Empowering student learning through Tablet PCs: A case study

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Abstract Empowering students to learn through ICT is seen as a way to address the growing awareness and demand for preparing students to effectively participate in the emerging global knowledge economy. It is believed that, in order to maintain competitiveness in a global economy, traditional classroom practices must be re-conceptualized in a way that enables students to engage themselves in knowledge building, to become more self-directed, and to assume greater autonomy and social responsibility over their own learning. In this article, we report a case study on the use of Tablet PCs to support teaching and learning in a primary school in Hong Kong, and provide insights into how schools can harness and capitalize on the opportunities offered by such emerging technologies.

Keywords ICT in education · Tablet PC · Information literacy

1 Introduction

From the birth of the television in the 1920s, to the advent of the personal computer in the 1970s, educators had been intrigued with the potential of technology to help transform education and improve learning (Hew and Brush 2007). The primary motivation for integrating ICT into teaching and learning is the belief that it supports students in exploring and articulating thoughts, knowledge construction and theory building (Scardamalia and Berieter 1991), collaboration, negotiation of meanings, reflection,

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meaningful learning through accessing authentic information and immersing themselves in complex and contextualized learning situations (Jonassen et al. 1999). The belief that technology can have positive impact on student learning has spawned a proliferation of studies in the past three decades. There have been research studies on ICT in education (Hew and Brush 2007), demonstrating that the use of technology can help improve students' self-concept and motivation (Sivin-Kachala and Bialo 2000), and their performance in problem solving (CEO Forum on Education and Technology 2001).

Despite the successes expounded above, it is apparent that successful implementation of technology in school hinges on a number key factors (Frank et al. 2004; Levin and Wadmany 2008; Norris et al. 2003; Robertson et al. 2006; Wells 2007). Obviously, technology *per se* is not a wand for bringing about miraculous change in student learning. In fact, a number of articles (Hew and Brush 2007; Wong and Li 2006) have indicated that the success of ICT implementation in schools hinges on a number of factors, including (1) teachers' attitudes and beliefs, (2) skills and pedagogies, (3) assessment, (4) resources, (5) school culture, (6) professional development and (7) leadership. Moreover, the ways that researchers conceptualise student learning and their expected outcomes affect the methodology they employ to analyse the data and interpret the results. (Jonassen et al. 1999; Schwartz and Beichner 1999) argue that if one agrees that learning with ICT is or should be an active, constructive, intentional, authentic, and collaborative process which is different from the traditional mode of learning, then one must re-conceptualise the ways to assess and evaluate student learning. (Li et al. 2006) also echo that ICT should serve as a vehicle or a lever for developing our students into information-literate citizens with adequate skills to sustain self-directed and life-long learning.

2 Self-directed learning and information literacy

In parallel with the growing interest in the development of life-long learning abilities as an important educational goal, more and more people have come to espouse the social character of learning and the importance of social interaction in developing cognition (Pelgrum and Anderson 1999; Scardamalia and Berieter 1991). For at least two decades, there has been a resurgence of interest in bringing in group collaborative activities in the restructuring of classroom teaching. There is growing research evidence that collaborative co-construction activities which comprise elements of positive interdependence, face-to-face interaction, individual account-ability, shared responsibility, shared leadership, sharing and feedback, are effective in enhancing students' self-esteem, developing their thinking skills and changing their attitudes towards different racial groups (Cabral-Pini 1994; Johnson et al. 1994). Collaborative learning thus can and should be integrated with self-directed learning as these reinforce each other in achieving similar learning goals (Borghoff and Pareschi 1998; Li et al. 2006). Self-directed learning refers to learner autonomy rather than to learning as a solitary personal exercise. Self-directed learning is not seen as a one-off activity but a lifelong learning process which is featured by four aspects, namely, learner control, learner self-management, personal autonomy and autodidaxy (Candy 1991). Learner control refers to an instructional approach to learning that facilitates learners to have control over the learning process. Self-

management emphasizes the learners' willingness and capabilities to regulate their learning. Similar to self-management, personal autonomy indicates a desirable attribute of learners; while autodidaxy refers to the independent pursuit of learning outside formal institutional settings (Kreber 1998; Wilcox 1996). These aspects manifest that self-directed learning is both a goal and a process to enhance learners' readiness and capacity to take the responsibility to manage their own learning activities.

