

Teacher Perception of the Use of Different ICT Tools for Doing Practical Science

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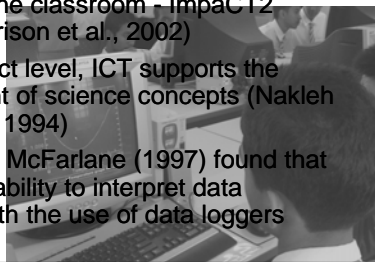
Abstract

Practical work plays an integral role in the teaching and learning of school science. However there are a number of shortcomings to doing practical work. Among them is that they are too time consuming with too many things to focus that the intended goals of practical work is diluted. We know for example, that, students tend to spend too much time on lower level tasks like recording data and drawing graphs that they do not have adequate time to focus on making meaning from them. The use of ICT has been suggested to address many of these shortcomings. A number of tools are readily available and they include microcomputer based laboratories (MBL), virtual laboratories and other interactive simulations. This study explored how science teachers and teacher educators perceived the use of the traditional apparatus, MBL, virtual laboratories and interactive simulations to understand relationships regarding simple pendulums. Four batches of teachers and teacher educators from the SEAMEO member countries and African countries who attended a one month in-service course in RECSAM at various times during 2006-2007 participated in this study. Most of the teachers and teacher educators had 15 to 20 years of teaching experience. The four modes of experiments together with three possible scenario of usage for each mode were demonstrated to two of the groups. Data was collected through two questionnaires, one measuring their attitude towards IT and the other their perception towards the use of each mode in the scenarios shown. Interviews were conducted with groups of participants of two other groups. All participants showed a very high positive attitude towards IT. Although the respondents perceived all the four tools positively, they perceived the efficacy of traditional experiments and MBLs more positively than the other ICT based modes. Interview with participants suggested that they hold deeply to the idea that science is basically hands-on and that students should always be given opportunities to do hands-on work. They are willing to accept the idea that MBLs are good replacements as it extends hands-on work but not virtual labs and interactive simulations. However, they believed that virtual labs and other interactive simulations can fulfil enrichment roles. This has implications for the adoption of ICT by science teachers as training need to take into account the fact that teachers hold deeply held beliefs about how science should be taught.



ICT Helps Improve Learning

- ▷ Generic level vs subject specific level
- ▷ ICT have +ve impact on teaching and learning in the classroom - ImpaCT2 survey (Harrison et al., 2002)
- ▷ At the subject level, ICT supports the development of science concepts (Nakleh and Krajcik, 1994)
- ▷ Friedler and McFarlane (1997) found that that pupils' ability to interpret data improves with the use of data loggers



ICT Helps Improve Learning

- ▷ Data-loggers and simulation in practical work improve learning when used in appropriate ways - Harlen (1999) in his review of literature
- ▷ Learning improvements when simulations are used, Cholmsky (2003)
- ▷ Barton (1997) argues that data logging could change the nature of children's thinking in experimental work in science
- ▷ Barton (2004) adds that data logging helps pupils by reducing data collecting and processing times



ICT Tools for Learning Available Widely

- ▷ Commercial ones (e.g., Gizmos at <http://www.explorellearning.com>)
- ▷ many available for free to use online and freely downloadable for use off-line (e.g., <http://www.skoolool.co.uk>), <http://phet.colorado.edu/web-pages/index.html>)



Many Initiatives in Place to Provide ICT Infrastructure in Schools

- ▷ countries continually spending considerable amount of money - equip schools with ICT facilities
- ▷ E.g. Malaysia, Vietnam and Thailand have their own ICT Master Plan which includes provision for equipping schools with the necessary ICT infrastructure
- ▷ Heavy investments on equipping teachers with the necessary skills to effectively use ICT in the classroom



But yet..

- ▷ A number of cases where teachers from schools with ICT facilities and reasonably tech savvy refused to use it regularly in the classroom



Are teachers using ICT regularly for instructional purposes?

- ▷ Cuban (2000) argues that very few teachers are serious users of computers in the classroom
- ▷ reasons are that teachers face intractable working conditions, external groups making constant demands on the teachers and technology being inherently unreliable



Are teachers using ICT regularly for instructional purposes?

- ▷ Becker (2001) reports that very few teachers reported students using computers during class hours and provides reasons ranging too many topics to teach (versus few topics to be covered in depth) to lack of teacher expertise with technology
- ▷ Becker & Ravitze (2001) found that teachers with reasonable expertise in using computers, when 5 to 8 computers are available for use in the classroom, and where they believe strongly in a constructivist pedagogy tend to regularly use computers in the classroom



Are teachers using ICT regularly for instructional purposes?

