

Extrinsic and intrinsic barriers in the use of ICT in teaching: A comparative case study in Singapore

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This study examined the use of ICT for teaching undertaken by two primary school teachers at pre-examination period and at post-examination period. Their perceptions of using ICT for teaching and learning and their ICT experiences were also analysed. The results showed that both teachers improved in ICT integration from Adoption stage to Adaptation stage after examination (when the curriculum is more flexible and teachers had more time for lessons), with increased scope and sophistication in ICT use in classrooms. These observations confirmed that extrinsic barriers - time and curriculum constraints - are negatively impacting ICT integration of teachers.

Keywords: ICT integration, time constraint, curriculum constraint, case study, Singapore schools

Introduction

The benefits of integrating Information Communication Technology (ICT) in enhancing classroom learning and teaching have been well documented in education research (Sutherland, 2004; Korte & Hüsing 2006; Grabe & Grabe, 2007). Educational researchers and practitioners are making every effort to pursue “ubiquitous computing” (Weiser, 1991) in which technologies are woven into diverse dimensions of pedagogical practices in formal educational contexts. Singapore is no exception in this regard. To make “ubiquitous computing” a reality, the Ministry of Education in Singapore has launched a series of ICT Masterplans (MOE, 2008) and the Programme for Rebuilding and Improving Existing Schools (PRIME) (MOE, 2008) to promote the meaningful use of ICT in schools.

With the cognition that ICT integration will not naturally happen by solely providing technological “assets” (Horrihan, 2007) in classrooms, teacher development activities are designed and implemented to augment favorable “actions” and “attitudes” toward technology in the agents of change of classroom practice. In the National Institute of Education (NIE) of Singapore, the teacher training institute for all public school teachers, courses concerning ICT use for educational purposes have long been incorporated into its teacher training programs. Given the extensive support for teachers, one might assume that ICT use in classrooms should improve and inspire the transformation of traditional pedagogical practices. According to Cuban (2001) and the Office for Standards in Education (2004), the adoption and integration of technology into classroom learning and teaching is behind expectations. In practice, ICTs are either scarcely used or only used to supplement traditional and frontal teaching (Redecker, 2009).

This reality makes investigating the factors that compromise ICT integration in school settings imperative. There have been scholarly efforts made for this end. Informed by previous research, the present study explores the issues that undermine teachers’ ICT use in authentic, regular classrooms in Singapore via a comparative case study approach. The findings in this micro-analysis can help school authorities and policy makers to plan interventions to encourage ICT use and the progression of “ubiquitous computing” in Singapore schools.

Research Goal & Framework

In existing literature, there has been discussion concerning the barriers that teachers face in using ICTs from a general perspective. Peggy Ertmer (1999) classified those exposed into two categories: 1) Extrinsic barriers, first order barriers that result from inadequate and/or inappropriate configuration of ICT infrastructures,

including access, time, support, resources and training; 2) Intrinsic barriers, second order barriers that related to teachers' personal experience and awareness, including attitudes, beliefs, practices and resistance.

Previous studies have extensively investigated teachers' beliefs and attitudes toward ICT adoption and the results indicate that most teachers were positive about ICT integration as it makes learning more effective and teaching and learning resources easier to reach (Gulbahar & Guven, 2008; Prestridge, 2012). Thus, the unsatisfying implementation of ICT-supported learning and teaching could probably be ascribed to the lack of Technological Pedagogical Content Knowledge (ICT-TPCK) (Angeli & Valanides, 2009) to design and deliver effective pedagogies in technology enhanced learning environments and to the shortage of time and support for ICT use. In the Singapore context, the former is confirmed. Chen, Lim & Tan (2010) disclosed the existence of discrepancy between every ICT skills and those essential for teaching in pre-service teachers born after 1980, which limited their ICT adoption in teaching.

