table 2:

Teacher perception of IT	**Number of teachers**
Administrative tool	18
Teaching tool	16
For skill development	14
Support learning	12
Material production & presentation	10
Games, or for playing	9
Something to know about	5
Motivates children	5
Bandwagon	3
Expert tool	2
For programming	2

Table 2: Teacher perception of IT from an interview survey with 66 staff in one institution (n = 66) (Parsey and Rdgway, 1992).

The commonest single response was to see IT as an administrative tool. Overall, the responses were rather sparse. Only responses are concerned with the support that IT can offer for learning. These data show that in this institution educational ambitions for IT are somewhat modest.

In two institutions staff were asked to categorize their use of IT on a scale which ranged from IT terrified to ' IT curriculum user'. Their responses are shown in Table 3 below:

How teachers viewed their use of IT	**Report 1 N = 66**	**Report 2 N = 53**
IT terrified	5% (3)	10%(5)
IT unconvinced	20% (14)	8%(4)
IT convinced (but not using IT in lessons)	30% (20)	28% (15)
IT administrative user	25% (16)	51% (27)
IT curriculum user	45% (30)	51% (27)

Table 3: How teachers in Two institutes viewed their uses of IT.

Experience reported	No.of respondent
Inexperienced	19
Little experience	16
Experienced	4

Table 4: The way in which teachers reported their level of IT experience in one institution.

Classroom Use	No.respondents
Used at least once per week	5
Used occasionally	21
Used more	11

Table 5: The regularity of classroom use of IT reported by teachers in one institution.

Some major concerns of the teachers are listed here : [10].

* Beliefs about why IT is being introduced into education (e.g.,a misplaced belief about the needs of employment, a plot to save teacher salaries) and what IT is really good for, in educational terms (e.g., playing games, and drill and practice);
* concerns about change itself, such as the number of changes taking place at the same time, and the uncertain nature of government planning will these changes still be required in a few months.
* time pressures;
* loss of traditional skills, such as handwriting, spelling, and mental calculation;
* IT can be seen to be irrelevant to the teaching of their subject, which can be done better, and more cheaply, in other ways;
* quality of software, and its match to the existing curriculum;
* personal confidence and competence;
* inversion of roles, where students know more than teachers;
* resource implications- direct and indirect costs, and the need to replace equipment regularly;
* problems of access by staff and students;
* security; the problems of vandalism and file security for the work of students and teachers;
* electrical safety;
* worries about radiation associated with prolonged working with screens;
* space, and a loss of flexibility in room uses.

Curriculum:

What kind of informatics curriculum should we provide for our students? What vision of society, individuals and learning should it embody ? Why ? These key questions are often overlooked. In this paper I focus on two diametrically opposed curriculum models [7,8] which could be (and are) used by institutions in implementing an informatics curriculum.

1. Technocentric curriculum models:

In these models, the purpose of the information technology curriculum is typically to provide:

- some knowledge and understanding of computers and their technology;
- some knowledge and understanding of the impact of computers on society;
- some knowledge of computer application and the use of a variety of contexts for them;
- the ability to use a few standard types of software;
- the ability to write some simple programs.

This type of curriculum is usually presented as a senior IT course, or at a lower level, as " computer awareness" and the computer remains a technological entity, to be studied in an abstract way.

- **Humanistic curriculum model:**
- A curriculum based on this model should at least have a focus on:
- the student as the constructor of knowledge;
- independent and flexible pathways through traditional curriculum areas;
- an appreciation of the difficulties of "realistic assessment" as currently being debated in the literature;
- the use of computational media to facilitate learning.

Perhaps the most widely understood, and best researched in this paradigm, is Papert's computational model [11].

If we compare the said models, humanistic curriculum has mush to offer, putting real knowledge and learning in the hands of individuals [12].

Recommendations:

A: key decision makers and the general public be made aware of the following facilitating factors which will determine successful integration of IT into the curriculum;

- sufficient equipment;
- adequate teachers guidelines and teaching materials
- suitable curriculum;
- qualified teachers and resource co-ordinators, technicians;
- resource centers;
- feedback from students, teachers;
- incorporation into national syllabus and national examination program;
- authors integrating IT topics into their textbooks;
- international collaboration;
- vendor support.

Note: Constraints were also noticed such as financial limitations, overloaded curriculum and timetable, political interests and resistance to change.

B: The teachers need to know the following about IT:

* understand general idedas behind any form of programming, but not necessarily details of coding programs in particular languages;

* understand a veriety of IT tools, indluding word processors, spreadsheets and hypertext, so that they and their students can choose intelligently, and also understand the need for new tools;

* participate in developing educationally appropriate software by being able to evaluate IT tools both as software and as educational resources;

* know whether and how IT fundamentally changes their own subject areas;

* understand the pedagogical and didactic processes that various IT tools aim to address;

* Be able to recognize along with their students when computers produce nonsensical or useless answers – output isn't meaningful just because a computer produces it.