Most of the contemporary interpretations of life-long and self-directed learning are inextricably intertwined with information literacy. Information literacy is often deemed to be pivotal in the pursuit of both personal empowerment and economic development of a society and being recognised as a kind of "new economy" skills essential for people to cope with the rapidly evolving changes in the information age. Information literacy, as a capacity for sustaining life-long learning, embraces four dimensions (Li et al. 2006): cognitive, metacognitve, affective and socio-cultural. The cognitive dimension addresses the need to enable students to master the necessary skills to comprehend, locate, analyse, critically evaluate and synthesise information and apply their knowledge to inform decisions and problem solving. The meta-cognitive dimension emphasises on developing students as reflective learners. To engage students in meaningful learning, learning by itself should not be divorced from its social context and student's experience. Along this vein, the affective and socio-cultural dimensions address the need to enable students to appreciate and enjoy the process of inquiry; and to empower them with greater autonomy and social responsibility over the use of information in their individual as well as collaborative learning.

3 Methodology

3.1 Research questions

In conducting this case study, we adopted the information literacy framework proposed by (Li et al. 2006) to examine student learning in a Tablet PC supported environment. The research questions are two-folded:

(1) Does the immersion of students in a technology-rich environment lead to the enhancement of their information and technology literacy?
(2) What are the factors conducive to the use of Tablet PCs to support teaching and learning in a school-wide context?

The information literacy framework as shown in Fig. 1 was used as a lens for scrutinising student learning. To develop an in-depth understanding of the dynamics of various factors contributing the student learning supported by technology, a variety of qualitative methods were adopted in this study, which included lesson observations and shadowing, focus-group discussions, in-depth interviews, evaluation of selected student work, and students' self-reported logging of daily learning experiences.

3.2 The case school

The case school chosen for this study is a typical government-aided primary school situated in the Northern District of HKSAR. The school CCLMS was founded in
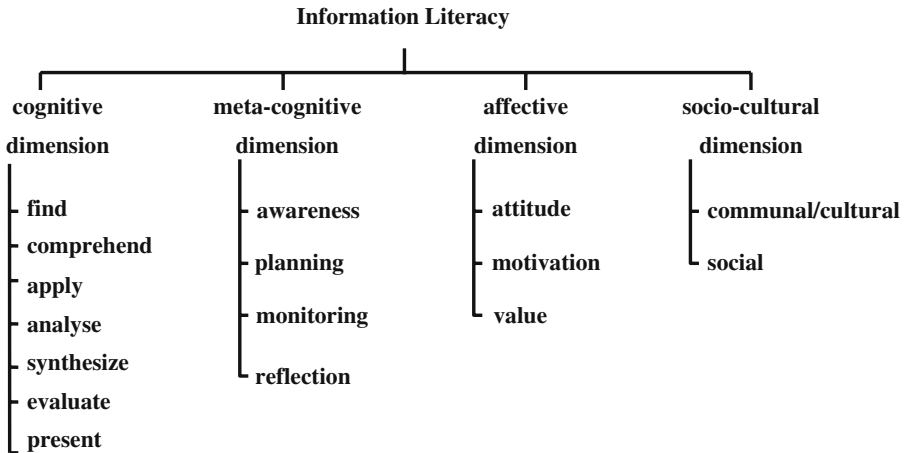
Information Literacy

cognitive	meta-cognitive	affective	socio-cultural
dimension	**dimension**	**dimension**	**dimension**
- **find**	- **awareness**	- **attitude**	- **communal/cultural**
- **comprehend**			- **social**
- **apply**	- **planning**	- **motivation**	
- **analyse**			
- **synthesize**	- **monitoring**	- **value**	
- **evaluate**			
- **present**	- **reflection**		

Fig. 1 The four dimensional information literacy framework (Li et al. 2006)

2002, with students coming mostly from the neighbouring residential areas. CCLMS is among those schools which have a vision of empowering students to embrace new technology in their learning. Without any external funding support, CCLMS has pioneered an "IT School Bag" scheme in which Tablet PCs are used to support teaching and learning in some of their classes since 2005.

