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# USE OF PADAGOGICAL TOOLS FOR TEACHING OF MATHEMATICS IN HIGHER EDUCATION

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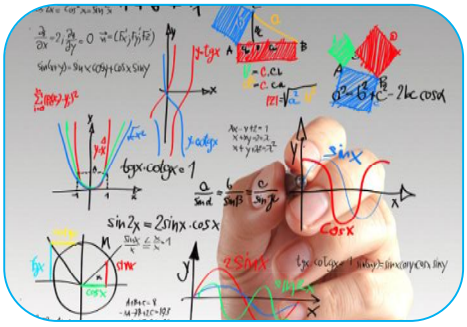
## ABSTRACT



*In the current curriculum of mathematics is the expectation that mathematics teachers will integrate technology in their teaching. However, teachers have not been given importance of Pedagogical Tools for preparing their instructions. This paper reports on a study conducted to explore the possibility of Pedagogical Tools use in mathematics teaching at college levels. Technology has advanced so much that the geographical gap is bridged with the use of tools that make you feel as if you are inside the mathematics classroom. E-learning offers the ability to share material in all kinds of formats such as videos, slideshows, word documents, HTML and pdf. Conducting webinars (live online classes) and communicating with professors via chat and message forums are also an option available to students. Some of the most important developments in mathematics education have happened since the launch of the internet. These days' learners are well versed in the use of smart phones, text messaging and using the internet so participating in and running an online course has become a simple affair. In this connection teaching and learning mathematics connect with e-learning resources, multimedia tools, e-learning trends and some of the mathematics e-learning resources.*

**KEY WORDS**: - *Professional development, Computer competencies, Mathematics education, Padagogical Tools and Software.*

## INTRODUCTION:

E-learning is a computer based educational tool or system that enables you to learn anywhere and at any time. Today e-learning is mostly delivered though the internet, although in the past it was delivered using a blend of computer-based methods like CD-ROM. In the past 15 years there has been a significant increase in information communication technology (ICT) investment in education, so students and teachers now have a much wider access to ICT than before (OECD, 2015). The reason for the investment is the belief that introducing ICT will improve teacher productivity, student outcomes, and prepare students for a world where technology is an important part of life. Governments have also mandated the importance of ICT in education.

Mathematics teaching, Drawing on a wide range of research, it describes the kinds of pedagogical approaches that engage learners and lead to desirable outcomes. The aim of the booklet is to deepen the understanding of practitioners, teacher educators, and policy makers and assist them to

optimize opportunities for mathematics learners. Mathematics is the most international of all curriculum subjects, and mathematical understanding influences decision making in all areas of life-private, social, and civil. Mathematics education is a key to increasing the post-school and citizenship opportunities of young people, but today, as in the past, many students struggle with mathematics and become disaffected as they continually encounter obstacles to engagement. It is imperative, therefore, that we understand what effective mathematics teaching looks like and what teachers can do to break this pattern. The principles outlined in this booklet are not stand-alone indicators of best practice: any practice must be understood as nested within a larger network that includes the school, home, community, and wider education system. Teachers will find that some practices are more applicable to their local circumstances than others. Collectively, the principles found in this booklet are informed by a belief that mathematics pedagogy must:

• be grounded in the general premise that all students have the right to access education and the specific premise that all have the right to access mathematical culture.

• acknowledge that all students, irrespective of age, can develop positive mathematical identities and become powerful mathematical learners

• be based on interpersonal respect and sensitivity and be responsive to the multiplicity of cultural heritages, thinking processes, and realities typically found in our classrooms

• be focused on optimising a range of desirable academic outcomes that include conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning

• be committed to enhancing a range of social outcomes within the mathematics classroom that will contribute to the holistic development of students for productive citizenship.

Recent research has shown that teacher integration of ICT into mathematics classroom has an impact on student outcomes (Hegedus, Tapper, & Dalton, 2016). It aims at developing in the student the ability and willingness to perform investigations using various mathematical ideas and operations. As part of their forms the curriculum places a lot of emphasis on Information and Communication Technology (ICT) as a tool for teaching mathematics (MOESS 2007). It is therefore, designed to meet expected standards of mathematics in many parts of the world. In spite of government efforts, mathematics has not undergone much change in terms of how it is presented. These reflect consistently in low achievement levels in mathematics among students at the college levels.

