



Technological pedagogical differences in the teaching of English and Mathematics in a primary school

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Abstract

This case study research attempts to examine the difference in technological pedagogical approaches adopted by teachers in the teaching of English and Mathematics in a school in Singapore. The study adopts the learning *from* and learning *with* technology framework in reporting and analysing the findings. From the lesson observations, review of teachers' written reports and curriculum plans, interviews with teachers and group interviews with students. Mathematics teachers adopted predominantly the learning *from* technology pedagogy with occasional learning *with* technology approach. In contrary, English teachers facilitated students to learn *from* and also *with* technology. This case study illustrated how technological pedagogical approaches were influenced by the subject (i.e., English and Mathematics). This study also highlights the limited use of the co-constructivist approach by the teachers in the teaching of both of the subjects.

Keywords: technology and pedagogy, learning *from* and learning *with* technology, integration of ICT into the curriculum

Introduction

The main intent of this case study is to have an in-depth understanding of how ICT has been integrated into the teaching of English and Mathematics in a primary school in Singapore. Of the various learning subjects offered in the primary schools in Singapore, both the English Language and Mathematics are two very important academic subjects that take up a significant portion of the students' time in school. Students have English Language and Mathematics lessons each day. However, the nature of the two subjects is different – the learning of the English Language focuses on the expression of oneself through the use of text and in multimedia format to develop not only language skills but also media literacy, whereas the learning of Mathematics focuses on acquisition of problem-solving skills and concepts. Due to the differences in terms of the content of the two subjects, the pedagogical approaches could be different and this in turn influences how technology could be

used to teach these subjects.

The main objective of this paper is to explore how ICT has been integrated into the teaching of English Language and Mathematics in a primary school. The paper also investigates whether there is a difference in terms of pedagogical approach adopted by the teachers in using ICT for the teaching of English and Mathematics.

Background

This research study took place in a primary future school in Singapore. The FutureSchools@Singapore program is an initiative by the local infocomm authority and the ministry of education. The main intent of future school initiative to have a group of schools to harness the use of ICT effectively for engaged learning. The future schools at the various levels (i.e., primary, secondary and post-secondary levels) are set as models for other schools for innovative transformation of the education experience that leverage on ICT. Currently, there are a total of 3 primary school level future schools in Singapore. The schools under the FutureSchools@Singapore program are poised to lead the way in the seamless and pervasive integration of ICT into the curriculum for engaged learning in the schools and classrooms. The school has implemented a successful one-to-one computing program for all its students and this case study focuses on how eight teachers have integrated ICT into the teaching of English and Mathematics for their primary 4 students.

Theoretical framework – learning *from* and *with* technology

Broadly speaking, learning *from* and learning *with* technology (Ringstaff and Kelley, 2002) could provide a very useful and simple conceptual technological pedagogical framework when teachers try to integrate ICT into their teachings. Learning *from* the computer leans itself more towards the behaviouristic theories of learning whereas learning *with* technology has its roots from the constructivist and social constructivism paradigms. More passive behaviours such as reading and listening are associated with learning *from* technology, while more active behaviours such as creating, writing and updating are associated with learning *with* technology (Harris & Rea, 2009). Learning *from* computers takes various forms – computer-based instruction, computer-assisted instruction and intelligent learning system, to name a few. Basically, learning *from* computers sees the computer system as a tutor. While learning *from* computers can help students to enhance their performance on basic skills, learning *with* computers could facilitate the learning of higher-order thinking (Jonassen, 2000; Lim & Tay, 2003). As compared to the learning of basic knowledge and skills, it is much harder to quantify the learning of higher order type of thinking and skills. Bower, Hedberg and Kuswara (2010) further propose a framework for technology learning design, suggesting four types of online pedagogies – transmissive, dialogic, constructionist and co-constructive. These pedagogies are categorised according to their degree of production and collaboration as shown in Table 1 below. This synthesised framework would be used to discuss and analyse the findings of this case study.

