

Pre-Service Teachers' ICT Experiences and Competencies: New Generation of Teachers in Digital Age

Wenli CHEN, Carolyn LIM & Ashley TAN

National Institute of Education, Nanyang Technological University, Singapore
wenli.chen@nie.edu.sg

Abstract: This study is to gather baseline data on the technology experiences and competencies of the new generation of pre-service teachers who were born after 1980. This paper presents findings from a survey study conducted in 2009 with 1554 young pre-service teachers in Singapore. The results show that ICT permeates all aspects of the new generation of pre-service teachers' lives. It is found that they own the mainstream ICT devices (such as desktop and laptop computers) and they are comfortable with a core set of ICT applications but have less access to emerging devices (such as smartphone, PMP) and are less comfortable with specialised technologies. Student use of ICT and competency with emerging technologies is far from universal. Only a minority of the students are engaged in content creation activities using multimedia tools. There is a gap between their everyday ICT skills and the skills of ICT for teaching and learning. The findings are discussed in light of Prensky's notions of the 'Digital Natives'. The implications for using technology to support teaching and learning in teacher education are discussed.

Keywords: digital immigrant, digital literacy, digital native, ICT competency, teacher education

Introduction

The rapid development of Information Communication Technology (ICT) affects the way in which people, largely the younger generation, interact, socialize and work. ICT skills and knowledge have been considered as the core literacy which students need to possess for the 21st century. The new generation of students born roughly after 1980 is considered to be "Digital Natives" who are fundamentally different from previous generation [1]. "They've had digital technology surrounding them from the time they were infants. ...That digital world affords them many things that the previous world didn't."

In the past decade, there has been a considerable amount of discussion on "Digital Natives". The main argument is that the digital culture in which the Digital Natives have grown up has influenced their preferences and skills in a number of key areas related to education (see [2], [3], [4], [5]). Digital Natives are said to prefer receiving information quickly; be adept at processing information rapidly; prefer multi-tasking and non-linear access to information; have a low tolerance for lectures; prefer active rather than passive learning; and rely heavily on communication technologies to access information and to carry out social and professional interactions [1], [2], [4], [6], [7], [8], [9].

Given that teachers have tremendous potential to affect the beliefs and values of the students, it is important to understand teachers' ICT experiences and competencies. Teachers need to adjust their pedagogical models to suit the new kind of learner they are encountering in this

new generation of students [1], [2], [7]. Some researchers expressed concern at the lack of technological literacy among teachers who are labeled as “Digital Immigrants” - foreigners in the digital lands of the Net Generation, and regarded the disparity between the Natives and the Immigrants as the “the biggest single problem facing education today” [1, p. 2].

To ensure that teachers are able to integrate technology into the curriculum to better engage the Digital natives, the groundwork must be laid at the pre-service teacher's level. A decade has passed since Prensky first coined the term Digital Natives. In recent years, many “Digital Natives” have grown up and become pre-service teachers. This new generation of pre-service teachers could be different from previous generation of teachers. Are these new generation pre-service teachers who were born after 1980 “Digital Natives” or “Digital Immigrants”? Do they have universal sophisticated ICT knowledge and skills?

So far little empirical research has been published on ICT experiences and competencies of this new generation of pre-service teachers (born after 1980). The “Digital Natives” issue for the new generation pre-service teacher is far from clear. This study focuses on the new generation Singapore pre-service teachers’ ICT experiences and competencies. Since 1997, the Singapore Ministry of Education (MOE) implemented three Masterplans for IT in Education [10], [11], [12] to prepare students for the knowledge economy in the 21st century. To prepare teachers for better integration of ICT in teaching, MOE and the National Institute of Education (NIE) Singapore weaved ICT pedagogical training into the pre-service and in-service teacher training. With the ever changing and often diverse characteristics of the pre-service teacher cohorts, understanding who they are is an important factor in knowing how to enhance the learning experiences of new generation teachers through the use of technology. The aim of this study is 1) to investigate the new generation pre-service teachers’ access to and use of an array of ICT devices and applications, 2) to examine their competencies of ICT applications for daily use and for teaching and learning. The three research questions of the study are:

1. What is the overall profile of pre-service teachers' experiences with ICT?
2. What are the pre-service teachers' competencies towards ICT for daily use?
3. What are the pre-service teachers' competencies towards ICT for teaching and learning?