## 1. Caring about the development of students' mathematical proficiency and mathematical identities

Students want to learn in a harmonious environment. Teachers can help create such an environment by respecting and valuing the mathematics and the cultures that students bring to the classroom. By ensuring safety, teachers make it easier for all their students to get involved. It is important, however, that they avoid the kind of caring relationships that encourage dependency. Rather, they need to promote classroom relationships that allow students to think for themselves, ask questions, and take intellectual risks.

Teachers are the single most important resource for developing students' mathematical identities. By attending to the differing needs that derive from home environments, languages, capabilities, and perspectives, teachers allow students to develop a positive attitude to mathematics. A positive attitude raises comfort levels and gives students greater confidence in their capacity to learn and to make sense of mathematics. In the following transcript, students talk about their teacher and the inclusive classroom she has developed a classroom in which they feel responsibility for themselves and for their own learning.

## 2. Arranging for learning

When making sense of ideas, students need opportunities to work both independently and collaboratively. At times they need to be able to think and work quietly, away from the demands of the whole class. At times they need to be in pairs or small groups so that they can share ideas and learn with and from others. And at other times they need to be active participants in purposeful, whole-class

discussion, where they have the opportunity to clarify their understanding and be exposed to broader interpretations of the mathematical ideas that are the present focus.

### Independent thinking time

It can be difficult to grasp a new concept or solve a problem when distracted by the views of others. For this reason, teachers should ensure that all students are given opportunities to think and work quietly by themselves, where they are not required to process the varied, sometimes conflicting perspectives of others.

### Whole-class discussion

In whole-class discussion, teachers are the primary resource for nurturing patterns of mathematical reasoning. Teachers manage, facilitate, and monitor student participation and they record students' solutions, emphasising efficient ways of doing this. While ensuring that discussion retains its focus, teachers invite students to explain their solutions to others; they also encourage students to listen to and respect one another, accept and evaluate different viewpoints, and engage in an exchange of thinking and perspectives.

### Partners and small groups

Working with partners and in small groups can help students to see themselves as mathematical learners. Such arrangements can often provide the emotional and practical support that students need to clarify the nature of a task and identify possible ways forward. Pairs and small groups are not only useful for enhancing engagement; they Effective teachers provide students with opportunities to work both independently and collaboratively to make sense of ideas, also facilitate the exchange and testing of ideas and encourage higherlevel thinking. In small, supportive groups, students learn how to make conjectures and engage in mathematical argumentation and validation. As participants in a group, students require freedom from distraction and space for easy interactions. They need to be reasonably familiar with the focus activity and to be held accountable for the group's work. The teacher is responsible for ensuring that students understand and adhere to the participant roles, which include listening, writing, answering, questioning, and critically assessing.

### Using students' misconceptions and errors as building blocks

Learners make mistakes for many reasons, including insufficient time or care. But errors also arise from consistent, alternative interpretations of mathematical ideas that represent the learner's attempts to create meaning. Rather than dismiss such ideas as "wrong thinking", effective teachers view them as a natural and often necessary stage in a learner's conceptual development. For example, young children often transfer the belief that dividing something always makes it smaller to their initial attempts to understand decimal fractions. Effective teachers take such misconceptions and use them as building blocks for developing deeper understandings. There are many ways in which teachers can provide opportunities for students to learn from their errors. One is to organize discussion that focuses student attention on difficulties that have surfaced. Another is to ask students to share their interpretations or solution strategies so that they can compare and re-evaluate their thinking. Yet another is to pose questions that create tensions that need to be resolved. For example, confronted with the division misconception just referred to, a teacher could ask students to investigate the difference between using diagrams, pictures, or number stories.

## 3. Assessment for learning

Effective teachers make use of a wide range of formal and informal assessments to monitor learning progress, diagnose learning issues, and determine what they need to do next to further learning. In the course of regular classroom activity, they collect information about how students learn, what they seem to know and be able to do, and what interests them. In this way, they know what is working and what is not, and are able to make informed teaching and learning decisions.