The time constraint for ICT use, to some extent, has been neglected in the Singapore context. Research into teachers' ICT use in other countries has identified the lack of time as a common barrier that most, if not all teachers face (Cuban, Kirkpatrick & Peck, 2001). Teachers, apart from finishing allocated teaching load, also help out in arranging and organizing both curriculum-related and unrelated activities and other administrative work. To many teachers, adopting ICT is additional work that is only looked at when there is extra time. Curriculum constraint, which is closely related to the time issue, has been confirmed as another barrier. Research done in North Carolina shows that teachers "having insufficient freedom to make decisions about content and pedagogy" (Kauffman, 2005) discourages teachers from exploring and experimenting with innovative teaching leveraged on ICTs. Illuminated, we would like to investigate whether the same barriers (time and curriculum constraints) exist in Singapore.

To achieve this, we observed and documented the ways two teachers used ICTs for teaching and learning during regular lessons (before the Primary School Leaving Examination, PSLE) and in post-exam lessons (lessons after PSLE). These two teaching periods were chosen as, in Singapore, after PSLE students still have to attend school but there is no longer a prescribed curriculum to follow, which gives teachers more freedom to plan and practice intended activities. Teachers also have more time due to reduced administrative work and school activities after PSLE. A comparative case study has been conducted to examine whether there was a discrepancy in ICT use between these two periods.

To describe the level of ICT integration of the teachers observed, we have translated the developmental trajectory of ICT use proposed by Dwyer, Rinstaff and Sandholtz (1991) into our context. According to this framework, teachers generally go through five stages in the process of incorporating ICTs into their classrooms indicated by their ICT-related teaching performance: 1) Entry stage, where the physical environment of learning starts to change with the introduction of ICT devices yet the learning activities and supporting tools used remain relatively traditional (e.g. pen, paper and books); 2) Adoption stage, where ICT devices are used but for traditional learning activities (i.e. using new tools for old practices); 3) Adaptation stage, where various ICTs are used with increasing depth and breadth, and integrated into specific learning scenarios; 4) Appropriation stage, where ICTs are routinely used and transforming pedagogical practices in a broader context (e.g. more extensive and frequent application of technology-enhanced collaborative learning); 5) Invention stage, where both the physical environment and teachers' mindsets about learning have been transformed and teachers are actively exploring and experimenting with new tools and activities to enhance learning effectiveness. In analysis, the level of ICT use of the teachers involved at both the pre and post examination period was examined and compared. It should be noted that in our study, the determination of ICT integration level was phenomena-based, i.e. based on the users' existing practice. The progression of ICT integration was thus defined as the improvement in the scope and frequency of ICT adoption which might and might not indicate the increase in users' competence in "ICT for teaching".

Participants & Data Collection

Two teachers, Tom and Paul, participated in this study. Both teachers were from a group of pre-service teachers who had responded to a call for volunteers for a research project in NIE to study the ICT habits and practices of pre-service teachers. Before graduation, this group of teachers was asked whether they would like to participate in the present study and these two teachers indicated their interest. Approvals were then sought from their respective schools for data collection.

Data was collected via lesson observations and interviews. Observation sessions were arranged once a month for a semester (from July to November). In practice, the researcher shadowed the two teachers throughout the

whole school days. Observation notes, videos and photos were recorded and documented for analysis. The interview sessions took place right after the observation sessions. In the interview, teachers were asked about their perceptions and reflections on these ICT use experiences. All the interview sessions were audio-recorded and transcribed.

Data Analysis & Discussion

Adoption level at pre-examination period

Both Paul and Tom were found at the Adoption level of ICT integration before the examination. In Paul's lessons, most activities were supported by traditional tools and resources such as whiteboard and paper-based textbooks, workbooks and exercise books. ICT platforms were present but used infrequently. Basic applications such as PowerPoint presentations and visualizers were adopted most, but for very traditional practices. He used a visualizer for flashing worksheets, examination practice papers, passages and pictures for oral description. Sometimes, he used PowerPoint presentations to teach students the meanings of some new words. Only in one instance, he was observed using the online resources—the online timer to train his students to complete their work within time. Though a student portal – the LEAD Portal (an e-learning portal by Marshal Cavendish) was readily available in school, Paul did not use it often. He only turned to it when he lacked time to go through the answers of the examination papers with the students before PSLE. On these occasions, he merely used the portal to post answers and explanations for the students to look through on their own.

