EAI Endorsed Transactions
on e-Learning

Research Article ICST.ORG

Pre-service Teachers' Perspectives on One-to-one Computing: A Mixed Method Study

D. Xiao[1] and W.F. Chen[2,*]

[1]The University at Albany, State University of New York, 1400 Washington Ave., Albany, NY 12222, USA
[2]The Pennsylvania State University, Information Sciences and Technology, Lehman, PA 18627, USA

Abstract

This study aims at exploring pre-service teachers' perspectives on one-to-one (1:1) computing in teaching and learning. It gathered data regarding various aspects of 1:1 computing from 145 pre-service teachers at a public university in USA. Both quantitative and qualitative methods were applied in data analysis. Findings show that pre-service teachers consider the use of 1:1 computing in the classroom changes interactions between instructors and students. The positive influence includes enhanced communication and providing medium for presenting materials. Significant difference was found in time spent using 1:1 computing in varied types of settings ($F(3,576)=37.70$, $p<.05$). In addition, pre-service teachers believe that technology can influence teaching in a positive way; the use of 1:1 computing increases engagement and facilitates knowledge transfer.

Keywords: one-to-one computing, ubiquitous computing, mixed method, pre-service teachers, K-12, e-learning.
Received on 14 November 2014, accepted on 22 May 2014, published on 2 December 2014
Copyright © D. Xiao and W.F. Chen, licensed to ICST. This is an open access article distributed under the terms of the Creative Commons Attribution licence (http://creativecommons.org/licenses/by/3.0/), which permits unlimited use, distribution and reproduction in any medium so long as the original work is properly cited.
doi: 10.4108/el.1.4.e2

1. Introduction

One-to-one (1:1) computing in education is an active learning environment in which students take control of computing devices (wireless laptops or tablets, Internet, software, etc.) in classrooms so that the students can learn anytime and anywhere. Researchers found that teachers in 1:1 computing classrooms created student-centred instruction and provided students with opportunities to engage in higher-order thinking [1]. With access to emerging technologies, 1:1 learning environment is changing from a traditional teacher-centred one to a student-centred one. Wireless laptops were perceived as they enhance student-centred, hands-on, and exploratory learning [2].

During the two decades after the mid-1990s, 1:1 computing and the concept of ubiquitous computing had become a noticeable, widely spread trend in both K-12 and higher education settings in the USA and other countries. O'Dwyer, Russell, Bebell, and Tucker-Seeley [3] indicated that administrative support was a strong predictor of teachers' computer use. Successful implementation depends on the extent to which the organization supports the innovation [4]. Many researchers indicated that a significant factor affecting the implementation of 1:1 computing was teachers' willingness to accept changes and invest their time [5-6]. Teacher's professional training is also essential [7-8].

As to the effect of 1:1 computing on students' achievement and subject learning, there were limited results indicating that students' achievement increased due to the integration of 1:1 computing [9]. A number of studies have focused on the relationship between student achievement and participation in 1:1 programs [7]. Gulek and Demirtas [8] examined test scores between students participating and not participating in a 1:1 laptop program. Significant differences in both Math and English Language Arts test scores were found. However, other researchers found that the use of portable computers had a positive effect on students' science achievement, but it did not have a positive effect on English or Math achievements [11]. Zucker [9] focused on Math and science instruction and did not address language arts or social science. They found that students effectively utilized digital technology for high school physics.

Despite the above growing interest in 1:1 computing, there has been a lack of studies providing deeper exploration of the impact of 1:1 computing on students' learning as well as the changes and possible transformation 1:1 computing brings about in teaching and learning. Therefore, this study explores the experiences, behaviors, and shared culture of pre-service teachers in 1:1 computing teaching and learning environments.

*Corresponding author. Email:weifan@psu.edu

2. The Survey

The purpose of this study was to gather information from pre-service teachers regarding their perceptions of 1:1 computing in teaching and learning. An online survey was designed to achieve the purpose. The survey had 28 open- and close-ended questions that explored the following topics related to their experience of 1:1 computing: (1) time spent using 1:1 computing, (2) the way that 1:1 computing changes pre-service teachers' view on teaching, (3) the role of 1:1 computing in learning outside of school, (4) the way that 1:1 computing changes the dynamic between instructors and students, (5) the impact of 1:1 computing on pre-service teachers' engagement and knowledge-transfer. The 28 questions included 9 rating-scale and Likert scale questions, 4 open-ended questions, 7 yes/no questions, and 8 multiple choice and descriptive questions.