2. Method

2.1.1 Sample

The participants in this research were first year pre-service teachers who were commencing their studies at the National Institute of Education (NIE) Singapore in July 2009, and were eligible to receive a laptop loan from NIE. 2278 students were eligible, and of these, 1886 students opted to take up the laptop loan. These 1886 students were the study population. When the pre-service teachers went to collect their laptops, they were invited to take the online survey on the spot. In total, 1787 pre-service teachers completed the questionnaire. The response rate is 94%, which is 78.5% of the July 2009 intake of students eligible for the laptop loan at the institution. This study focuses on pre-service teachers age 30 and below. There are 1554 pre-service teachers age 30 and below, which accounts for 87% of the survey respondents. Among these pre-service teacher respondents, 280 (18%) are under 25 years, 987 (64%) are from 21 to 25 years, and 287 (18%) are from 26 to 30 years. 447 (29%) are enrolled in the 4-year Undergraduate teaching degree programme (for those who hold either GCE 'A' Levels or polytechnic diplomas), 815 (52%) are enrolled in the one year Postgraduate Diploma in Education (for those who hold at least a Bachelor's degree), and 292 (19%) are enrolled in the 1-year Diploma in Education programme (for those who hold

either GCE 'A' Levels or polytechnic diplomas). The population includes more females (71%) than males (29%). 1125 (72%) are Chinese, 229 (15%) are Malay and 133 (9%) are Indian. More than half (52%) have some sort of working experience.

The respondents were asked about at what age they started using computers. About half (52%) started using computers at the age of 11-15 years, 1/3 started using computers at the age of 6-10 years, 13% started using computer at the age of 16-20. 2% started using computers even below 5 years old. A very low percentage (0.5%) of pre-service teachers started use computer from 21 years onwards.

2.2 Instrument - questionnaire

A questionnaire, developed specifically for this study, asked students about their access to, use of, and skills with an array of established and emerging technologies and technology based tools and their attitudes towards ICT for teaching and learning. The questionnaire has been validated by more than 120 pre-service teachers in the July 2008 cohort. The questionnaire comprised four main sections:

1. Demographic information (including gender, race, nationality, age, education level, programme enrolled, curriculum subjects, previous working experience etc)
2. The ownership and experiences of a range of ICT devices (e.g., desktop, notebook, netbook, smartphone, Portable Media Player (PMP) and game console). The computer experience in this study was measured by asking the participants "how often do you use a computer?" and "On average, how many hours do you spend on the computer on a typical day?"
3. The use of ICT applications/tools. This was measured by asking "How many hours do you spend in a week to use the following applications/tools?"
4. The competency with ICT applications/tools. The perceived competency was measured by asking "How do you rate your skill level for each of the following applications/tools?" with responses on a 4-point scale where 1= I have never used this, and 4 = I am able to teach this to others"

2.3 Procedure

Data was collected during August and September 2009 when the students collected their laptops at the computing department. All the students who took the laptop loan were invited to participate in the study. The survey was on a voluntary basis and no course credits were given for participation. Twenty desktop computers were provided at the notebook collection site with the online survey URL at the front page of the computer. At all occasions, a member of the research team was present throughout the data collection process. The researcher firstly briefed pre-service teachers about the project and informed them that participation was voluntary and confidential. They were told that they could withdraw their participation during or after the data collection. They were informed that they could ask the researcher if they have a query when filling in the questionnaire. Then the students used the desktop or their newly acquired laptop computers to go to the online survey URL to complete the survey. On average, students took about 15 minutes to complete the survey questionnaire.

3. Findings

3.1 Ownership and usage of ICT devices

Table 1 shows the results of the access to ICT devices. Among the 1554 new-generation pre-service teachers who participated in the survey study, most commonly a moderate to high proportion have access to the mainstream ICT devices. The vast majority (n=1336, 86%) have laptops before coming to the institution to study, and more than half (n=875, 56%) have desktops at home. Additional analyses show that 43% (n=667) have access to both a desktop and a laptop computer while only 0.6 % of students (n=10) have access to neither. Less than 10% (n=118, 8%) have access to a netbook computer. It is interesting that most of the netbook users (n=92) have a laptop as well. For those who have laptops, about 47% carry their laptops with them 1-2 times a week, 18% carry laptops 3-4 times a week, 4% carry laptops 3-4 times a week and less than 5% carry their laptops everyday. About ¼ of them never take the laptop out of their homes.

