

# From Device Centric to People Centric Ubiquitous computing: Pre-service teachers using technology across spaces

Wenli CHEN\* & Cheryl LEE

*National Institute of Education, Nanyang Technological University, Singapore*

\*wenli.chen@nie.edu.sg

**Abstract:** This case study examines how three pre-service teachers in Singapore use different computing devices across different spaces. It provides a snapshot of their ubiquitous computing experiences and sheds light on how their ICT experiences affect their learning and consequently teaching. On closer examination, we found that in general pre-service teachers owned more than one mobile device, and chose which to use according to their needs and situation. The mobile device most often used for work-related purposes, whether as a student or as a trainee teacher, is the laptop. However, the usage of the devices is also limited by the ICT infrastructure of the different locations. The laptop is also sometimes used for leisure activities. The pre-service teachers' perceptions of the various devices and their affordances are also reflected in this paper.

**Keywords:** ubiquitous computing, ICT environment, digital native, people-centric, seamless integration

## Introduction

Personal computing technologies are increasingly widespread in the lives of students, influencing many aspects of our social and work lives. Ubiquitous computing initiatives are already expanding in educational contexts. Since the early 2000, education colleges in the US such as University of South Florida, Pennsylvania State University and University of Texas at Austin, had implemented laptop initiatives for their trainee teachers and faculty [1], [2], [3]. Research showed that the use of computers in teacher education programs better prepares future teachers for integrating technology into their own instructional practice [4], [5]. Resta [5] emphasized that it is essential for future teachers to immerse in technology-rich environments throughout their preparation in order to assure that they are comfortable and competent in integrating new tools into their instruction.

ICT has always played a central role in Singapore's education system in preparing our students for 21st century learning. To date, the Ministry of Education has implemented three Masterplans for IT in Education [6]. ICT skills for education have been an integral part of the teacher training program at the National Institute of Education (NIE), as teachers have a profound influence on students' attitudes toward technology. They are agents of change in their classrooms.

In January 2009, the Ministry of Education (MOE) introduced one-to-one laptop initiative for its pre-service teachers in an attempt to create a ubiquitous computing environment. A ubiquitous computing environment is one where technology is completely incorporated into

our lives [7]. However, a one-to-one laptop program alone does not automatically mean that a ubiquitous computing environment is created or achieved. There are also other factors to be considered. Also, NIE is only one part of the student-teachers' lives. A truly ubiquitous computing environment looks at how ICT is involved in all parts of their lives – the different spaces that they engage in and even the mindsets of the pre-service teachers towards ICT. As Bahr, Shaha, Farnsworth, Lewis and Benson [8] said, "Attitude remains the critical factor in feeding the drive towards progress".

It is of little use to only provide the physical infrastructure if the student-teachers have no interest in using them. Environment and attitude need to go hand-in-hand, as one without the other would be ineffective.

The use of technology in education is becoming more and more prevalent. Pre-service teachers play very important roles in this environment as education is taken to a new frontier. They are the next generation of teachers. Many of them are young and are considered 'digital natives' [9], people who grew up with technology and are supposedly very comfortable with technology. However, just because they grew up with technology does not necessarily make them 'natives'. In studies done by Chen, Lim and Tan [10] and Bennet, Maton and Kervin [11], it was found that although there were "high levels of ownership...and high levels of some academic and recreational activities", "only a minority were engaged in creating their own content and multimedia for the Web".

So far, there have been quantitative studies done on the student-teachers' perceptions of laptops [12] and [13], but these only offer a generic view of their perceptions.

This study is unique in that it takes a deep look not just at the physical support structure of Information and Communication Technologies (ICT) in the main spaces that the student-teachers engage in, but also at how well these student-teachers have used and integrated the affordances of ICT in these spaces into their lives, and how some of these affordances overflow across spaces. It is a people-centric study, focusing on the interaction between the student-teachers and multiple environments they engage in, and the attitudes of the student-teachers towards ICT in these environments.

The three spaces that are studied in this paper are NIE, the schools the pre-service teachers go to for their practicum and their personal spaces, as these are the primary spaces that the pre-service teachers move in. The purpose of this study is to draw a more detailed, richer picture of how trainee teachers use technology and their experiences with it. This insight would help policy makers and stakeholders integrate the use of technology appropriately in teacher education. It could form the basis of more effective career screening and aptitude testing. It would also give valuable feedback to the institution's one-to-one laptop initiative.