One hundred forty-five pre-service teachers participated in the study. The participants were education majors in the college of education at a public university in USA. The majority of the participants had a moderate amount of teaching experience. They were comfortable when using laptop computers in the classroom.

The participants were directed to a URL with the survey in one of their classes. They completed the survey during times allocated by the researchers and class instructors. All respondents answered virtually every question, except the 4 open-ended items, where the response rate varied such as 51% for question 4, 76% for question 5, 68% for question 23, and 14% for question 19.

3. Data Collection and Analysis

This paper reports on the results of the survey questions and examines the following research questions: (1) does the use of 1:1 computing change pre-service teachers' learning and how? (2) does the use of 1:1 computing change pre-service teachers' perspectives in teaching and learning and how? The "mixed methods research" model [10] is employed by using both quantitative and qualitative methodologies in the analysis and interpretation of the pre-service teachers' responses to the online survey.

3.1. Analysis of close-ended questions

Both quantitative and qualitative data analysis methods are applied to the responses to the 10 close-ended questions, which include rating scale and Likert scale questions, multiple choices, and yes/no questions. Basic analyses are conducted for all quantitative data. Analyses include both descriptive and inferential statistics. Responses to 3 out of the 10 questions are exposed to ANOVA to sort out the result of one aspect that addresses the research questions.

3.2. Analysis of open-ended questions

Qualitative data, especially for pre-service teachers' responses to open-ended questions, are systematically reviewed and coded for content. This study adopts a phenomenological analysis approach. The 2 open-ended questions include: Question 4, in what ways has your view of teaching been altered? Question 23; please provide an example of a change in the dynamic between you and your instructor. Codes are developed from the responses to the open ended questions and aggregated into overall themes related to 1:1 computing. While analyzing the data, special attention is paid to frequency of occurrence, consistency of data, countervailing findings, and relevance to the research questions. Reflective notes and memos are taken during the analysis process. Verification is achieved by confirmation of different researchers, just as what Creswell [12] suggests for verification in phenomenology study. The authors required two other researchers to synthesize the responses to the 2 open-ended questions and also carry out the qualitative analysis. Each researcher read the pre-service teachers' answers, classified each response. Based on these reviews, each researcher articulates interpretations reflecting on the pre-service teachers' views on the 2 questions. After discussion, the code is revised to develop themes.

3.3. The scheme of analysing survey responses in relation to research questions

The 28 survey questions and responses are analyzed and grouped into five aspects to answer the research questions. The five aspects are: (1) time spent using 1:1 computing, (2) the way that 1:1 computing changes pre-service teachers' view on teaching, (3) the role of 1:1 computing in learning outside of school, (4) the way that 1:1 computing changes the dynamic between instructors and students, and (5) the impact of 1:1 computing on pre-service teachers' engagement and knowledge transfer.

4. Results and Discussions

4.1. Time spent using 1:1 computing

The time pre-service teachers' spent using 1:1 computing for class activities and non-class activities was measured by a rating scale of ten categories from 10% to 100% of class time. An average of 59.03% of class time spent on class activities and 54.90% spent on non-class activities were found. The time pre-service teachers spent using 1:1 computing per day was measured by a rating scale of ten categories of one to ten hours per day. An average of 4.8 hours per day was reported spent using 1:1 computing, with a median of 4.0 hours. The time pre-service teachers spent using 1:1 computing per week was measured by a

rating scale of six categories of 2-5, 5-9, to 26 hours and above a day. An average of somewhere between 15-20 and 20-25 hours per week was reported spent using 1:1 computing a week for school, work, and personal activities, with a median of 20-25 hours.

To understand how frequently pre-service teachers used 1:1 computing both in and out of school and for both academic and personal use, one-way ANOVA was applied to analyze the above data examining the following question: is the portion of time pre-service teachers spent using 1:1 computing different from (1) class activities in class, (2) non-class activities in class, (3) course assignment daily, and (4) school, work, and personal use weekly? To analyze this question, data obtained through questions 7, 8, and 9 were converted into a 5 point Likert scale (where "1" represents "rarely" and "5" represents "constantly") and were treated as interval data. The results of the ANOVA indicate significant difference found in time spent using 1:1 computing when examined by four varied settings [$F(3,576) = 37.70$, $p < .05$]. Post-hoc comparisons using the Tukey HSD test show that significant difference was found among time spent using 1:1. However, there is no significant difference found among time spent using 1:1 computing for class activities and non-class activities ($p=0.433$) and for non-class activities and daily for course assignment ($p=0.059$).