3.3 Lesson observations

The lesson observation component comprised three phases which were conducted separately in March, April and June of 2007. To enhance the inter-rater reliability, two researchers were involved in each lesson observation. Based upon a semi-structured assessment rubrics, the two raters would take notes about the teaching strategies employed, types of learning activities conducted, teacher-student interaction, student-student interaction and student-technology interaction, and the learning skills exhibited by the students as well as their general impressions of the lesson being observed. All the lessons were video-taped for further analysis. Phase I and Phase III involved classroom observations conducted for the two Tablet PCs classes 4A and 5E. In Phase II, one Tablet-PC class (5E) and one non-Tablet-PC class (5A) were observed for comparison. Phase I entailed a whole-day classroom observation exercise in which the two researchers shadowed a student, following him/her through all lessons and activities conducted during the day. It was hoped that the shadowing exercise could help the researchers portray a clear picture of how students with the support of technology learn in various subjects. In Phase II, when the Tablet-PC class (5E) and the non-Tablet-PC class (5A) were selected for comparison, the focus was on how project learning was conducted among those two different groups of students. In Phase III, students from the two Tablet-PC classes were engaged in self-study and independent learning, using Tablet-PCs for completing assignments, revision, individual learning, collaborative work, etc. The above selection of classes and lessons was undertaken in order to maximise the variation in the type of pedagogies and learning situations, modes of learning, subject disciplines and student background being observed.

3.4 Focus-group discussions, in-depth interviews and daily logging

The focus-group discussions and in-depth interviews were conducted for various stakeholders, including two student groups (with one from each Tablet-PC class), subject teachers involved in teaching the two Tablet-PC classes, IT team leaders, the principal and two groups of parents from respective Tablet-PC classes. The discussions and interviews entailed a set of semi-structured questions for probing respondents' (1) perceived learning outcomes and impacts of Tablet PC on learning and pedagogies; (2) views on school climate and how it affects the ICT implementation; (3) perceived difficulties in using Tablet PC; (4) expectations and areas for improvement of the ICT implementation. As the entire cohort of respondents comprised of heterogeneous groups of stakeholders, the questions for discussion and interview derived from the four domains were tuned in a manner to address the uniqueness of each group. For instance, teachers were asked about their beliefs, understanding and their needs regarding professional development while parents were asked about their perceptions on how the use of Tablet PC brings about changes in students' learning habits and outcomes. Each discussion or interview session lasted for approximately 45 min to one hour, which started with a brief introduction to explain the background of the research, followed by a semi-structured discussion session. With consent from the respondents, all discussions and interviews were digitally recorded for further analysis.

4 Results and key findings

4.1 School culture and support

The school selected for our study had a clear vision about IT in education. IT was generally perceived by the teachers as a vehicle to empower student learning and help students develop themselves as life-long learners. A strong sense of collegiality was found among the staff. The school principal had a strong leadership in vision building and cultivation of a caring and supportive culture in which teachers were empowered to exercise their leadership at different levels. For instance, the IT team was entrusted to play the role of a change agent, bringing in curriculum innovations and emerging practices to the school. The team piloted new ideas and provided appropriate professional support and development for their colleagues. Teachers were generally receptive and supportive to new initiatives. Apart from that, the school had established good relationship and partnership with parents. For instance, some parents indicated that the reason they joined the Tablet-PC scheme was mainly due to the trust they had placed in the school.

4.2 Resources management, classroom setting and curriculum

4.2.1 Resources management

Unlike in other schools where IT equipments are commonly kept at school and can only be accessed by students during particular time-slots stipulated in the school

time-table, the Tablet PCs are used by students participating in the "IT School Bag" scheme as their 'learning companions'. Students assume the ownership of and autonomy in working with the tool in their daily learning. To make this happen, CCLMS had rightly sought support from the parents. The school also did not set any explicit selection criteria for choosing students to participate in the scheme. However, parents who volunteered their children to join the scheme were required to purchase a Tablet PC and take the full ownership and responsibility of managing and maintaining the tool.