Table 1. Ownership of ICT devices (N = 1554)

	Freq	%
Desktop	875	56.3
Laptop	1336	86
Netbook	118	7.6
Ultra Mobile PC	20	1.3
Game Console	408	26.3
Portable Multimedia Player (PMP)	795	51.2
Smartphone/PDA	665	42.8

As for the emerging handheld mobile technologies, while the access to mobile phones is universal, less than half (n=665, 43%) have smartphones. Half of them have portable multimedia player (PMP) (n=795, 51%). About ¼ (n=408, 26%) have handheld gaming console. Additional analyses show that about ¾ of pre-service teachers have one other type of mobile device besides the mobile phone. Around 10% (n=146) of the pre-service teachers have all mobiles device types including laptop, smartphone, game console and portable multimedia player, and they carry multiple devices with them all the time. These ICT devices are nearly ubiquitous with this group of pre-service teachers.

When asked about “How many hours do you spend on the ICT devices on a typical day”, about ¼ of the pre-service teachers reported that they spent less than 3 hours, about 1/3 of them spent 3-5 hours, ¼ of them spent 5-7 hours, 14% spent 7-11 hours, 5% spent even more than 11 hours on the devices per day. Those who spent a high amount of time on the ICT devices are roughly the same group of pre-service teachers who own many different ICT devices.

3.2 Usage of ICT applications

The pre-service teachers were asked how long they spend in a week using ICT applications, and the results are presented in Table 2. In general, many pre-service teachers surveyed in this study are 'tech-savvy' and incorporate a range of traditional and emerging technologies in their daily lives. However, areas clearly exist where the use of ICT applications is far from universal or uniform among the new generation of pre-service teachers.

Table 2. Usage and skills of different ICT applications (N=1554)

		Adoption (%)	Time spent in a week within those who use it (Hours)		Skills (1 = do not know how to use it, 4 = can teach others how to use it)	
			Mean	SD	Mean	SD
Communication/ Networking	Send & receive emails	100	2.03	1.991	3.73	.472
	Chat online	95	3.35	2.630	3.67	.523
	Social networking website	95	3.10	2.475	3.45	.674
	Participate in message boards	57	1.42	1.368	2.95	.897
Media Consumption	Watch videos/ videocasts	96	4.24	2.075	3.57	.554
	Listen to music / audio podcasts	91	3.75	1.926	3.52	.606
	Read online news	83	1.71	1.712	3.38	.706
	Use RSS	21	1.48	.968	1.67	.960
	Social booking marking/tagging	14	1.16	.653	1.50	.851
Content Creation	Write blogs/ microblogs	53	1.73	1.531	2.54	1.102
	Create graphics	34	1.67	1.310	1.94	.980
	Create or edit wiki	34	1.25	.955	1.80	.903
	Design websites	23	1.56	1.060	1.84	.969
	Produce videos	19	1.38	.870	1.72	.956
	Create online mindmap	18	1.09	.639	1.58	.858
	Produce audio podcasts	11	1.36	.669	1.53	.869
Others	Search information online	99	3.17	2.304	3.59	.578
	Use productivity tools	98	3.42	2.327	3.41	.648
	Shop online	59	1.84	1.668	2.95	1.005
	Maintain online photo album	41	1.53	1.321	2.39	1.095
	Play online games	48	2.05	1.796	2.38	1.907
	Participate in multi-user virtual environment	14	1.79	.938	1.62	.956

As shown in Table 2, more than 90% of pre-service teachers use core ICT applications such as email, chatting, social networking, watching video, listening to music, searching information online and using productivity tools. However, the adoption rate of other specialised technologies is lower. Many ICT tools were not used by a substantial proportion of pre-service teachers. Moreover, for a number of emerging technologies, the proportion of students who have never used a particular application outstripped those who had (e.g. create a website (23% vs 77%), create graphics (34% vs 66%), create/edit wiki (34% vs 66%) and online mindmap (18% vs 82%), produce video (19% vs 81%) and audio podcasting (11% vs 89%), use RSS feeds (21% vs 79%) and social bookmarking/tagging (14% vs 86%), maintain online photo album (41% vs 59%), participate in multi-user virtual environment (14% vs 86%)).

Examination of the usage of different applications shows a pattern that pre-service teachers use ICT for media consumption intensively. More than 80% of pre-service teachers use media consumption tools such as video, audio, podcasting and online news. Among those who use media consumption applications, on a typical week, they spent 4.2 hours watching videos, 3.8 hours listening to music and 1.7 hours reading online news.

A high percentage of pre-service teachers use ICT for communication and social networking. Among those who use the communication applications, on a typical week, they spent 2 hours sending and receiving emails, 3.4 hour chatting online, 3.1 hours on social networking websites, and 1.4 hours participating on message boards. A comparatively lower percentage of pre-service teachers use ICT applications for content creation. Slightly

more than half write blogs/microblogs. Less than 1/3 create or edit a wiki, design websites, create graphics, or produce videos. Those who use the content creation applications spent less than 2 hours per week on content creation activities.