Compared to Paul, Tom adopted more ICTs in his teaching, yet his usage was still within the Adoption level. Whiteboard and paper-based textbooks, workbooks and exercise books were still the main vehicle for most learning activities. Sometimes Tom used digital textbooks (on his laptop) instead of the physical ones. The visualizer was the most common tool for presenting and demonstrating learning materials. Sometimes, he also used MS Word to take notes. Instead of writing the words out on the whiteboard, he typed the words out on a blank Word document (while the document was projected on the board) for the students to copy. He felt it was neater that way, and was easier for the students to read the typed words, as compared to the written words. To encourage student participation, he created a simple scoring programme using Flash to use in class and it worked very well with the students. Like Paul, Tom was also observed using an online timer. He used it during oral practice to remind students of the time passage in oral practice.

Adoption-Adaptation level at post-examination period

After the PSLE, ICTs were more significantly used in both teachers' lessons and these applications were of enhanced scope and effectiveness. Paul used significantly more ICT in his lessons and these applications were with enhanced scope and effectiveness. PowerPoint presentation was still mostly commonly used but Paul experimented with more functions. He played a charades-inspired game with the students on this platform. He also incorporated an activity about a girl caring for her mother in his PowerPoint slides to encourage students' reflections in class. Apart from basic applications, inspired by Amazing Race, Paul created a game specific for Primary 6 students via combining various ICT tools. In this activity, students had to apply skills such as typing in Chinese, searching web engines using Chinese and using online translator (Google Translate). During this process, he voluntarily reflected on the limitations of Google Translate and taught his students how to tell reliable online resources from unreliable ones.

Like Paul, Tom also brought the students to the computer labs more often after the PSLE. The post-examination activities for his Primary 6 students were also more creative and incorporated better use of ICTs. He created a game to test students' general knowledge and ability to read in Chinese using multiple ICT tools. In the learning activity, selected students were put in groups and the groups had to play against each other, while the rest of the students watched. There were various categories of questions to choose from and the students were also given options like polling the (student) audience, doubling their points for a question or throwing the question to another group.

From these observations, we found both Paul and Tom had enhanced agency in exploiting the affordances of ICTs within reach and improved awareness and techniques to address the changing requirements and side-effects brought about by the introduction of ICTs. From the evidence, we can see both teachers' progress from Adoption to Adaptation with regard to ICT use for teaching.

Time and curriculum constraints for limited ICT use

Apart from performance analysis, the investigation of teachers' perceptions of their ICT use experience offered further validation for pinning down time and curriculum issues as negative forces hindering ICT integration in classrooms. During the interview sessions, the two teachers were asked about their thoughts and reflections on ICTs. Paul directly cited the lack of time as the main reason he did not add much ICTs to his regular lessons. Activities like planning and preparing ICT-related lessons, bringing the students to the (computer) lab, setting up the systems was all quite time-consuming. There was also time needed for troubleshooting technological issues.

In addition, Paul felt the existing curriculum had somehow restrained his teaching. As a beginning teacher, he had "a certain curriculum to follow already, so it was not so easy to think out-of-the-box to and plan certain ICT instructional or even ICT-based activity for them (the students)" as "a lot of things are already in place". The academic activities for the year were already mapped out for teachers. There were workbook activities and other academic related activities like spelling tests (dictated by the heads of department) that the teachers had to complete, so little time was left for other activities. He also "didn't want to try anything new or incorporate certain things that they (the students) might not be used to".