Based on our main objective to examine pre-service teachers' technology experiences in a ubiquitous computing environment, this study addresses the following questions:

- 1) What personal computing devices do the pre-service teachers use or own?
- 2) How do they use technology in different stages of training and across different spaces?

## **2. Research design methodology**

The methodology used is a longitudinal case study. A case study method is adopted for this study to examine pre-service teachers' attitudes and experiences in a ubiquitous computing environment. A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context using multiple sources of evidence [14]. It has been

commonly used in different fields in social science and education is of no exception. Case study is a useful method to gain insight and interpretation rather than hypothesis testing [15]. It emphasizes on process and meanings and is undertaken to get a closer lens of investigation of a phenomenon to add dimension to what is already known through previous research. Three pre-service teachers (Steve, Kenneth and Nicole) from NIE voluntarily participated in this study over a one-year period. They were all pursuing their post-graduate diploma in education (PGDE) and have since graduated.

### **3. Context**

Pre-service teachers pursuing their PGDE in NIE have to go through a year-long training program. In the course of the training program, they have to undergo a ten-week long practicum (or teaching practice).

### **4. Data collection**

This case study adopts a “phenomenological inquiry” to “inductively and holistically understand human experience in context-specific settings” [16]. Areas of inquiry include examining how learners use laptop computers in the ubiquitous computing environment, and how this impacts their learning and teaching. Data collected included: (1) Reflective diary: A diary template was designed by the researchers, consisting of a table whereby the pre-service teachers recorded their technology usage pattern in terms of time and place, devices and applications used, and purpose; and an open response section whereby they reflected on their personal use of technology. (2) Interviews: Periodic interview sessions were held with the focus group. A semi-structured interview was employed at each session, as this offered a more flexible way to approach different participants while still focusing on the same area of data collection. The questions were designed to probe into the pre-service teachers’ perceptions, attitudes and use of technology. Each interview was about one hour long, and was recorded and transcribed.

### **5. Findings**

This section focuses on the findings of the three pre-service teachers in terms of their use of computing devices, usage and their attitudes towards ubiquitous computing technology.

#### *5.1 In NIE (as students)*

The student-teachers were each loaned a laptop from NIE. Some classrooms in NIE are also equipped with desktops and there is wireless Internet network all over the campus. NIE also has a team of IT support staff based in the school library. The student-teachers can approach them for assistance anytime.

Steve and Kenneth brought their laptops to NIE almost every day. Nicole would bring her laptop only when she needed to use it for a presentation or when an instructor made it compulsory to have a laptop in class.

Nicole described the laptop as ‘cumbersome and distracting’. She said she did not use it much in school as her classes were quite closely packed. When she needed a desktop, she would book one to use in the library. She also preferred to use the computer in the library as it is too slow to stream videos so she would focus only on her work. Describing her laptop as ‘distracting’ hints at some negativity in the way she perceives the laptop.

When in NIE, most of them used their laptops for doing their school assignments like preparing lesson plans, PowerPoint slides for presentations and surfing the Internet for resources and information. Steve also used his laptop to take down notes during lectures and tutorials. He feels typing is faster and it is easier to organize information on a computer. Once, he was challenged to make his presentation livelier, so he spent time learning how to use Flash. He described the process as ‘tiring and time-consuming’, but the end results were ‘satisfying and fulfilling’.

Nicole prefers to use the pen and paper to take down notes as the laptop takes time to start up and switch on. She believes that books are more credible than websites, are less stressful on the eyes, easily available, easy to read and flip, and holding a book feels ‘real’. To her, IT is very ‘exasperating’, especially when she has to deal with applications for the first time and has little time to explore how it can be used. She finds the huge amount of resources available online to be ‘confusing’.

When her fellow student-teachers simulated classroom lessons using IT, she felt there was generally no clear purpose or objectives for applying IT activities to their teaching. The lessons conducted by them were fun and creative but she felt no learning took place.

However, she likes chatting online for group projects because links can be sent and viewed immediately and a discussion can take place straightaway. She perceives ICT as something she has to learn as there is a lot of ‘hype surrounding it’.