3.3 ICT Competency

The pre-service teachers were asked about their perceived competency with ICT applications. The results in Table 2 show that they perceive themselves as comfortable and capable with the core technology applications such as email (mean = 3.73), chatting (mean = 3.67), networking (mean = 3.45), watching video (mean = 3.57), listening to music (mean = 3.52), reading online news (mean = 3.38), searching information online (mean = 3.59) and using productivity tools (mean = 3.41). A majority of them are very tech savvy with different media tools in that they can teach others how to use computers to watch videos, read online news, and listen to music.

The results show that pre-service teachers perceived themselves as competent in using ICT applications for communication/networking and media consumption. However, they perceived themselves as less comfortable with the emergent applications related to content creation. A majority of them are unfamiliar with creating or editing digital images, audio and video files (mean < 2).

3.4 Competency in using ICT for teaching

Since these pre-service teachers will influence future generations of students, we obtain the baseline data on their competency in using ICT for teaching. Results are shown in Table 3.

Table 3. Skills in using ICT for teaching

	Mean	SD
Create online assessments, quizzes & activities	1.80	.862
Use learning management systems for teaching	2.20	.925
Use presentation software for instruction	3.32	.643
Create a learning environment using Web2.0	2.57	.970
Use online resources to prepare lessons	2.79	.858
Create lessons using videos	2.24	.997
Create lessons using podcasts	1.61	.832
Incorporate online games in lessons	1.77	.886
Use live conferencing platforms to manage projects	1.36	.677
Use storyboarding or comic creation tool in curriculum	1.40	.716
Use virtual learning environments in schools	1.44	.741
Use email to communicate with students	3.10	.935
Create digital portfolios	1.73	.930

Table 3 shows that pre-service teachers are very familiar with presentation software (mean = 3.29, SD = .660) and communication tools (mean = 3.08, SD = .934) for teaching. They tend to be unfamiliar with storyboarding/comics creation tools, virtual learning and conferencing platforms (over 70% have not used these tools). Apparently the pre-service teachers' perceived ICT competency for teaching is lower than their perceived ICT competency for everyday use. The pre-service teachers are not yet ready for effective integration of ICT for teaching. This is understandable as they have just commenced their teacher training when they participated in the survey.

4. Conclusion and Discussion

This study investigates the new generation pre-service teachers' ownership of, uses of and competency with a range of ICT devices and applications. Overall, the participants have good access to mainstream ICT devices such as desktop and laptop computers. ICT permeates all aspects of their lives. They have a high level of usage of the core set of ICT applications, which could be attributed to the technology emphasis given to the pre-service teachers at various stages of their education. This had taken place prior to the participants enrolling in the teacher training program. This young generation of pre-service teachers has been through the *MasterPlans*. Chronologically, they would have benefited from the goals of the *MasterPlans* in ways that may have shaped their computer access/ownership, uses and competency in a positive way. However, when one moves beyond the basic computer device and the core set of ICT applications, the patterns of access/ownership, use of and competency with a range of other emerging ICT applications show considerable variation. The core ICT application skills do not necessarily translate into sophisticated skills with other applications.

The pre-service teachers make intensive use of ICT for media consumption, communication, information searching, and productivity tools. A low percentage of pre-service teachers perform content creation activities. While some pre-service teachers have embraced the technologies and tools as the "Digital Natives", this is by no means the universal pre-service teacher experience. The results of this study highlight the lack of homogeneity in young pre-service teachers with regards to ICT and a potential "digital divide" between them. This finding echoes Caruso and Kvavik's [13] finding that while the majority of university students possess a core set of technology based skills, beyond those a diverse range of skills exist across the student population. It is clear that there is a more complex mix of technology experiences and skills among the young generation of pre-service teachers.

The final set of analyses in this study assessed the pre-service teachers' competency in using ICT for teaching and learning. ICT can *enable* new forms of teaching and learning to take place, they cannot *ensure* that effective and appropriate learning outcomes are achieved. It is not technologies, but educational purposes and pedagogy, which makes the use of ICT for teaching and learning more meaningful. This study found that a gap exists between pre-service teachers' everyday ICT competency and that of ICT for teaching and learning. They embrace technologies for non-educational purposes intensively but they may not have the expertise to judge how to best use ICT for educational purposes. The transfer from a social or entertainment technology to a learning technology is neither automatic nor guaranteed [14], [15]. This study suggests a need for teacher educators to provide a conducive and non-threatening environment for pre-service teachers to experience success in ICT for teaching and learning.

