From Placement to Practice: Factors Affecting the Classroom ICT Integration of Pre-Service Teachers

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Abstract
Technological progress has resulted in unprecedented access to technology in education. While this removes the age-old issue of information and communications technology (ICT) availability for pre-service teachers, it does not remove the need to meaningfully integrate technology into their practice. Three areas of influence significantly impact the self-efficacy of pre-service teachers and, therefore, their ability to effectively use technology. The first, initial teacher education, should provide technological, pedagogical, and content knowledge (TPACK) initiatives to prepare trainees for practice, alongside mentors who are themselves competent in ICT integration. The second, schools and school communities, must provide relevant professional development around ICT use alongside a positive and open-minded culture around ICT use in the school, as well as addressing issues of access for students in lower socioeconomic areas. Finally, the pre-service teacher themselves must maintain an open mind and a constructivist pedagogical perspective to increase their own self-efficacy and successfully integrate technology into their future practice.

Keywords: *Technology integration, efficacy, digital pedagogy, teacher education, pre-service teacher*

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Introduction

Due to the rapid changes in technology available to students in schools, education technology has long been an area of interest to both teacher educators and educational theorists (Instefjord & Munthe, 2017). As general access to devices and software has increased with the introduction of inexpensive devices such as Chromebooks and free applications such as Google apps, so has the ubiquity of use in the classroom. In their report for the Ministry of Education, Bolstad, R., Gilbert, J., McDowall, S., Bull, A., Boyd, S., & Hipkins, R. (2012) wrote that simply adding information and communications technology (ICT) into the classroom is not going to "trigger beneficial and meaningful educational change" (p. 6), and that a set of interconnecting strategies are required to do so. This implies that the challenge is not *if* ICT should be used in the classroom, but how technology can be *meaningfully* integrated into classroom practice in a way that enhances learning (Bolstad et al., 2012; Chai, Koh, & Tsai, 2010). Approaches like the technological, pedagogical, and content knowledge (TPACK) framework allow for educators and pre-service teachers to consider the intersections of thoughtful teaching and learning, and the relevance technological competency has to the world the students enter after school every day.

Preparing teachers and supporting the increase of self-efficacy (or 'belief in one's ability to succeed') in this area should be a key focus of initial teacher education, as opposed to simply supporting digital competence (Instefjord & Munthe, 2017). Further, the role of the school environment and wider community is to continue to support teacher perceptions of their own self-efficacy and to provide professional development opportunities to continue to promote effective integration in the school (Kopcha, 2012). Finally, the way teachers' themselves interact with personal barriers, such as time and perception, has a significant impact on their commitment to increasing or maintaining their digital competence and constructivist versus traditional pedagogical views (Petko, 2012).

The Role of Teacher Education

Teacher education programmes are a pivotal point for pre-service teachers in developing their teaching philosophies and perspectives on vital areas of their teaching practice. Initial teacher education is often the first place pre-service teachers engage with technology in a classroom context, and so has a marked effect on the teacher's ability and motivation to integrate technology successfully into their practice. Among the largest impacts on these factors are reported to be the competency and relatability of their mentor teachers and educators, and the focus of the initial teacher education programme (i.e., looking to the TPACK framework: a tool for teaching integrated ICT as opposed to skills and outcomes-based teaching).

The Impact of Coursework

Chai et al. (2010) developed a special ICT course for Singaporean pre-service teachers to study the contribution content knowledge, pedagogical knowledge, and technological knowledge had towards overall TPACK competency. While the content knowledge was left to other classes in the programme, they provided specific lessons on

pedagogical knowledge looking at approaches to using ICT for learning and related classroom management issues. They went on to provide specific technological knowledge classes where the pre-service teachers would learn about a new technology, and would link the use to pedagogical pros and cons, as well as considering how it could result in "tech enhanced lessons (TEL)" (p. 66). Finally, the last few lessons looked at integrating these concepts into the TPACK framework where students needed to come up with a tech-integrated unit with justification of the use (or not) of technology and the pedagogical approaches used in the decisions. The data gathered focused on the perceived competency of each strand (content, pedagogical, technological) before and after the completion of the course. Generally, students rated themselves as slightly above average in all areas before the course, and increased their ratings in all areas after the course ended. Pedagogical knowledge was correlated most strongly with overal TPACK competence in both surveys, though all areas were strong in the post-course survey. It could be argued that the article is missing some data to support their conclusions about the learned competence of the students – for example, exemplars of the final integrated unit plan assignment, rubrics, or perhaps interviews with the students once they were teaching in schools and putting their learning into practice. Did their perceived competence fresh from a course actually result in confidence implementing these skills in the classroom?

Lee and Lee (2014) performed a similar study with a specially formulated ICT course focused on integrating technology into lessons. Instead of focusing primarily on TPACK competency, they instead provided training on the ASSURE model for lesson planning (i.e., analyse learners; state standards and objectives; select strategies, technology, media, and materials; utilise technology, media, and materials; require learner participation; evaluate and revise) including reflective steps on meaningful integration. The students were also provided with brief training on general programmes such as Photoshop and Windows Movie Maker, and classes on approaching technology integration using TPACK. Students reported the lesson planning training and ASSURE model to have the biggest impact on their self-efficacy, but again the study failed to provide examples of what exactly they were looking for to determine competency in these areas.