- ▷ Teachers engaged with peers in collaborative and leadership roles and who thus influence their peers more than most likely to have their students exploit computer resources during class
- ▷ Becta (2004) divides barriers/factors leading to the effectiveness of classroom use of ICT into teacher-level and school-level



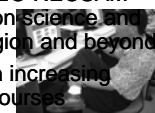
Are teachers using ICT regularly for instructional purposes?

- ▷ One major teacher-level barrier which has drawn considerable attention is teacher belief (Ertmer, 2006)
- ▷ For instance, teachers whose beliefs support the view that ICT need to play an integral part in classroom learning are likely to use ICT powerfully in the classroom
- ▷ Baggott, McFarlane, John, and Brawn (2005) suggest that beliefs are difficult to change. Any training on ICT integration should take into account the belief factor to ensure the likelihood of the participants to practice what they learned during training



Purpose of Study

- ▷ As part of its mandate in promoting science and mathematics in the region, SEAMEO RECSAM regularly conducts short courses on science and mathematics for the Southeast region and beyond
- ▷ These past few years has seen an increasing demand for ICT integration in its courses
- ▷ The courses offered are designed based on the constructivist philosophy and teacher educators get to not only see the integration of ICT in the teaching of the courses but also ample opportunities are provided for them to explore and experience ICT on their own



Purpose of Study

- ▷ It is hoped that they will go back to their countries with very positive attitudes towards the use of ICT in the classroom
- ▷ The major question to be answered is that by the end of the course were teachers' beliefs about ICT changed positively to increase the likelihood of them using ICT in their classrooms?



Purpose of Study

- ▷ Specifically:
 - Do teacher educators have a positive attitude towards ICT at the end of the course?
 - Barring school level barriers to using ICT in the classroom (like no computers), how do teacher educators perceive the use of ICT tools in practical work?
 - What is the preferred choice of tool if all are readily available?



Methodology - respondents

- ▷ Four batches of teachers and teacher educators from the SEAMEO member countries and African countries participating in in-service courses on science at various times during 2006-2007
- ▷ Typically each batch about 20 with more than 15 years of teaching science and with at least a basic degree
- ▷ Prior to coming - majority had no access to computers
- ▷ As part of the course - exposed formally to 8 hours of computer literacy (operating a PC, word processing, spreadsheet, presentation and Internet exploration).
- ▷ access to at least two hours of individual use of the PC in evenings.
- ▷ observed that they made full use of the opportunity throughout the course.
- ▷ During formal classes they had opportunity to see facilitators integrating ICT into their teaching mainly through presentation tools as well as exercises which involved the use of word processors to produce reports, presentation and exploration using the Internet



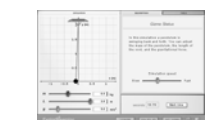
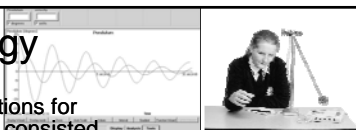
Methodology

- ▷ End of course demonstrated for about an hour the use of four different tools to help in the teaching and learning of simple pendulums.
- ▷ Simple pendulums because it is a common subject that all science students should be familiar with and that it is tenable to misconceptions especially regarding the relationship of its period to mass or the swing angle, even if one were to mentally imagine the relationship.
- ▷ confirmed among a large number of respondents who gave erroneous responses to the above two relationships.
- ▷ Another important reason was to create conditions that allowed respondents to focus on the potential of each tool.



Methodology

- ▷ The demonstrations for about one hour consisted of the following
 - Traditional pendulum and stopwatch
 - Traditional pendulum when connected to data logging system (<http://www.data-harvest.co.uk/index.html>)
 - Computer based simulation using gizmos (<http://www.explorelearning.com>)
 - Virtual pendulum (<http://www.crocodile-clips.com/crocodile/physics>)




Methodology

- ▷ Each of the above experiments were demonstrated in the context of three possible scenarios;
 - interactive demonstration by the facilitator,
 - procedural experiment with teacher facilitation &
 - open ended experiment with teacher facilitation.
- ▷ The term 'teacher facilitation' had to be included in the explanation because the respondents were overtly concerned that teacher presence in all modes of instruction is necessary and vital.




Methodology

- ▷ Before demonstration, Survey of Faculty Attitude Toward Information Technology (Gilmore, 1998).
- ▷ After demonstration, a separate questionnaire administered.
- ▷ The core of the questionnaire consist of six statements which required the respondents to respond to a 5 point Likert scale ranging from strongly disagree to strongly agree.