Nicole transitioned between traditional methods of communication and technology-enabled methods of communication. She felt a need to embrace these new methods, but at the same time, she thought that the use of ICT took away communication as she knew and was familiar with, and this might have scared her so she tried to hold on to what she was familiar with as much as she could.

While Nicole saw new programs and tools as ‘exasperating and confusing’, Steve embraced them. This marked difference in attitude could be due to the difference in how comfortable they are on the whole using technology.

## *5.2 In their personal spaces*

On top of the laptops provided by NIE, Steve and Kenneth also have their own laptops. Nicole has a desktop at home. All of them carry mobile phones. Only Kenneth carries a smartphone. Nicole said she did not like to carry her mobile phone out with her as her mother would call her frequently and that annoyed her. Kenneth used his smartphone to access the Internet when he did not have his laptop with him.

In their personal spaces, e.g. home, their activities on their laptops are generally as follows - all of them checked emails, chatted online, played games, logged on to Facebook, watched videos online and movies. Additionally, Steve also edited his photographs and watched online

television, Nicole watched Japanese animation and read online comics, and Kenneth did graphic design. Their leisure activities on the laptop were mostly similar.

Steve said he is very comfortable with technology. He turns on his laptop the moment he gets home. He enjoys exploring new tools and applications. Kenneth mentioned he sometimes prefers chatting with his friends face-to-face as he said it feels more 'human'. Although Nicole stores her photographs digitally, she prefers having them printed out so she can 'hold and feel' them.

Kenneth and Steve brought their laptops with them on their holidays. Kenneth ended up not using his laptop as the first place he went to did not have free Internet access and said that taking a break from technology, especially the Internet, is very 'refreshing', although he felt 'lost'. The second place he went to had Internet cafes, which he visited. Steve used his laptop as a storing device for his photographs. He would surf the Internet only when there was free Internet access. He also played games on his laptop while overseas. Internet access among some of them is gathered to be a preference, but not a strong one, as they would only use it when it is offered for free (when they are overseas).

All of them, except Steve, said that they used their laptops less during the holidays. Their laptop usage is inconsistent during the school term and when they were on holiday, indicating that the laptop was more often used for work and it may not be well integrated in their personal lives.

### *5.3 In their practicum schools (as trainee teachers)*

All the schools did not provide the student-teachers with laptops. The student-teachers used the NIE laptop during their practicum.

Although all the schools had Internet connection in the staffrooms and in classrooms, Nicole and Steve faced problems with limited Internet access for various reasons. Nicole was told by her cooperating teacher not to use the LAN cables with her own laptop. This may be because quite often, personal computing gadgets are not sufficiently protected against viruses due to poor security implementation. The teachers in her school were strongly encouraged to bring their own wireless modem. The teachers in the school that Steve did his practicum in were told they could not use the wireless Internet access in the classrooms. Both Nicole and Steve were also not given access to the wireless networks of the respective schools they were posted to as they were trainee teachers. Not being granted full access to the schools' ICT facilities may have been a slight hindrance to the use of ICT in the classrooms. All the classrooms in the school Steve was at were equipped with computers and ActivBoards.

However, there were also some other issues pertaining to the ICT infrastructure of the schools that the student-teachers faced while doing their practicum.

For Nicole, projectors in the classrooms did not work well and there were problems with the VGA (video graphics array) cables and sockets. She ended up using the blackboard. Moreover, there were limited sets of visualizers in the school and the schools' laptops were very old so the document files had to be converted to a suitable format. There was generally not much technical support from the school.

Steve brought his own laptop to class but faced problems with displaying Chinese fonts accurately. He also found it troublesome to set up his laptop in the classroom. Teachers in the school were also not allowed to log on to certain websites, i.e. social networking sites.

During practicum, Kenneth brought in simulation, applets and videos for the classes as he believed it to be a hidden expectation for his practicum assessments. He used PowerPoint presentations and Civilization 4 to teach Physics. He also used TED and other social networking tools to engage his class in discussions outside classroom time. He did not think sending emails to his students was a good idea as he said many of them did not check their mailboxes. He believes a tablet PC would be very useful for teaching as he can write whatever he needs to on his tablet PC and send it to the students. This way, the information can be stored and used again at a later date. With the whiteboards, the information simply disappears when the board is erased. His smartphone also came in handy when he could not find his mobile presenter and used an application on his mobile phone to substitute a mobile presenter. Also, in his opinion, ICT should be used with students who are academically stronger and for students who are not as academically inclined. He said that going through the 'normal tutorial is good enough' for students who are less academically inclined as they take a longer time to grasp concepts.