An evidence-based understanding of pre-service teachers' technological experiences and competencies is vital in informing education policy and practice. This study has significant implications for the Singapore teacher education sector. The findings run counter to key assumptions underpinning Prensky's [1] construct of the Digital Natives. The findings show that the new generation pre-service teachers do not have universal and uniform technology experiences and competencies. Not all the new generation pre-service teachers are digital natives with a sophisticated knowledge and understanding of ICT. It comprises a highly diverse pre-service teachers body with a wide variety of information literacy capabilities. Given this diversity within a single cohort of pre-service teachers, the challenge is how to cater for the broad range in students' levels of access to, usage and familiarity with, different ICT devices and applications. This study clearly provides sufficient evidence to negate the 'one size fits all' approach to the integration of ICT into teacher education curricula.

Certain limitations exist in this study. The data was collected using a cross-sectional, single administration design, and it was not possible to establish the stability of the technology experiences and competencies of the participants. The investigation reported in this paper would have benefited from more in depth, qualitative investigation of pre-service teachers' perspectives on technology. Future studies could include a systematic examination of all aspects of pre-service teacher experiences with ICT devices and applications. Also, more attention could be paid to the way in which their technology experiences impact competence in technology integration for teaching and learning. Finally, future studies could assess if and how the pre-service teachers' learning abilities and teaching competencies are correlated with their mastery of technology.

Acknowledgements

We wish to thank the staff of the Centre for User Support (CUS), NIE, for their help in the administration of the survey.

References

- [1] Prensky, M. (2001a). Digital Natives, Digital Immigrants. *On the Horizon*, 9(5), 1-6.
- [2] Oblinger, D. (2003). Boomers, Gen-Xers and Millennials: Understanding the new students. *EDUCAUSE Review*, July/August, 37-47.
- [3] Oblinger, D. (2006). Listening to what we're seeing. Keynote Paper presented at ALT-C 2006. Retrieved November 8, 2009, from http://www.cic.org/conferences_events/caos/2006_CAO_Resources/2006CAO_oblinger2.pdf.
- [4] Gros, B. (2003). The impact of digital games in education. *First Monday*, 8(7). Retrieved February 21, 2007, from http://www.firstmonday.org/issues/issue8_7/xyzgros/index.html.
- [5] Gibbons, S. (2007). Redefining the roles of information professionals in higher education to engage the Net generation. Keynote Paper presented at Educause Australasia 2007. Retrieved August 12, 2009, from http://www.caudit.edu.au/educauseaustralasia07/authors_papers/Gibbons2.pdf.
- [6] Prensky, M. (2001b). Digital Natives, Digital Immigrants, Part II. Do they really think differently? *On the Horizon*, 9(6), 1-6.
- [7] Frand, J. (2000). The information-age mindset: Changes in students and implications for higher education. *EDUCAUSE Review*, September-October, 15-24.
- [8] Oblinger, D. & Oblinger, J. (2005). Is it age or IT: First steps towards understanding the net generation. In D.Oblinger & J. Oblinger (Eds.), *Educating the Net Generation* (pp. 2.1-2.20). Boulder, CO: EDUCAUSE. Retrieved March 31, 2010, from <http://www.educause.edu/educatingthenetgen>.
- [9] Tapscott, D. (1999). Educating the Net Generation. *Educational Leadership*, 56(5), 6-11.
- [10] Ministry of Education (1997). MasterPlan for information technology. Singapore: Ministry of Education.
- [11] Ministry of Education, Singapore (2006). Overview of the Masterplan for IT in education. Retrieved March 15, 2007, from <http://www.moe.edu.sg/edumall/mp2/mp2.htm>.
- [12] 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>.
- [13] Caruso, J. B. & Kvavik, R. (2005). *ECAR study of students and information technology 2005: Convenience, connection, control, and learning*. EDUCAUSE. Retrieved January 15, 2010, from <http://connect.educause.edu/Library/ECAR/ECARStudyofStudentsandInf/41159>.
- [14] Kirkwood, A. & Price, L. (2005). Learners and learning in the 21st century: What do we know about students' attitudes and experiences of ICT that will help us design courses? *Studies in Higher Education*, 30(3), 257-274.
- [15] Katz, R. (2005). Foreword: Growing up digital. In J. B. Caruso & R. Kvavik (Eds.), *ECAR study of students and information technology, 2005: Convenience, connection, control, and learning*. EDUCAUSE. Retrieved January 15, 2010, from <http://connect.educause.edu/Library/ECAR/ECARStudyofStudentsandInf/41159>.