The result indicated that 1:1 computing was frequently used in and out of school. However, time was not evenly spent for school and personal lives; this was indicated by the ANOVA and post-hoc tests. Half of the class time was spent using 1:1 computing and was spent almost evenly for class activities and non-class activities. Although pre-service teachers used 1:1 computing frequently for course assignments, they might use it more frequently for work, non-academic, and personal purpose. 1:1 computing became an integrated and important part of pre-service teachers' lives in and out of school. This result echoed with the findings from Kathryn Holleque's survey at the Valley City State University. Results from Holleque's research [11] showed 78% of students using their computers at least four or more times a day for a variety of academic and personal uses, with an 13% using them at least three times daily.

4.2. The way 1:1 computing changes pre-service teachers' view on teaching

When asked whether using 1:1 computing altered pre-service teachers' perspectives on teaching, 57 participants (39%) answered "it has" and 88 (61%) answered "it has not". The participants' responses to the open-ended question: "what ways has your view of teaching been altered?" consisted of 51 statements. The responses were content analyzed and five main categories were found. The participants' views of teaching that had been altered included: incorporate technology into teaching (24/51), create project and present information (7/51), provide tools (11/51), transform teaching (6/51), and positive and negative evaluations (3/51). "Incorporate technology into teaching" received the highest percentage of the participants' responses.

In our study, 39% of the participants considered that 1:1 computing altered their perspectives on teaching. Content analysis revealed that 1:1 computing changed their views about teaching mainly in two aspects: (1) they realized that technology had a positive impact on teaching and were more willing to incorporate technology in teaching, and (2) they saw themselves more effectively in utilizing tools for different instructional purposes. This result was in accordance with Kay's findings [14] in exploring the benefits and challenges of using laptop computers in higher education classrooms. In their study, data reported by participants in laptop-based classes reflected instructors' attempts to incorporate laptops into instruction by using various applications such as online surveys, Web-based searches, videos, and online materials.

The result of our study was echoed in Jones' findings [15] in evaluating a national laptop initiative among New Zealand teachers. In their study, teachers found laptop with multimedia capability allowed them to make more use of visual materials and promoted students' understanding and interest. Our results also parallel the findings from Allsopp's [16] survey that examined perceptions of integrating technology in a teacher education program. The result of the survey suggested that pre-service teachers' self-perception of their ability to use technology for teaching increased.

In addition, Barron [1] found that pre-service teachers felt they would be better teachers as a result of their experience in laptop initiative in teacher preparation at the University of South Florida. The result was consistent with Barak's [2] findings on students' perceptions of laptop use in teaching. In the study, students perceived laptops as useful cognitive tools, because laptops facilitated understanding of learning materials and abstract concepts by enabling exploratory learning via Web and visualization. Another study [17] focusing on integrating laptops in the professional development of science teachers in Israel also found that introducing laptops in teachers' professional development changed teaching methods, brought about a shift from teacher-centred teaching to student-centred teaching.

4.3. 1:1 computing outside of school

The participants in our study were asked whether the computer skills acquired for courses added novelty, enjoyment, and creativity in computer use outside of school. "Novelty", "enjoyment", and "creativity" were measured separately using a rating scale of ten categories from 0 to 100 where 0 represents "rarely", 50 represents "frequently", and 100 represents "constantly". For "Novelty", the mean score was 38.15 with a standard deviation of 22.46; for "enjoyment", the mean score was 46.94 with a standard deviation of 25.22; for "creativity",

the mean score was 51.17 with a standard deviation of 24.89. The participants were also asked whether they thought 1:1 computing played an important role in learning outside of school. 144 participants answered the questions with a majority of 139 answering "yes".

Although almost all the participants in our study considered 1:1 computing played an important role in learning outside of school, they did not think laptop skills acquired for courses added much novelty, enjoyment, or creativity in computer use outside of school. This was probably because computer skills acquired for courses were not used outside of school for activities that were perceived by students as enjoyable, novel, or creative. However, participants' view on 1:1 computing outside of school was consistent with Eriksson's [18] study of students' use of laptop in the University of Lapland in Finland. That study took a further step in exploring the flexibility and effectiveness brought about by laptops in learning outside of class.