The Impact of Mentorship and Modelling

Instefjord and Munthe (2017), and Barton and Haydn (2006) both performed studies observing the impact mentor teachers and modelling had on the self-efficacy of their pre-service teacher counterparts. Instefjord and Munthe (2017) made a determination based on the correlation between teacher educators' technological self-efficacy and the subsequent reporting of self-efficacy from their trainees. Their study showed that 35% of the teacher educators surveyed believed they modelled technological integration at a high level to their trainees, however, the study went on to discover that when asked to rate their perceived interactive whiteboard competence, educators gave themselves a mean score of 2.94 (out of 6). A similar question was put to the teacher trainees, asking if they believed they had received good training in interactive whiteboard use. The trainees gave a mean score of 1.94, indicating that the low competence of their educators had a significant impact on the learning of the trainees. Further, despite teacher educators scoring themselves a 3.90/6 for being a good role model for effective technological integration, their teacher trainees rated them a 2.72/6. It is possible that trainees perceived different aspects of integration to be of higher value than those valued by the educators, and thus a discrepancy in ratings could be explained this way. Despite gathering a lot of quantitative data from this study, the researchers admit that the modelling technique used requires a larger sample size (>200) than they had (136). The participants ranged in focus from early childhood education to secondary education, resulting in significantly different use-cases for ICT in the classroom and no explanation as to whether this would affect their conclusions – the assumption was made that it would not.

Barton and Haydn (2006) asked trainee teachers what they perceived to be strategies and interventions implemented by their initial teacher education provider that positively impacted their ability to use ICT in their teaching. The study gathered data through quantitative questionnaires asking yes/no or 1-5 agree/disagree scaled questions. Of the participants, 79% responded that they had used ICT on placement, though this could have been only a small part of a single lesson. Of the trainees, 97% reported that they had used ICT to create teaching resources while on placement. The trainees went on to report that 86% of them had discussed the use of ICT with their mentors, though just over half of them believed they had a role model for the use of ICT within their department. Only 9% of participants believed they used ICT less than others in the department, and nearly a third reported that they used ICT more. Barton and Haydn (2006) concluded that the data positioned access issues and mentor support as major factors in the participants' self-efficacy progress, but this study was performed in the mid-2000s when personal computers and tablets were less ubiquitous and easily obtained as they are now, so access is less of a barrier than it was then. As shown in Instefjord and Munthe (2017) in a more recent study, no mention was made of access issues, but the impact of mentor teachers on trainee self-efficacy was reiterated in their data.

The Role of the School and School Community

Once pre-service teachers have begun their practical experience in schools, and when they have finished study and are beginning an in-service teacher role at a school, the impact of the mentor teacher remains, but the influence of their teacher educators is lessened. The significance of the attitudes and opportunities afforded by the school and the wider school community comes to the forefront, particularly the culture, demographic aspects, and openness to change.

The Impact of School Culture

Gil-Flores, Rodríguez-Santero, and Torres-Gordillo (2017), Inan and Lowther (2010), and Kopcha (2012), undertook studies on the influence of school culture on whole school perceptions of ICT, specifically focusing on how the provision of professional development opportunities impacted the effective integration of ICT in the classroom. Inan and Lowther (2010) found that, of their school-based factors, professional development opportunities had the greatest impact on the participant teachers' readiness to integrate laptop computers into their practice, alongside overall school support having the greatest impact on teacher self-efficacy. Technical support, while not ranking the highest, came a close third

behind professional development. It was also found that, while these factors had significant value in affecting teacher belief and readiness, if a teacher already has positive beliefs and considers themselves ready, this will mitigate negative effects from school-based factors. This study used the same model analysis as Instefjord and Munthe (2017), with a higher sample size (379 versus 136), meaning this study had more statistically stable results. Similarly, the participants of this research spanned primary and secondary sectors as well as rural to urban geographical locations, which is not considered a source of variance in their data.

Kopcha (2012) conducted a study with 18 primary school teachers where the participants received situated professional development (in-class and connected to classroom practice) and mentoring for one year, and developed communities of practice over the following year. The participants were surveyed and interviewed after the initial year of mentoring, and at the end of the year of developing communities of practice with minimal mentor guidance. The study was looking at changes in teacher perceptions of five barriers to ICT integration: access, vision, professional development, time, and beliefs. The study found that, while the teachers found the mentoring and professional development meaningful and useful over the initial year, once the mentor left and they were left to develop their communities of practice, the constraints of time and inexperience made the second year less successful than the first. Participants generally agreed that it was easier to find and use ICT resources with the help of the mentor, but that they had found that they could troubleshoot their own integration ideas by talking with other teachers about what they were implementing. As the school culture changed, demands on communal devices increased, resulting in an access issue. With the mentor gone, the technical support was also lacking, which meant that teachers spent time clearing updates on the communal laptops when they were able to book them, and had to sort technical issues themselves, something they did not feel adequately prepared for. Despite these issues, the participants' perceptions of ICT integration remained positive. The study determined that sustained professional development can have a significant impact on teacher and school perceptions of ICT, but that the communities of practice were not as influential and, in some cases, were detrimental. Kopcha (2012) had a small sample size (18), but was focused on a single primary school. Both quantitative data (Likert scale survey questions) and qualitative data (interviews and classroom observations) were collected. They note that the small, specific context makes it difficult to extrapolate to other contexts, but that the focus was on the ability of sustained professional development to change a school culture, for which the case study method was appropriate.