Paul also mentioned that "ultimately, we are still preparing them (the students) for that (PSLE)", so a lot of drilling was necessary. That was the very reason why even if he had used ICTs, he used them for drills. The students were not going to be tested on their skills in ICT, so that was "not crucial". Moreover, the tests were to be done using pen and paper, not on the computer. That students learning using various ICT platforms would not help much or even make them slow and uncomfortable in doing pen and paper-based tests. Besides, he believed that incorporating ICT was only used to enhance students' interest and skills like the games he played with the students. Paul was "quite sure that whatever they learnt in terms of content today, they will not remember on Monday", though he believed that they would retain the skills they had learnt "because it's more kind of kinesthetic kind of work".

Like Paul, Tom perceived the press for time in using ICTs in his lessons. He complained that school computers worked too slowly and mentioned that compatibility and security issues when he used his personal laptop in school and solving these technical problems took up a lot of class time.

Tom also mentioned the same problem with existing curriculum that he was fully-occupied with planned learning content and activities so that he was so tired and "not energetic enough to do extra stuff". He also said that the focus for his teaching was on preparing students for PSLE.

Other barriers that limited ICT use

Apart from time and curriculum constraints, other issues also became evident from Tom's feedback. That teachers had not fully comprehended the needs and methods to integrate ICTs to transform traditional teaching was one of them. According to Tom, ICT tools were not so necessary for teaching a language. In his opinion, he could conduct his lesson by just talking and using the whiteboard (chalk-and-talk), even if the visualizer was not working, or if he had forgotten to bring the textbook to class. He deemed traditional classroom tools more than sufficient to provide for his teaching needs. To him, ICT tools were fancy add-ons, to "attract" the students by showing them video clips or animation clips. He felt that the "area and the opportunity to use ICT to enhance teaching is limited". According to him, "language is all about the interaction" and multimedia simulation was the same as him talking and gesturing ("The sound, I can talk, I have the sound. The video I, my gesture, it's still the same"). To him, using ICT was merely a different mode of presenting the lesson, but ultimately, the lesson content was still the same, so it did not make much difference.

Another source of problem lay with the lack of ICT infrastructure for linking formal and informal learning contexts. Tom found giving his students learning materials and assignments from the LEAD portal was "effective", but he did not continue to do so after trying a couple of times as students complained about the problems with their Internet connections at home which prohibited them from finishing the learning activity. As such, Tom only used the portal for supplementary purposes like uploading answer sheets, posting examples and spelling lists.

Conclusion

This paper reports a comparative case study of teachers' ICT use for teaching before and after the examination period. After analysing two teachers' ICT experiences and perceptions towards ICT for teaching and learning, extrinsic barriers - time and curriculum constraints - has been confirmed as discouraging ICT adoption in classroom settings. After the examinations, both the teachers used ICTs more extensively and effectively due to increased freedom for embracing more diverse and sophisticated ICT-supported pedagogical practices. Though curriculum being responsible for reduced ICT integration in classrooms is suggested, we do not argue for the eradication of existing curriculum but for the modification as curriculum can give teachers a clear sense of what to teach and foster teachers' on-the-job training (Valencia, et al., 2006).

From these findings, it is recognised that policy makers and school authorities should make further efforts to better accommodate the "support" teachers and students need in leveraging on ICT supported learning environments if "ubiquitous computing" is to be attained. Apart from providing technology-centred support (e.g., ICT devices and software), people-centred support (e.g., initiatives that encourage ICT-related innovation in pedagogy and curriculum) are also needed to facilitate and stimulate teachers to explore and experiment in this area.

The study also revealed teacher beliefs and attitudes as well as ICT infrastructure as limiting factors. As these factors typically change over time, they could be further studied by comparing the findings from beginning and more experienced teachers.

It should be pointed out that this is an ethnographic study and is qualitative in nature. Data used was collected over several events with humans being "the research instrument" and "generalizability is interpreted as generalizability to identifiable, specific settings and subjects rather than universally" (Cohen, Manion and Morrison, 2000). Any application of findings and conclusions achieved in this study should be done with caution. Another limitation of this paper has been its sole focus on those extrinsic factors within the school context. As indicated in the interview data, these two teachers, if representative of other teachers, have not grasped the whys and hows in integrating ICTs and that there exists a lack of coherent infrastructure linking formal and informal learning contexts which also contributed to the encumbered ICT use. More extensive investigation is needed to offer a comprehensive capture of the factors impacting ICT integration.