4.4. The way 1:1 computing changes the dynamic between instructors and students

The participants thought that 1:1 computing changed the dynamic between students and instructors in the classroom. Among the 144 responses, 78 (56%) was "yes" and 62 (44%) was "no". Participants' responses to the open-ended question, "please provide an example of a change in the dynamic between you and your instructor", consisted of 68 statements, 35 of which were negative and 36 of which were positive. Three statements contained both negative and positive opinions. The responses were content analysed; two negative categories and five positive categories were found. The two negative categories are "distraction and off-task (32/68)" and "laptop requirement is a restriction (3/68)". The five positive categories are "facilitate communication (17/68)", "opportunities of sharing and peer learning (4/68)", "medium for presenting materials and understanding content (8/68)", "help get various tasks done (4/68)", and "transform instruction (3/68)". Among the negative statements, "distraction and off-task" received the highest percentage of the participants' responses. This indicated that the main reason for participants' negative opinion about 1:1 computing usage in class was distraction and off-task behaviour.

In our study, 56% of the participants considered that 1:1 computing changed the dynamic between instructors and students. Facilitating communication and proving medium for presenting materials were acknowledged as important benefits; distraction and off-task behaviour were the major negative impacts. Previous research [1-2, 12, 19] had similar findings about the positive impact of 1:1 computing on communication. Barak's [2] study found that 1:1 computing facilitated immediate feedback, in-class collaboration, and sharing work and ideas. Students' comments from Barron's [1] survey were centred on the ease of collaboration through iChat and other applications that enhanced social networking. The fact that implementing 1:1 computing in the classroom also contributed to distraction and off-task behavior was also discussed by previous research [2, 19, 21].

According to Lindroth [20], students were uncertain about what activities of 1:1 computing were considered appropriate; they considered that 1:1 computing reduced boredom during uninteresting lectures; some activities for non-learning purposes were observed, such as sending amusing videos and giving comments to each other and these activities made students lose track of the lecture. Based on their analysis, Lindroth [20] developed several strategies on how to handle students' inappropriate use of 1:1 computing in class. These included developing a learning culture that encouraged students to take responsibilities for their own learning, turning instant messenger to "do not disturb" mode, and closing email client during lectures, etc.

4.5. 1:1 computing on pre-service teachers' engagement and knowledge-transfer

Our results indicated that participants perceived 1:1 computing as useful and helpful in knowledge transfer and engagement. Among the 140 responses to the question "are the materials you create in one class useful to you in your other classes at Penn State", 87 (62%) answered "yes" and 53 (38%) answered "no". When asked about "does having your 1:1 computing help you make connections between materials in your various classes, during and/or between semesters", the participants asserted relatively high positive opinions: 89 (64%) participants asserted that connections were made between classes and 69 (49%) participants asserted that connections were made between semesters. Similarly, a majority of participants reported that they were likely to take on an active role in learning as a student (87 out of 139) and as a teacher (95 out of 139) because of having 1:1 computing in their class.

The result was slightly contradictory to the result of Barak's [2] online survey, which indicated that students were not too keen about being active in class. However, Barak [2] offered an explanation – being familiar with traditional teaching, students found it odd to be active in the 1:1 computing environment. Our results were echoed in Demb's [19] findings in exploring students' perception on using technology in a small university in Ohio. In their study, large percentages of students agreed that technology increased their engagement in critical thinking. Elwood's [21] study about individuals' acceptance of using technology in higher education also showed a positive students' attitude toward using 1:1 computing. By the same token, Eriksson [18] found that 1:1 computing made it possible for students to choose study modes, the places and time for studying, and thus contributed to study motivation and increased students' proactive effort, persistence, and sense of responsibility.

5. Conclusions

There was a trend that pre-service teachers exhibited a positive view of 1:1 computing in teaching and learning. They saw themselves more effectively utilizing 1:1 computing in the classroom and also believed that technology influenced teaching in a positive way. In addition, they saw the dynamic change between instructors and learners and agreed that 1:1 computing empowered them as learners and further improved their engagement and knowledge transfer. Educators and policymakers should consider this positive trend in future teacher preparation while developing effective strategies to improve teaching and learning with new technologies. By offering descriptive learning experiences and perspectives about 1:1 computing in pre-service teachers' teaching and learning, this study was expected to help with the preparation of future teachers in digital teaching and learning environments.

This study did not intend to evaluate the quality and effectiveness of 1:1 computing initiative, nor did it intend to describe the experience of 1:1 computing use in K-12 settings; but it intended to provide useful insights to understand pre-service teachers' experience with 1:1 computing in teaching and learning. The participants in our study acquired a certain technical proficiency and were familiar with 1:1 computing in the environment. Thus, there are limitations to generalize from our findings to other 1:1 computing programs in varied learning contexts.