4.2.2 Classroom setting

Participating students of the same level were grouped together for teaching and learning. Currently, there are two Tablet PC classes, one at Primary 5 and the other at Primary 4, which have started using Tablet PCs since 2005 and 2006 respectively. The classroom settings of these two classes are basically the same as other classes except that they are wired, with access to the Internet and an intranet linking up all the Tablet PCs. Using the Tablet PCs, students can run software packages that take advantage of the digital screen. For instance, students can use "OneNote", an application which capitalizes on the latest handwriting recognition technology, to write and search for words in both Chinese and English with a stylus. OneNote also has a recorder with a time stamp, so it can synchronize the recording with the written notes (Wu 2006). Teachers or students may use these functions to record a lesson and re-play it at a later time.

4.2.3 Tablet PC versus notebook

The ICT leaders indicated that the key determinants for choosing Tablet PC in lieu of other technologies such as notebook and handheld devices were that (1) Tablet PC provides a reasonable size of screen display which is essential for primary students as their reading abilities are still underdeveloped; (2) it supports software applications run on Windows XP or Windows Vista; (3) it possesses the handwriting recognition capability which helps to reduce the cognitive demand for inputting Chinese characters and keyboarding without deprivation of the opportunity to develop students' handwriting skills; and (4) with the use of OneNote, Tablet PC provides a platform for knowledge co-construction, that is, students can network their Tablet PCs together to co-author their shared OneNote documents.

4.2.4 Curriculum

The curricula implemented in the two Tablet PC classes are identical to those in other classes of their same level. However, students of these two 'experimental' classes do not need to bring textbooks to school, as a digital version of the textbooks is installed already in each Tablet PC. Likewise, home assignments, worksheets and other teaching and learning resources can be uploaded to and retrieved from a dedicated server using the Tablet PCs. In addition, marking of and feedbacks to students' work are given by the teachers in digital format.

4.3 Classroom practices with Tablet PCs

A total of 12 lesson observations were conducted, covering a wide range of subject areas such as Chinese Language, English Language, Mathematics, General Studies and Life Education. A variety of teaching strategies, such as task-based learning, collaborative learning, project learning, inductive and exploratory learning, inquiry learning as well as expository teaching were observed. Teachers exhibited their competence in employing IT to enhance their presentations and lesson delivery and to empower students to make use of authentic information and resources from the Internet to accomplish the tasks assigned to them. In addition, some teachers expressed that, with the school intranet, they were able to better manage, organise, assess and provide feedback to students' work.

4.4 Student learning

To scrutinise student learning, we adopted the coding scheme comprising the four dimension of learning: cognitive, affective, metacognitive and socio-cultural, as depicted in Fig. 1 to analyse the lessons observed in the TabletPC classes. It was evident that students from the two Tablet-PC classes exhibited a comparatively high level of competency across the four dimensions:

(1) The Cognitive Dimension—During the lessons observed, students generally exhibited their competency (i) determining the nature and scope of the information needed; (ii) employing different strategies for locating information; (iii) identifying, recording, organizing and managing a variety of potential sources of information; (iv) collecting primary data to frame and address questions and (v) applying information to inform decisions. For instance, students were skillful in using OneNote to draw mind-maps to frame their inquiry and to write annotations or summaries on digital media that they have collected. Apart from that, students were able to master some of the sophisticated functions of the Tablet PC by their own exploration or learning from their classmates. Some teachers in the focus-group interview expressed that students of the TabletPC classes were more willing to experiment new ideas and thoughts:

> "They have a better sense of using colours as they could research on the Internet to locate relevant information and experiment their ideas of design using software applications before they actually draw and paint on papers ...... I observed that they had a richer exposure to a variety of paintings and designs ....," said the Visual Arts teacher.

> "….. they are less afraid of making mistakes as the computer allow them to undo everything ….. I find the writings of this group (the TabletPC class) of students seem to be more creative and richer in terms of their content ....," said the Chinese Language teacher.

(2) The Affective Dimension—Students of the Tablet-PC class were highly motivated in learning as reflected from the lesson observations, students',

teachers' and parents' perceptions expressed during the focus-group interviews. Some students regarded the Tablet-PC as a toy or a companion that they were fond of:

"When my kid first received the TabletPC, she was so excited that she said that she is now giving birth to her baby (TabletPC) ……," said Parent A.