References

- Angeli, C. & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, 52(1), 154-168.
- Chen, W., Lim, C., & Tan, A. (2010). Pre-service teachers' ICT experiences and competencies: New generation of teachers in digital age. *Society*, 58(3), 631-638.
- Cohen, L., Manion, L., & Morrison, K. (2000). *Research Methods in Education* (5th edition). London: Routledge Falmer.
- Cuban, L. (2001). *Oversold and underused: computers in the classroom*. Cambridge: Harvard University Press.
- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High Access and Low Use of Technologies in High School Classrooms: Explaining an Apparent Paradox. *American Educational Research Journal*, 38(4), 813-834.
- Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Educational Leadership*, 48(8), 45-52.
- Ertmer, P. (1999). Addressing first- and second-order barriers to change: Strategies for technology implementation. *Educational Technology Research and Development*, 47(4), 47-61.
- Grabe, M. & Grabe, C. (2007). *Integrating technology for meaningful learning* (5 Ed). Boston: Houghton-Mifflin.
- Gulbahar, Y. & Guven, I. (2008). A Survey on ICT Usage and the Perceptions of Social Studies Teachers in Turkey. *Educational Technology & Society*, (11)3, 37-51.
- Horrigan, J. (2007). 'A typology of information and communication technology users'. *Pew Internet & American Life Project*. Available at: <http://www.pewinternet.org/Reports/2007/A-Typology-of-Information-and-Communication-Technology-Users.aspx> (Retrieved May 2010).
- Jimoyiannis, A. & Komis, V. (2007). Examining teachers' beliefs about ICT in education: implications of a teacher preparation programme. *Teacher Development*, (11)2, 149-173.

- Kauffman, D. (2005). Curriculum Prescription and Curriculum Constraint: Second-Year Teachers' Perceptions, Available at <http://www.gse.harvard.edu/~ngt/Prescription%20&%20Constraint.pdf>. (Retrieved March 2012)
- Korte, W. B. & Hüsing, T. (2006). Benchmarking Access and Use of ICT in European Schools 2006. Available at http://www.empirica.biz/publikationen/documents/No08-2006_learnInd.pdf (Retrieved March 2012)
- Ministry of Education, Singapore. (2008). Masterplan III for IT in Education, Available at <http://www.moe.gov.sg/media/press/2008/08/moe-launches-third-masterplan.php>. (Retrieved March 2012)
- Ministry of Education, Singapore. (2008). Programme for Rebuilding and IMproving Existing Schools (PRIME), Available at <http://www.moe.gov.sg/initiatives/prime>. (Retrieved March 2012)
- Office for Standards in Education (2004) ICT in schools: the impact of government initiatives five year on London: Ofsted.
- Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education*, 58, 449–458.
- Redecker, C (2009). Review of Learning 2.0 Practices: Study on the Impact of Web 2.0 Innovations. Education and Training in Europe. JRC Scientific and Technical Report, Available at <ftp://ftp.jrc.es/pub/EURdoc/JRC49108.pdf>. (Retrieved March 2012).
- Sutherland, R. (2004). Designs for learning: ICT and knowledge in the classroom. *Computers & Education*, 43, 5–16.
- Tan, J. & Gopinathan, S. (2000). Education Reform in Singapore: Towards Greater Creativity and Innovation. NIRA Review, (7)3, Available at <http://www.apecknowledgebank.org/resources/downloads/SingaporeCurriculumReformCreativity.pdf>. (Retrieved March 2012)
- Valencia, S.W., Place, N.A., Martin, S.D. & Grossman, P.L. (2006). Curriculum Materials for Elementary Reading: Shackles and Scaffolds for Four Beginning Teachers. *The Elementary School Journal*, 107(1), 93-120.
- Weiser, M. (1991). The computer for the 21st century. *Scientific American*, 265(3), 94-104.

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