### Teacher Questioning

By asking questions, effective teachers require students to participate in mathematical thinking and problem solving. By allowing sufficient time for students to explore responses in depth and by pressing for explanation and understanding, teachers can ensure that students are productively engaged. Questions are also a powerful means of assessing students' knowledge and exploring their thinking. A key indicator of good questioning is how teachers listen to student Effective teachers use a range of assessment practices to make students' thinking visible and to support students' learning responses. Effective teachers pay attention not only to whether an answer is correct, but also to the student's mathematical thinking. They know that a wrong answer might indicate unexpected thinking rather than lack of understanding; equally, a correct answer may be arrived at via faulty thinking. To explore students' thinking and encourage them to engage at a higher level, teachers can use questions that start at the solution; for example, *If the area of a rectangle is 24 cm2 and the perimeter is 22 cm, what are its dimensions?* Questions that have a variety of solutions or can be solved in more than one way have the potential to provide valuable insight into student thinking and reasoning.

### Feedback

Helpful feedback focuses on the task, not on marks or grades; it explains why something is right or wrong and describes what to do next or suggests strategies for improvement. For example, the feedback, *I want you to go over all of them and write an equals sign in each one* gives student information that she can use to improve her performance. Effective teachers support students when they are stuck, not by giving full solutions, but by prompting them to search for more information, try another method, or discuss the problem with classmates. In response to a student who says he doesn't understand, a teacher might say: *Well, the first part is just like the last problem. Then we add one more variable. See if you can find out what it is. I'll be back in a few minutes*. This teacher challenges the student to do further thinking before she returns to check on progress.

### Self and peer assessment

Effective teachers provide opportunities for students to evaluate their own work. These may include having students design their own test questions, share success criteria, write mathematical journals, or present portfolio evidence of growing understanding. When feedback is used to encourage continued student–student and student–teacher dialogue, self-evaluation becomes a regular part of the learning process and students develop greater self-awareness.

## 4. Tools and representations

Effective teachers draw on a range of representations and tools to support their students' mathematical development. These include the number system itself, algebraic symbolism, graphs, diagrams, models, equations, notations, images, analogies, metaphors, stories, textbooks, and technology. Such tools provide vehicles for representation, communication, reflection, and argumentation. They are most effective when they cease to be external aids, instead becoming integral parts of students' mathematical reasoning. As tools become increasingly invested with meaning, they become increasingly useful for furthering learning.

### Thinking with tools

If tools are to offer students "thinking spaces", helping them to norganize their mathematical reasoning and support their sensemaking, teachers must ensure that the tools they select are used effectively. With the help of an appropriate tool, students can think through a problem or test an idea that their teacher has modelled. For example, ten-frame activities can be used to help students visualize number relationships (e.g., how far a number is from 10) or how a number can be partitioned. Effective teachers take care when using tools, particularly predesigned, "concrete" materials such as number lines or ten-frames, to ensure that all students make the intended mathematical sense of them. They do

this by explaining how the model is being used, how it represents the ideas under discussion, and how it links to operations, concepts, and symbolic representations.

## Communicating with tools

Tools, both representations and virtual manipulatives, are helpful for communicating ideas and thinking that are otherwise difficult to describe, talk about, or write about. Tools do not have to be readymade; effective teachers acknowledge the value of students generating and using their own representations, whether these are invented Effective teachers carefully select tools and representations to provide support for students' thinking. Notations or graphical, pictorial, tabular, or geometric representations, For example, students can take statistical data and create their own pictorial representations to tell stories well before they acquire formal graphing tools. As they use tools to communicate their ideas, students develop and clarify their own thinking at the same time that they provide their teachers with insight into that thinking.

## Teacher knowledge

How teachers organize classroom instruction is very much dependent on what they know and believe about mathematics and on what they understand about mathematics teaching and learning. They need knowledge to help them recognize, and then act upon, the teaching opportunities that come up without warning. If they understand the big ideas of mathematics, they can represent mathematics as a coherent and connected system and they can make sense of and manage multiple student viewpoints. Only with substantial content and pedagogical content knowledge can teachers assist students in developing mathematically grounded understandings.

## Teacher content knowledge

Effective teachers have a sound grasp of relevant content and how to teach it. They know what the big ideas are that they need to teach. They can think of, model, and use examples and metaphors in ways that advance student thinking. They can critically evaluate students' processes, solutions, and understanding and give appropriate and helpful feedback. They can see the potential in the tasks they set; this, in turn, contributes to sound instructional decision making.