Future research should continue to explore effective strategies to prevent distraction and off-task behaviors in 1:1 computing learning environments. Another area for future research is a more focused, in-depth qualitative study that uses in-depth interviews and observations with participants, exploring more concurrent issues with regard to interactions between teachers and students in 1:1 computing teaching and learning environments.

References

[1] Barron, A. E., Feyten, C. M., Venable, M., Hilbelink, A., Hogarty, K. Y., Kromrey, J. D., and Lang, T. R. (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] Barak, M., Harward, J., Kocur, G., and Lerman, S. (2007). Transforming an introductory programming course: From lectures to active learning via wireless laptops. *Journal of Science Education and Technology*, **16**(4): 325-336.

[3] O'Dwyer, L.M., Russell, M., Bebell, D., and Tucker-Seeley, K.R. (2005). Examining the relationship between home and school computer use and students' English/language arts test scores. *Journal of Technology, Learning, and Assessment*, **3**(3). Retrieved from: http://www.jtla.org.

[4] Venezky, R.L. (2001). Procedures for evaluation the impact of educational interventions. *Journal of Science Education and Technology*, **10**(1): 17–30.

[5] Windschitl, M. and Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics and institutional culture. *American Educational Research Journal*, **39**(1): 165–205.

[6] Wozney, L., Venkatesh, V., and Abrami, P. (2006). Implementing computer technologies: teachers' perceptions and practices. *Journal of Technology and Teacher Education*, **14**(1): 173–207.

[7] Dunleavy, M., Dexter, S., and Heinecke, W. F. (2007). What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning? *Journal of Computer Assisted Learning*, **23**(5): 440–452.

[8] Kanaya, T., Light, D., and Culp, K. M. (2005). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education*, **37**(2): 313–329.

[9] Zucker, A. A. and Hug, S. T. (2008). Teaching and learning physics in a 1:1 laptop school. *Journal of Science Education and Technology*, **17**(6): 86-594.

[10] Gulek, J.C. and Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *Journal of Technology, Learning, and Assessment*, **3**(2): 1-39.

[11] Gardner, J., Morrison, H., Jarman, R., Reilly C., and McNally, H. (1994). Learning with portable computers. *Computers & Education*, **22**(1/2): 161–171.

[12] Creswell, J. W. (2008). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Thousand Oaks, CA: Sage Publications, Inc.

[13] Holleque, K. (2002). Technology and Education at Valley City State University. Available: http://community.vcsu.edu/facultypages/kathryn_holleque/Surveys.htm.

[14] Kay, R.H. and Laucicella, S. (2011). Exploring the benefits and challenges of using laptop computers in higher education classrooms: A formative analysis. *Canadian Journal of Learning Technology*, **37**(1): 1-18.

[15] Jones, A. and Cowie, B. (2011). Evaluation approaches for a national ICT initiative: The example of laptops for New Zealand teachers. *Educational Research for Policy Practice*, **10**(1): 3–15.

[16] Allsopp, D. H., McHatton, P. A., and Gingras, A. C. (2009). Examining perceptions of systematic integration of instructional technology in a teacher education program. *Teacher Education and Special Education*, **32**(4): 337–350.

[17] Klieger, A., Ben-Hur, Y., and Nurit, B. N. (2010). Integrating laptop computers into classroom: Attitudes, needs, and professional development of science teachers—A case study. *Journal of Science Educational Technology*, **19**: 187-198.

[18] Eriksson, M. J., Vuojarvi, H., and Ruokamo, H. (2009). Laptop computers and wireless university campus networks: Is flexibility and effectiveness improved? *Australasian Journal of Educational Technology*, **25**(3): 322-335.

[19] Demb, A., Erickson, D., and Wilding, S. H. (2004). The laptop alternative: Student reactions and strategic implications. *Computers & Education*, **43**(4): 383-401.

[20] Lindroth, T., and Bergquist, M. (2010). Laptopers in an educational practice: Promoting the personal learning situation. *Computers & Education*, **54**(2): 311-320.

[21] Elwood, S., Changchit, C., and Cutshall, R. (2006). Investigating students' perceptions on laptop initiative in higher education: An extension of the technology acceptance model. *Campus - Wide Information Systems*, **23**(5): 336-349.