Nicole used her laptop mostly for teaching-related matters as she said she had little time for 'non-teaching stuff'. In the classroom, she used PowerPoint presentations, videos, Wikipedia and crossword puzzles. She said they 'did not have time for too many creative lessons' as they had to finish covering the given syllabus. She said that there were time constraints as they were required to teach many things for the examinations and for that, she felt the most efficient method was frontal teaching. She thought PowerPoint presentations were good because they could be re-used. For her thirty-minute lessons, she also did not see the point in using her laptop as the laptop takes a while to start up.

Steve used PowerPoint presentations in the classroom and tried to bring in computer games and 'online stuff' for his Primary Five students. He said the classes were well-received. He did not do the same for his Primary Three class as he felt they were 'too young for that'. His belief about technology not being suitable for lower-ability students might be due to him attempting to force-fit ICT into traditional classroom methods and activities and these end up being ineffective as the introduction of ICT may have changed the dynamics of the traditional activities. He also used Flash to design a scoring program and a program for learning new Chinese words. He commented that Adobe Flash opens a lot of possibilities in designing teaching tools and new methodologies.

For their practicum, most of them tried to use other software and tools apart from PowerPoint presentations in their classroom teaching session, and found them to be rather useful. Nicole and Kenneth only did so because they felt pressured to or that it was a necessity. Although this is a form of adoption of laptop affordances, it is not a willing one. Steve is the only one who had gone to the extent of designing programs himself for his class and not just used whatever was available online.

## **6. Implications of the study**

Overall, there were some observations that stood out in the study. Kenneth and Nicole used ICT tools mostly on a need-to basis, and most of their ICT usage involved work. Secondly, Nicole's level of comfort with ICT tools did not seem to increase much with the increase in her level of familiarity with her ICT tools. This is contradictory to the results found in the study done by Resta, Abraham, Gerwels and Tothoro [17], which showed that after a year of forced implementation, the student-teachers' attitude towards ICT tools changed for the

better. Also, the student-teachers seem to only be scratching the surface of what ICT tools can be used for in the classrooms, and in their personal lives. The factors affecting the smooth transition of the laptops into their classroom session and their lives include the lack of ease and familiarity with ICT, and their general perceptions about laptops and ICT. Also, they were sometimes not able to effectively manipulate the tools to suit their needs, and as a result, they view the tools as ineffective.

Mostly, the student-teachers seem to view the ICT tools as objects to enhance, rather than as a main tool in itself.

## **7. Conclusion**

We live and work in an increasingly ubiquitous computing environment, and personal computing devices in education and learning have become more human-centered, less visible, and available to students whenever and wherever they need it [18], [19], [20]. The ubiquitous, 24/7 access to computers makes it possible for students to access a wide range of resources to support their learning, to communicate with peers and their teachers and to become adept in their use of the technological tools of the 21st century workplace. Today in most technologically advanced societies, it is not uncommon for people to own more than one computing device. Although an individual has more than one device, he/she would usually only use one device at a time, switching between different devices to serve different purposes. Seamless integration of technology happens when technology becomes a part of the student-teachers' lives, be it in NIE, their homes or in the schools they were posted to for their practicum. From the data above, it can be seen that generally, there seem to be a dissonance between the usage of laptops / desktops for work and for personal use among the student teachers.

Many of them see the computer mostly as a work tool and even when they employ it for personal utilization, many of them only use it for a limited set of activities and mostly do not seem interested in exploring much further than they have to.

According to Dwyer, Ringstaff and Sandholtz [21], teachers generally go through five stages in the process of incorporating the use of computers into their classrooms. The same model can be adapted and applied to gauge how well the student-teachers have adopted the affordances of ICT tools into their lives. From the data collected, Nicole seems to hover around stage two and Kenneth around stage three. Steve might qualify to be in stage five. This shows that there is still much room for improvement when it comes to using ICT devices.

## **8. Limitations of the study**

This study has a number of limitations. The key data was collected via self-reportage during interview sessions. Future studies could include personal observations or even "shadowing" of the pre-service teachers to achieve a greater in-depth study. Nevertheless, this case study serves as a complement to a quantitative self-reported impact study by the research team. This research adds to the growing body of knowledge about pre-service teachers and their attitudes towards ICT.