## Teacher pedagogical content knowledge

Pedagogical content knowledge is crucial at all levels of mathematics and with all groups of students. Teachers with in-depth knowledge have clear ideas about how to build procedural proficiency and how to extend and challenge student ideas. They use their knowledge to make the multiple decisions about tasks, classroom resources, talk, and actions that feed into or arise out of the learning process. Teachers with limited knowledge tend to structure teaching and learning around discrete concepts instead of creating wider connections between facts, concepts, structures, and practices. To teach mathematical content effectively, teachers need a grounded understanding of students as learners. With such Effective teachers develop and use sound knowledge as a basis for initiating learning and responding to the mathematical needs of all their students. Understanding, they are aware of likely conceptions and misconceptions. They use this awareness to make instructional decisions that strengthen conceptual understanding.

## Teacher knowledge in action

As the following transcript illustrates, sound knowledge enables the teacher to listen and question more perceptively, effectively informing her on-the-spot classroom decision making. Like this teacher, those with sound knowledge are more apt to notice the critical moments when choices or opportunities present themselves. Importantly, given their grasp of mathematical ideas and how to teach, they can adapt and modify their routines to fit the need.

## 5. Digital technologies / information communication technologies

For thousands of years, humans made presentations using only the tools they were born with: their voice and body. That was followed by tools such as chalkboards and projectors, and then by digital tools such as PowerPoint. More recently other tools have emerged, such as Sliderocket, Prezi, Glogster, Animoto, and Magic Magnify. Since the 1980's, the importance of computer support in the teaching and learning of mathematics has been emphasized more and more. Information and Communication Technology (ICT) is basically an umbrella term that encompasses all communication technologies such as internet, wireless networks, cell phones, satellite communications, digital television computer and network hardware and software; as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs etc. that provide access to information. There are various types of technologies currently used in traditional classrooms. Among these are: Radio, television, audio tape, video tape, slide projector, overhead projector, Google class room, cloud method are of passive learning when interaction of the learner is less.

**Computer in the classroom:** Having a computer in the classroom is an asset to any teacher. With a computer in the classroom, teachers are able to demonstrate a new lesson, present new material, illustrate how to use new programs, and show new websites.
**Class blogs and wikis:** There are a variety of Web 2.0 tools that are currently being implemented in the classroom. Blogs allow for students to maintain a running dialogue, such as a journal, thoughts, ideas, and assignments that also provide for student comment and reflection. Wikis are more group focused to allow multiple members of the group to edit a single document and create a truly collaborative and carefully edited finished product.
**Wireless classroom microphones:** Noisy classrooms are a daily occurrence, and with the help of microphones, students are able to hear their teachers more clearly. Children learn better when they hear the teacher clearly.
**Mobile devices:** Mobile devices such as clickers or smart phone can be used to enhance the experience in the classroom by providing the possibility for professors to get feedback.
**Interactive Whiteboards:** An interactive whiteboard that provides touch control of computer applications. These enhance the experience in the classroom by showing anything that can be on a computer screen. This not only aids in visual learning, but it is interactive so the students can draw, write, or manipulate images on the interactive whiteboard.
**Digital video-on-demand:** Digital video eliminates the need for in-classroom hardware (players) and allows teachers and students to access video clips immediately by not utilizing the public Internet.
**Online media:** Streamed video websites can be utilized to enhance a classroom lesson.
**Online study tools:** Tools that motivate studying by making studying more fun or individualized for the student.
**Digital Games:** The field of educational games and serious games has been growing significantly over the last few years. The digital games are being provided as tools for the classroom and have a lot of positive feedback including higher motivation for students. There are many other tools being utilized depending on the local school board and funds available. These may include: digital cameras, video cameras, interactive whiteboard tools, document cameras, or LCD projectors.
**Online Classes:** online classes tools are ZOOM, Google Meet, Teams, Youtube and etc

### 5.1 Soft ware used for teaching learning Mathematics

It is no secret that many students are not passionate about math. Students feel disconnected from what is taught in class, unsure of the benefits of math and reluctant to pursue careers in the field. Edtech is trying to change these attitudes by providing them with new ways to engage with numbers. Many companies have developed virtual tools for math, which allow students to learn, practice, and have fun with different math concepts. We will discuss ten of the best on the market.
**Geometry Pad–** This virtual graph paper allows students to draw shapes, charts, and other geometric features. Students can change the properties of shapes, zoom in, save their work and add written notes

on the side. Geometry Pad is a great application that can be used with students of any age and across mathematical disciplines.