Methodology

- ▷ The six statements:
 - Highly engaging and motivating experience for students;
 - Deeper understanding of concepts by students;
 - More time for student to focus on understanding concepts;
 - Enable students to remember concepts longer;
 - Most practical method;
 - Most pedagogically desirable;




- ▷ A number of participants more fluent in spoken English from the last two batches were asked to state their preference of tool with reason(s)
- ▷ In order to allow the respondents to focus on teacher level rather than school level (e.g. lack of materials), they were asked to imagine a scenario where the laboratory was fully equipped and technical support readily available, e.g. in RECSAM.




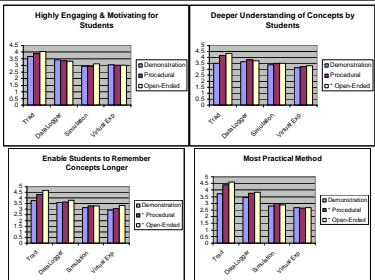
Results – FAIT scores

- ▷ The FAIT questionnaire consists of 68 items categorized into five categories of Enthusiasm, Anxiety, Productivity Improvement, Avoidance and Email Use for Classroom Learning.
- ▷ Some of the items were worded negatively and thus these scores adjusted so that a score of 5 in the Likert scale can be interpreted in a positive sense as regards to attitude towards IT.




Survey of Faculty Attitude Toward Information Technology (FAITv1.1) for one batch

Category	N	Mean	Std Deviation
Enthusiasm	19	4.45	0.26
Anxiety	18	3.82	0.41
Productivity Improvement	17	3.84	0.28
Avoidance	19	4.12	0.71
Email Use for Classroom Learning	19	4.04	0.48

- ▷ Score ≥ 3 for all (except 'practical method')
- ▷ Higher scores for the physical side rather than the virtual side
- ▷ * shows significant difference



Interview Findings

- ▷ Given a choice – strong preference for traditional tools
- ▷ Reason – science is essentially hands-on
- ▷ MBL having very good potential but not simulations and virtual laboratories
- ▷ Simulations and virtual laboratories can play enrichment roles



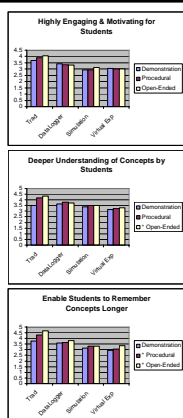
Discussion

- ▷ positive attitude towards an experience the tendency is for you to go for a repeat of that experience
- ▷ In the case of the 20 respondents, they had a positive attitude towards IT based on the FAIT score.
- ▷ The chances are therefore great that they will perceive new IT based solutions in a positive light.



Discussion

- ▷ opposite seemed to be true for these respondents.
- ▷ In most cases they perceived the traditional experiment, and in some cases, data loggers more positively than simulations and virtual experiments.



Discussion

- ▷ But further reflections suggest that the respondents did indeed perceive the simulation experiment and the virtual experiment in a positive light. It was just that traditional experiments and data loggers were perceived at an even more positive light



Discussion–Why was this so?

- ▷ One argument, Baggot et al. (2004) is that there is a subject subculture of secondary science as seen through the eyes of individual teachers.
- ▷ Goodson as found in Baggot et. al. (2004), “subjects are well-established bodies of knowledge and social practices that carry with them particular assumptions about ‘worthwhile knowledge’, ‘effective teaching’, ‘the good’ student and ‘appropriate assessment’”.
- ▷ In that sense teachers already have a belief on what constitute to be effective science practical. In this subculture, there is a tendency for teachers to view science as a practical subject.
- ▷ Thus it is greatly possible that these experienced teachers do not regard ‘virtual’ experiments as highly as physical experiments



Discussion

- ▷ Another argument is that these teachers view the role of ICT as a functional tool. In that case, data loggers, simulations and virtual experiments can only play a supporting role when doing practical science.
- ▷ One other plausible explanation that can be put forward is that the design of the demonstrations are such that the content (simple pendulum) could be learnt adequately without the need for use of innovative ICT tools like the data logger, simulations and the virtual experiment. Experienced teachers have already through experience developed the most efficient way to teach the curriculum using existing technologies. Thus their perceptions toward traditional experiments was more positive.



Discussion

- ▷ However there is a positive tone to the above argument. Perhaps if the demonstrations were on a content which is pedagogically dependent on the ICT resource (Ruthven, Hennessy, & Brindly, 2004), that is, where the success of the learning is dependent on the nature of the ICT resource and its affordances the participants would have been likelier to have perceived it in a more positive light (John, 2005).



Conclusion

- ▷ Both school and teacher factors are responsible for teacher use of ICT in t-l
- ▷ A positive attitude towards ICT does not necessarily translate to a choice toward ICT especially when equivalent readily available physical materials are present



Thank You

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