C: Appropriate agencies, i.e., Government and Private sector:

* describe activities that IT makes possible and document the importance in education, identify benefits to the discipline that might come from these new activities, support specialistis who need to validate benefits and state clearly how they can be realozed;

* create a climate that encourages teachers to innovate;

* support wide spread dissemination of successful innovation;

* support development of model sites, managed by skilled and enthusiastic teachers, giving access to other teachers to observe and validate;

* establish computer network contact between teachers where appropriate;

* improve the quality of pre-service and in-service teacher development by integrating the use of technology into teacher's courses in their disciplines;

* make available a resource directory to include sites to visit and reports on experiences;

* establish education programs specifically for co-ordinators, including development of group motivation skills;

* establish partnerships among various stakeholders for implementation, innovation and dissemination.

D: On a somewhat less general level it is useful to delineate the various actors in the educational community;

* Policy makers

* Curriculum makers

* Teacher educattors

* Institutions/teachers

* Students/ parents

Stronger links need to be established between various pairs of these actors. Of particular importance to this group is the link between teacher educators and

schools/teachers. This leads to the general recommendation.

"Integration of IT into education requires close cooperation between teacher training institutions and the institutions and teachers themselves".

E: Action Plan:

Teacher training in institutions are playing a crucial role for any change in the educational system. So successful IT integration, in the long run, is simply impossible without a strategy for these institutions. In particular, the following factors have to be taken into consideration.

Partnership: Since IT integration is an ongoing process, not only teachers have to be trained, but feedback from organiation to teacher training institutions to the immediate needs of the organizations. Therefore partnerships between institutions and teacher training institutions should be encouraged. Such partnerships should be fostered across the whole educational system.

Training the teacher trainers: Currently the IT awareness of teacher trainers seems to be the weakest spot with respect to IT in the educational system.

Train the student trainers: Student teachers should have experiences with IT during university studies in the following three different contexts:

* university departments should provide it experience as part of the subject oriented studies;
* teacher educators should provide experiences with it as a learning and teaching tool during the courses as well as during the internship;
* students should use it as a personal productivity enhancement tool during their studies.

Train teachers through partnerships: Ongoing in-service teacher training is a key issue for successful IT integration.

Involving teacher training institutions in policy activities: they need to be involved in influencing curriculum changes software development creating supplementary educational material research.

Conclusions

Integration means, " Combine parts in a whole", we have to study what the parts are and what the whole could be and which whole we would wish for. The evolution of education, the charges in the profession of a teacher, the need for generalizing and integrating new technologies, make teacher training a pivotal point. Teachers training must incorporate both knowledge acquisition, and professional and pedagogical competencies. when new technologies are integrated into teaching they will no longer be "visible", it becomes as natural as telephone or a watch.

Teachers who are terrified of IT need careful nurturing; those unconvinced need some persuasive communication, those who are convinced, but don't use IT in lessons, need vivid exemplification, resource and encouragement, and curriculum users probably need encouragement to push forward their IT uses as well as encouragement to help others.

The desired use of IT in teaching depends upon a symbiosis between supply side: innovators, national programs, resources and software developers;and the demand side: institutions, Teachers, Students. At

present the demand side is rather weakly developed, as also is the national program aspect of the supply side. I think IT integration in education requires appropriate steps to stimulate demand for IT from teachers and institutions.

References

[1] Fey, J.T. (1989) *Technology and mathematics education:* a survey of recent developments and important problems. Educational Studies in Mathematics 20, 237-272.

[2] Kaput, J.J. (1992) *Technology and mathematics education*. In D.A. Grouws, (ed), Handbook of Research on Mathematics Teaching and Learning. Macmillan, 515-556.

[3] Ruiz I Tarrago, F. (1993) Integration of Information Technology into Secondary Education – Main Issues and Perspectives. Guidelines for Good Practice. IFIP TC-3/WG3. 1, Geneva.

[4] Howson A.G. & Wilson B.(1986) School Mathematics in the 1990's ICMI Study Series, Cambridge University Press.

[5] Cornu B. & Ralston, A. (eds) (1986) The influence of Computer and Informatics on Mathematics and its Teaching (2nd edition) Science and Technology Education Document Series 44, UNESCO, 1992. 1st edition: Churchhouse R.F. et al., (eds.), ICMI Study Series, Cambridge University Press.

[6] 11.Biehler, R., Scholz, R.W., Straer, R. & Winkelmann, R. (eds) (1994) Didactics of Mathematics as a Scientific Discipline. Mathematics Education Library, 13, Kluwer.3.

[7] Department of Education and Science and Welsh Office (1991) *Science in the National Curriculum*. HMSO: London.

[8] Department of Education and Science and Welsh Office (1991) *Mathematics in the National Curriculum*. HMSO: London.

[9] Gower, S. (1992) *Primary Teachers and Computers – A Survey*. Undergraduate Project, Department of Psychology, University of Lancaster: Lancaster.

[10] Watson, D. (ed) (1993) *The Impact Report – An evaluation of the impact of Information Technology on children's achievements in primary and secondary schools*. Department for Education and King's College London Center for Educational Studies: London.

[11] Papert, S. (1980) *Mind Storms*. New York: Basic Bookds.

[12] Abelson, H. and P. Goldernberg (1976) *Student Science Training Program in Mathematics, Physics and Computer Sciernce*. Final Report to the National Science Foundation. Massachusetts Institute of Technology.