**Pattern Shapes–** Understanding the properties of shapes, fractions and creating precise figures is easy with Pattern Shapes. Students can use the virtual protractor to measure angles, change the dimensions and color of forms and annotate answers. It is ideal for elementary and middle school students, and the bright colored shapes can inspire creative design.

**Globaloria–** Learning math through games is a great educational tool. Globaloria allows students to create games that test STEM subjects. With a gallery full of games, students can explore creations that were made by their peers. This application aims to promote STEM subjects on a global level through games and social networking.

**MathsPlayground–** This collection of math-based games is perfect for younger students. Aligned with Common Core standards the games are separated by grade and topic. Students will enjoy learning while playing interesting games. The games test timetables, fractions, and other mathematical concepts. Combining education with easy to play games is what makes MathsPlayground ideal for young students.

**Fluid Math–** FluidMath is the first "pen-centric "platform that works on iPads and interactive whiteboards. Students and teachers can write, in their own handwriting, as they solve problems and engage with difficult concepts. FluidMath has won many awards, and its many features make it a great tool for both teachers and students in any math classroom.

**GetTheMath–** The aim of this tool is to relate algebra to the real world. Through topics like "Math in Music" and "Math in Fashion," students can learn how math is an integral part of everyday life. There are videos, exercises and other ways that students can engage with algebra in its real world setting. GetTheMath is an excellent way to combine theory with application.

**Dragon Box–** This learner-based approach to math claims that 83% of children learn the basics of algebra in an hour. Through interactive games and explanations, students as young as five are introduced to algebra and how variables work. Students have no idea they are engaging with academic content, and the graphics are colorful and cute.

- Graphic Calculators
- Dynamic graphing tools (Geo-gebra)
- Dynamic geometry tools
- Microsoft Excel / spreadsheet
- Microsoft Mathematics
- Geo-Gebra
- Auto shape
- Mat lab

So, there you have it. All of these tools push students towards self-exploration and allow them to see how math is an integral part of the world they live in. Through the use of these tools, students can also take control of their academic achievement, and foster a positive relationship with a subject that previously felt ambivalent about.

### 6.2 Learning resource centre (Indian system of Education)/Websites

Thousands websites provide e-resource for both offline and online teaching –learning. IGNOU (http://www.ignou.ac.in/) The Indira Gandhi National Open University (IGNOU), http://www.ncert.nic.in/NCERTS/textbook/textbook.htm The website is a e-resource for syllabus, online text books, other publications such as sample question papers and multimedia packages which helps both the students and teachers in teaching learning Mathematics. http://www.ciet.nic.in Central Institute Of Educational Technology(CIET provides information of educational technologies viz. radio,TV, films, Satellite communications and cyber media either separately or in combinations. www.cbse.nic.in & http://www.icbse.coml provides information regarding online application for different examinations such as Mathematics Olympiad. http://www.mathplayground.com/ ASB_Meteor Multiplication. html is a very good website which allows the learner to motivate learning Mathematics through different game. http://cbse.meritnation.com/cbsesignup2? Mncid = Adwords_Banner_Test &

gclid = CJnSm9yj2LMCFQV66wodpnQAgg http://www.ixl.com/math/algebra-1/ absolute-value-and-opposites http://mathforum.org/library/ Lesson Plan http://illuminations.nctm.orgis a very interactive website for Geometry.

http://www.discoveryeducation.com/searchlite/page/Mathematics/Geometry/Worksheets.

There are some other useful sites provide wonderful mathematical investigations for our students and answers to the many perplexing questions that invariably arise in the classroom, for general teaching- learning mathematics. Researchers have found that the move from traditional paper-based mathematical notations to on-screen notations (including algebraic symbols, but also graphs, tables, and geometric figures) can have a dramatic effect. In comparison to the use of paper and pencil which supports only static, isolated notations, use of computers allows for "dynamic, linked notations" with several helpful advantages.