## References

- [1] Barron, A. E., Feyten, C. M., Venable, M., Hilbelink, A., Hogarty, K. Y., Kromrey, J. D., et al. (2008). Laptop computers in teacher preparation: Lessons learned from the University of South Florida implementation. *Journal of Computing in Higher Education*, 20(1), 95-117
- [2] Murray, O. T. & Zembal-Saul, C. (2009). Educate at Penn State: Preparing beginning teachers with powerful digital tools. *Journal of Computing in Higher Education*, 20 (2), 48-58.
- [3] Resta P., & Tothoro, M. *Establishing a ubiquitous computing environment for teacher preparation students and faculty: The University of Texas at Austin laptop initiative.*
- [4] Fullan, 1999. *Change forces: The sequel.* London: Falmer Press.
- [5] Resta, P. (Ed) (2002). *Information and communication technologies in teacher education: A planning guide.* Paris: United Nations Educational Scientific and Cultural Organization, Division of Higher Education.
- [6] Ministry of Education, Singapore (2008). Masterplan III for IT in Education. Retrieved May 1, 2009, from <http://www3.moe.edu.sg/edumall/mp3/mp3.htm>.
- [7] York, J. & Pendharkar, P.C. (2004). Human-computer interaction issues for mobile computing in a variable work context. *International Journal of Human-Computer Studies*, 60, 771-797
- [8] Bahr, D.L., Shaha, S.H., Farnsworth, B.J., Lewis, V.K. & Benson, L.F. (2004). Preparing Tomorrow's Teachers to Use Technology: Attitudinal Impacts of Technology-Supported Field Experience on Pre-Service Teacher Candidates. *Journal of Instructional Psychology*, 31(2), 88-97
- [9] Prensky, M. (2001). *Digital Natives, Digital Immigrants.* In *On the Horizon, October 2001*, 9(5). Lincoln: NCB University Press.
- [10] Chen, W., Lim, C. & Tan, A. (2010). Pre-Service Teachers' ICT Experiences and Competencies: New Generation of Teachers in Digital Age. Proceedings of the 18th International Conference on Computers in Education. Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education.
- [11] Bennet, S., Maton, K. & Kervin, L. (2008). The 'digital natives' debate: A critical view of the evidence. *British Journal of Education Technology*, 39(5), 775-786
- [12] Drazdowski, T. (2004). Laptop Lessons: A Case Study of the Perspectives of Professors and Preservice Teachers. In R. Ferdig et al. (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2004, 2123-2128. Chesapeake, VA: AACE.
- [13] Resta, P., Scott, C., Bin-Taleb, A. & Tothoro, M.L. (2006). Creating a Pervasive Computing Environment in Teacher Education: Differential Experiences and Perspectives of Preservice Teachers, Faculty, and Support Staff. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2006, 1754-1759. Chesapeake, VA: AACE.
- [14] Yin, R. K. (1989). *Case study research: design and methods.* Beverly Hills, CA, Sage.
- [15] Merriam, S. B. (1988). *Case study research in education.* San Francisco: Jossey Bass.
- [16] Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2ed). Newbury, CA: Sage.
- [17] Resta, P., Abraham, L., Gerwels, M.C. & Tothoro, M.L. (2004). Establishing a Ubiquitous Computing Environment for Teacher Preparation Students and Faculty: The University of Texas at Austin Laptop Initiative. In R. Ferdig et al. (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2004 (pp. 2570-2575). Chesapeake, VA: AACE.
- [18] Norris, C., & Soloway, E. (2004). Life in the handheld-centric classroom. Paper presented at the Annual Meeting of the World Conference on Educational Multimedia, Hypermedia & Telecommunications (Ed-Media), Lugano, Switzerland, June.
- [19] Roschelle, J., & Pea, R. (2002). A walk on the WILD side: How wireless handhelds may change computer-supported collaborative learning. *International Journal of Cognition and Technology*, 1(1), 145-168.
- [20] van 't Hooft, M., & Swan, K. (2007). What is ubiquitous computing? In M. van 't Hooft & K. Swan (Eds.), *Ubiquitous computing in education: Invisible technology, visible impact* (pp. 3-17). Mahwah, NJ: Erlbaum.
- [21] 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.