"I was amazed that he was very self-disciplined and self-motivated in accomplishing her assignment at home since he joined the scheme…", said Parent B.

"Initially, I was quite worried that my kid would get addicted to computers, but I was surprised that he was able to manage the tool very well in assisting his learning …," said Parent C.

(3) The Metacognitive Dimension—As the skills and competency associated with metacognition are more tacit and more difficult to probe than those in other dimensions, the data collected from interviews and lesson observations thus do not have strong indication of metacognitive activities. Nevertheless, students reported from their daily-logs that the use of TabletPCs helps them plan and regular their learning and improve their learning strategies.

(4) The Socio-cultural Dimension—The classroom climate of the two Tablet-PC classes was warm and supportive. Students were motivated, willing to share and collaborate with others. During the project learning session about campaigning for the Chief Executive election, students, by capitalising upon the Tablet PC technologies, were able to co-construct artifacts with their classmates. Interestingly, there were quite a number of self-initiated learning strategies found among these two classes of students. For instance, with the networked Tablet PCs, students were keen on posing problems or questions to challenge their classmates by uploading their self-made worksheets to the shared folder on the intranet. While some of these questions were derived or modified from the e-textbooks, some were formulated by the students themselves. Likewise, some students audio-recorded their self-recited English passages and uploaded them to the intranet for others to revise for dictation.

4.5 Comparison of project learning in TabletPC and non-TabletPC classes

In the project learning session we observed in this study, students were engaged in a WebQuest project about running an election campaign for the Chief Executive of Hong Kong Special Administration Region. Students were required to work collaboratively in groups of 4 to 5, to design a slogan, a political agenda and a poster for one of their group members to run for the election. The lessons for the TabletPC and non-TabletPC classes were conducted in two different classroom settings. The former was delivered in a normal classroom while the latter was conducted in a computer room. In both classes, the teachers followed basically the

same lesson flow and adopted the typical WebQuest model (Dorge 2007) to structure the entire activity. Comparison between the two lessons was drawn with respect to students' learning process and learning outcomes. In our analysis, the major differences between the two classes were found in (1) students' exhibited ICT competence; (2) patterns of collaboration and (3) the quality of the end-products. While students from both classes were able to demonstrate their skills in using computers to search appropriate information from the Internet, the TabletPC class exhibited high competence in using technology to enhance intra-group and inter-group collaboration. Through the TabletPC and the OneNote software application, students connected their TabletPC with their classmates, sharing their digital resources, co-designing posters, co-authoring slogans, etc. Because of this high connectivity and the capability of co-construction supported by technology, each student's role, participation and contribution within a group were on a more equal footing as compared to the pattern of collaboration found in the non-TabletPC class. In the non-TabletPC class, the work distribution within a group was more divided and differentiated. For instance, some students were assigned to work on the slogans; some were searching information from the Internet; some volunteered to design the poster and so on. Group leaders in this class played a prominent role in decision making and distribution of workload among their members. In addition, the group structures in the non-tabletPC class were seemingly more hierarchical as compared to those in the TabletPC class. Because of such division of labour, the scope of student learning experience in the non-TabletPC class was confined by the roles students assumed, and the focus areas they were engaged in the project learning activities. On the other hand, the group structure in the TabletPC class was relatively flat that it enabled students to have equal opportunity to participate in collective decision making and negotiation of meaning. Because of the flexibility and convenience in creating a co-construction session for different TabletPCs, students could form different sub-groups to work on their common tasks. This kind of sub-grouping was rather volatile and dynamic that it helped provoke greater synergetic effect among students. As a result, the student-student interaction in the TabletPC class was found to be more intense and the group works produced by the students were more sophisticated and complex as compared to the those collected in non-TabletPC class.