Table 1: Pedagogies according to the degree of Production and Collaboration – Learning *from* and *with* Technology (adapted from Bower, Hedberg, and Kuswara, 2010 and Ringstaff & Kelley, 2002)

	No collaboration	Collaboration
No production	Transmissive (learning <i>from</i> Technology)	Dialogic (Learning <i>with</i> Technology)
Production	Constructionist (learning <i>with</i> Technology)	Co-constructionist (learning <i>with</i> technology)

From the literature reviewed, it seems to suggest that the teaching of English (Abas, Fong, Yu & Lee, 2010; Tay, Nair & Lim, 2010; Andrews, Freeman, Hou, McGuinn, Robinson & Zhu, 2007; Melhuish, 2008;

Mullamaa, 2010) and Mathematics (Bosco, 2004; Chong, Sharaf & Jacob, 2005; Crisan, Lerman & Winbourne, 2007; Law, 2009; McAlister, Dunn & Quinn, 2005) could adopt the various approaches mentioned above – learning *from* and *with* technology, with or without production and with or without collaboration.

Research design and methods

A case study approach (Stake, 1995) is used in this research study to look into how ICT has been integrated into the teaching of English and Mathematics in this primary school. More specifically, this research case study examines the technological pedagogical approaches adopted by the English and Mathematics teachers in their integration of ICT into their classes.

The different research methods in this study act as a means for triangulation. The findings are derived and triangulated from the various research methods presented in the next section. The various research methods were: (1) lesson observations, (2) document reviews, (3) interviews with teachers and (4) group interviews with students. The findings were derived from data collected from the observation of three lessons conducted by the teachers; lesson reports and reflections written by five teachers; individual interview with eight teachers and group interviews with seven groups of students (four students in each group).

Findings

Learning *from* technology

The online quiz module found in the online management system of the school was a feature used by both English and Mathematics teachers to facilitate students' learning of the subjects. From observations and interviews with both teachers and students, the self-marking function in the quiz module cut down marking time for teachers and could also provide them with a quick and accurate overview of the students' understanding of the basic content knowledge being taught and learned. In addition, students were also given instantaneous feedback on their responses. The teachers also observed that students were more motivated to repeatedly try to get the correct answer. The readily available item analysis made it easier for the teachers to take any follow-up actions to address any misconceptions. Students learn *from* technology through their attempts of the online quizzes to practice and reinforce the content knowledge that they have learned. The online quizzes provided for a more transmissive pedagogical approach without much degree of negotiation or collaboration and production. Both teachers and students reflected that the online quizzes were more frequently used in Mathematics lessons as compared to English lessons. Mathematics teachers reflected that due to the nature of the subject, students needed a good basic procedural skills, knowledge and concept of how to work out the correct answers. The English teachers also shared that they did use the quiz module to reinforce some of the grammar items taught in class.

Both the English and Mathematics teachers set up blog sites for the dissemination of online teaching and learning information and resources. Through the interviews with the teachers and students, the Mathematics teachers used this approach more frequently as compared to the English teachers in consolidating the links to online free digital resources. For instance, one of the Mathematics teachers created and maintained the blog sites weekly for the various levels with the Internet links to the relevant teaching online resources, games and manipulatives. These blogs allowed students to access the suitable educational online games and manipulatives that were related to what was taught in class. The teachers used some of the free and readily available online manipulatives to make their lessons more interesting and engaging. This is another instance of learning *from* technology with the transmission of learning content via the online platforms. The consolidated links by the teachers to the quizzes and online digital manipulatives could be found on the blog site for the ease of students to learn *from* the technology and promote more independent learning. The above instances represented learning *from* technology, without production and collaboration.