### 6.3 Impacts on Student's Learning Process

Appropriate use of ICTs allow Learners to have the freedom of choice to decide their own time, place, pace, or path to study. Learning materials that are enhanced with various media such as sound, narration, video, animation, graphics etc. provide learner's choices to enhance their different intelligence or learning styles. If designed and implemented properly, ICT-supported education can promote the acquisition of the knowledge and 21st century skills such as Creativity, critical thinking and problem solving. Learners are able to exchange ideas more personably and directly. The new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from a teacher-centered pedagogy to one that is learner centered.

### 6.4 Technology helps teacher in lesson Planning

The ease and speed of obtaining information on the Internet definitely helps the teacher users to empower themselves. It gives teacher the opportunity to learn current innovations in teaching from other Countries that may be utilized in his/her her class to strengthen pupils' self-esteem. It adds further information about the topic he/she is teaching. He/she can make the content more colorful and purposeful by integrating slide show and videos related to the topic. He/ She can successfully impart education characterized by imparting instructions, collaborative learning, multidisciplinary problem-solving and promoting critical thinking skills as highlighted by National curriculum framework 2005 (NCF 2005)

### 5.5 Technology provides evaluation tools.

Technology provides different assessment tools such as Checklists, rating scales and rubrics to assess the 21st century skills such as creativity, problem solving, decision making and leadership skills which are criteria for project based learning. The rubrics for Research Report document, Power point presentation, Role Play helps the user The teachers can access number of printable worksheets for Mathematics. Checklists, rating scales and rubrics are readily available in some educational websites. The students can do self evaluation through different online tools and get immediate feedback for correction. The advantages include:

1. Instant feedback to students
2. Greater flexibility with respect to location and timing
3. Improved reliability.
4. Improved impartiality
5. Greater storage efficiency
6. Enhanced question styles which incorporate interactivity and multimedia.

### 6.6 Collaborative learning

There are a lot of internet sites providing interactive learning tools for students. Blogs, Forums, Communities, Webcast, Pod Cast, User Groups, Picassa (Google) and Flickr (Yahoo), W3Schools.com, Wikis, Web conferencing, Video Conferencing, Chat, E-mail, Instant Messaging, Bulletin Board, Data

Conferencing, Shout Box, Image Board, YouTube, Slide Share, Think quest, Schools online ,e-pal and British Council Schools online. Seeing what your friends are doing, and being able to fully participate in group activities, offers new ways of working in class, the researchers say. The findings published in the journal Learning and Instruction, show that children using these Synergy Net classrooms improve in both mathematical flexibility and fluency, while children working on traditional paper-based activities only improve in flexibility.

### 6.7 Barriers of use of Technology:

- Not enough or limited access to computer hardware & computer software
- Lack of time in college schedule for projects involving ICT
- Lack of adequate technical support for ICT projects
- Not enough teacher training opportunities for ICT projects
- Lack of knowledge about ways to integrate ICT to enhance curriculum
- ICT integration is not a school priority
- Students and Teachers do not have access to the necessary technology at home**. Curriculum**

## 6. CONCLUSION:

In order to educate students to be life-long learners and successful contributors to the new global market, educators must change the way they teach and the way students learn. Curriculum and assessment in school mathematics should explicitly require that all young people become proficient in using digital technologies for mathematical purposes. High-stakes assessment needs to change in order to encourage the creative use of digital technologies in mathematics classes in colleges.

Current research findings show that the nature of mathematics teaching significantly affects the nature and outcomes of student learning. This highlights the huge responsibility teachers have for their students' mathematical well-being. In this Paper, we offer ten principles as a starting point for discussing change, innovation, and reform. All colleges are needed student-led mathematical modeling, problem solving and computer programming which makes use of the powerful Mathematical digital technologies that are widely used in society and the workplace. Here highlight areas that require further attention to enable teachers use Padagogical tools in mathematics teaching. In particular, a professional development scenario that will assist pre-service and in-service teachers develop skills on ways to integrate ICT in their teaching processes was one of the significant issues identified by the researchers. Such a programme need not differ in content but in format for both groups of teachers. This will ensure that teachers will be able to use existing hardware and software in creative and situation specific ways to design Padagogica tools resources to accomplish their teaching goals. Among their recommendations, effective use of Padagogica tools needs to be optimized through extensive programmes of teacher support to improve mathematics and science teaching.

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