5 Conclusion

The results of this study indicated that the Tablet-PC implementation had positive impact upon student learning in various dimensions: cognitive, metacognitive, affective and socio-cultural. Apart from enabling students to attain a high level of IT competence, the use of Tablet-PCs enhanced students' motivation to and efficacy in learning. It was also evident that students of the Tablet-PC classes were keen on collaboration and sharing of their learning resources and had strong awareness in organizing and self-regulating their learning. Looking beyond the classroom, teachers were empowered to assume responsibilities and leadership at different levels, a strong sense of collegiality and a culture that supports IT in education and curriculum innovations had been instilled in the school. To sustain curriculum

innovations, cultivating a supportive school culture that can foster collegiality and teacher empowerment at different levels is thus pivotal to the effective implementation of ICT in teaching and learning.

References

Borghoff, U. M., & Pareschi, R. (1998). *Information technology for knowledge management*. Berlin: Springer-Verlag.

Cabral-Pini, A. M. (1994). *Cooperative Learning: Its Effect on Math Education*: U.M.I.

Candy, P. C. (1991). *Self-direction for lifelong learning: A comprehensive guide to theory and practice*. San Francisco: Jossey-Bass.

CEO Forum on Education and Technology. (2001). The CEO Forum school technology and readiness report: Key building bloacks for student achievement in the 21st century.

Dorge, B. (2007). What is a WebQuest. Retrieved 14 March, 2009, from http://www.webquest.org/index. php

Frank, K. A., Zhao, Y., & Borman, K. (2004). Social capitial and the diffusion of innovations within organizations: the case of computer technology in schools. *Sociology of Education, 77*(2), 148–171.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology, Research and Development, 55*(3), 223–252.

Johnson, D. W., Johnson, R. T., & Johnson, E. (1994). *The new circles of learning: Cooperation in the classroom and school*. Alexandar: Association for Supervision and Curriculum Development.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River: Prentice Hall.

Kreber, C. (1998). The relationships between self-directed learning, critical thinking, and psychological type, and some implications for teaching in higher education. *Studies in Higher Education, 23*(1), 71–86. doi:10.1080/03075079812331380502.

Levin, T., & Wadmany, R. (2008). Teachers'. *Views on Factors Affecting Affective Integration of Information Technology in the Classroom: Developmental Scenery, 16*(2), 233–263.

Li, S. C., Kong, S. C., Lee, F. L., & Henri, J. (2006). Capacity building for lifelong learning: a study of practitioners' perceptions on information literacy. *Informatics in Education: An International Journal, 5*(2), 231–244.

Norris, C., Sullivan, T., Poirot, J., & Soloway, E. (2003). No access, no use, no impact: snapshot surveys of educational technology In K-12. *Journal of Research on Technology in Education, 36*(1), 15–27.

Pelgrum, W. J., & Anderson, R. E. (1999). *ICT and the Emerging Paradigm for Life Long Learning: a Worldwide Educational Assessment of Infrastructure, Goals and Practices*: IEA/ University of Twente OCTO.

Robertson, M., Grady, N., Fluck, A., & Webb, I. (2006). Conversations toward effective implementation of information communication technologies in Australian schools. *Journal of Educational Administration, 44*(1), 71–85. doi:10.1108/09578230610642665.

Scardamalia, M., & Berieter, C. (1991). Higher levels of agency for children in knowledge building: a challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1*(1), 37–68. doi:10.1207/s15327809jls0101_3.

Schwartz, J. E., & Beichner, R. J. (1999). *Essentials of educational technology*. Boston: Allyn and Bacon.

Sivin-Kachala, J., & Bialo, E. R. (2000). *Research report on the effectiveness of technology in schools*. Washington: Software and Information Industry Association.

Wells, J. G. (2007). Key design factors in durable instructional technology professional development. *Journal of Technology and Teacher Education, 15*(1), 101–122.

Wilcox, S. (1996). Fostering self-directed learning in the university setting. *Studies in Higher Education, 21*(2), 165–186. doi:10.1080/03075079612331381338.

Wong, E. M. L., & Li, S. C. (2006). Is ICT a lever for educational change? A study of the impact of ICT implementation on teaching and learning in Hong Kong. *Informatics in Education: An International Journal, 5*(2), 329–348.

Wu, C. (2006). Take a tablet: tablet computers have the potential to redefine the way engineering is taught. *ASEE Prism, 16*(4), 42–45.