Learning *with* technology

The English teachers engaged the students in the creation of their digital stories, a key approach used by the school for the learning of language and digital literacy skills. The lesson idea was a very simple one. The students used an appropriate software application to create a digital story with text, digital images and sound recordings (i.e., students' own voices in narrating their stories). Pupils were given a series of scaffolding tasks

prior to the completion of their digital storytelling assignment, which included brainstorming for ideas in groups or pairs for profiles of characters, drafting of story outlines and finally recording their narration of the stories. Teachers provided feedback for improvement when pupils completed the various tasks at different times. The completed digital stories were then published in the school network and also Internet, via blog sites, so that peers and parents could view and also provide their comments. This process of putting the students' ideas into text and colourful visuals excited and engaged them. Facilitated by technology to present their digital stories, students could easily create and refine their stories and learn from each other in the creation process. In recording the narration of their stories, students attempted multiple readings and recordings till they felt satisfied with their digital readings. This was another instance where English teachers facilitated students to learn *with* technology (with elements of production and traces of collaboration); the student created their digital stories (Tay, Lim, Lim, 2011).

Several English teachers encouraged their students to post their reflections and thoughts as online journals via online blog sites. The teachers modelled the writing and steps on how to post their journal online. The students' online journals were commented by both their English teachers and fellow classmates. This process encouraged the students to express themselves more clearly as they need to be understood, especially their fellow classmates. The students were also observed to write more frequently through their blogs. The students were engaged in constructing or producing their own online journals; they were also engaged in online dialogue and exchanges through the comments posted via the blogs. This was another instance of learning *with* technology, with students writing their own journal with comments from friends and teachers.

One of the Mathematics teachers taught her students computer programming. Her exploration provided encouraging evidence that computer programming had the potential to equip the young children with digital literacy and Mathematics thinking skills. This is one example of learning *with* technology through a constructionist pedagogical approach. All students from the various primary 4 classes were also exposed to the creation of pictorial graphs using the spreadsheet software application to analyse trends and patterns. This was a simple instance of learning *with* technology from a constructionist perspective.

Discussion

From a technology pedagogical perspective, the student learned *from* and also *with* technology in both subjects, with and also without production and collaboration. From the findings, it seemed to suggest that Mathematics teachers adopted a more learning *from* technology and transmissive approach as compared to the English teachers. From the interviews with the teachers, the learning of Mathematics require basic computational skills and the reinforcement of these skills need more 'drill and practice' type of pedagogy through the use of quizzes found within the learning management system. However, there were snippets of learning *with* technology in the learning of Mathematics, where students were taught computer programming and also the creation of pictorial graphs using the spreadsheet software application. In general, the teaching of Mathematics took a more learning *from* technology and much lesser occasions for learning *with* technology. The elements of collaboration were limited in Mathematics lessons.

On the contrary, the English teachers seemed to use a hybrid of pedagogical approaches in their teaching of English. Both learning *from* and learning *with* technology approaches were used. Teachers made use of the online social networking applications to transmit information, learning resources, online quizzes and also to allow students to comment on each other's journals and digitally written works. Students were also given opportunities to construct or write their own digital stories or compositions with their personal voices embedded in both offline and online software applications. In summary, as the nature of the subject, the students were given opportunities to express their thoughts with the ICT tools available. However, the co-construction aspect was not evident in the English lessons.

Conclusion

This paper looks into the difference in technological pedagogical approaches adopted by the teachers in the teaching of English and Mathematics. The above discussion suggested that the difference in the technological pedagogical approach adopted by the teachers was influenced by the content subjects (i.e., English and Mathematics in this case) they were teaching. In addition, we have also to be aware that other factors, such as individual teacher's beliefs, curriculum plans that explicitly state the use of ICT and other contextual factors

may also influence how technology is being used in the classrooms (Crisan, Lerman & Winbourne, 2007).

In conclusion, the findings seem to also suggest a lack of the use of co-constructivist approach by the teachers in both the subjects. Hence, future research could look into how to support and encourage teachers in the use the co-constructivist approach in the primary school context.

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