Gil-Flores et al. (2017) carried out a large study of 3339 secondary educators in Spain. They observed the effect of the presence or lack of ICT infrastructure in schools through quantitative data collection via ranked surveys. Their data showed that if the perceived need for professional development was low, the frequency of ICT use increased. As teacher collaboration increased, so did the frequency of ICT use. If a school does not have appropriate access to education software, the frequency of ICT use will drop significantly. While this study did determine some areas of correlation within ICT infrastructure in school, it found that, in general, teacher characteristics were more relevant to ICT usage than any infrastructure-related variable. The large sample size could be considered to negate the geographical differences between participating schools. Trends can be picked out from a sample size this large that can be considered general. However, because this study was so large it was impossible to gather and analyse qualitative data which means that, while there is enough quantitative data to determine frequency of ICT use, there is no way to determine quality of use.

The Impact of Location

Maxwell (2000) analysed the effect of certain biases on equitable student access to technology in the US, but a lot of the findings can also be true for New Zealand. They write that often rural and poor areas of the country are the last to receive new technology, and for similar reasons do not have the same level of access to professional development training to learn to use new technologies. Students and families in low socioeconomic zones tend to view technology as a luxury, and not a necessity, resulting in a technological disparity between students who can afford their own device to use at school and those who cannot. This puts further pressure on the school to provide the devices to shorten the gap and promote equity, an expense schools in more affluent areas do not have to bear. It is of particular importance to invite families into the integration process so that they can understand how technology can enhance student learning. This means that they can encourage technology use at home, even if this is in the form of regular trips to local libraries or a family purchase of a laptop for communal use. Often schools in low socioeconomic areas have further expenses to bear that others do not. On top of trying to provide students with devices at school, there is also pressure to ensure students are fed and clothed in order to be able to engage in their education. Teachers in these schools not only face their own barriers to technology integration, they must address the barriers facing the students' access to and engagement with technology in the classroom and at home. Maxwell's paper is not a study but more an overview, and it is fairly out of date, but the points it brings are still relevant in a current New Zealand context. There is generally a lack of data on New Zealand inequity about student access to devices, and the literature covers barriers to teacher integration and simply assumes ubiquitous access to technology on the part of the school and students. While it is true that it is easier and cheaper than ever for schools to purchase devices and educational software, and that students in general have constant access to smart devices, there are areas of New Zealand in which this is not the case, and the schools inevitably bear the financial brunt of this disparity.

The Role of the Teacher

Each of the studies presented also referenced the relative importance of teacher belief, perception, and characteristics. Across the board, the teacher-based barriers to ICT integration are the most significant. Pedagogical belief, perception of the severity of barriers, and understanding of personal self-efficacy are deciding factors in the ability of a pre-service or in-service teacher to successfully and effectively integrate ICT into their practice.

The Impact of Teacher Belief

Petko (2012) performed a study based on the model adopted by Knezek, Christensen, and Fluke (2003), which was

developed to explain the variance in technology use in the classroom. The model covers three core variables – the teacher's will or belief in the relevance and meaning behind using technology; the skill of the teacher, in both personal and pedagogical contexts, and the availability of tools and devices in the school. Part of Petko's study focuses on the "will" part of the model, surveying 357 teachers from 15 secondary schools on pedagogical beliefs and perceptions of the effectiveness and efficiency of ICT in the classroom. Results of the survey show that positive beliefs surrounding ICT use have significant impact on the frequency of ICT use. Further, teachers reporting a constructivist view of teaching were more likely to use ICT in their classrooms, though this was not as significant as simply having a positive perception of ICT. The study suggests that the small amount of variance in answers from constructivist teachers is due to the fact that most of the participants identified as constructivist, so there was not enough non-constructivist data to draw a solid conclusion. The findings of Lee and Lee (2014) support this conclusion, also finding that teachers felt their self-efficacy increased with targeted training around ICT. The pedagogical focus of TPACK allows for teachers to look for the meaning behind their use of technology and consider whether it is necessary or enhancing learning.

The Impact of Time

Aside from teacher perception of their own ability and pedagogical beliefs, time is the most significant barrier to teachers who want to integrate ICT in their classrooms. Even if teachers have the will, the skill, and the tools, as well as supportive schools and a solid background from their initial teacher education programme, the time it takes to find and adapt digital resources and plan for meaningful ICT use in class is still present. Kopcha (2012) wrote that, despite having a mentor for professional development and establishing communities of practice, teachers' perception of the time it took to use technology in the classroom was overwhelmingly and consistently negative. Haydn and Barton (2007) also recognised the importance of providing time to trainee teachers and their mentors to discuss ICT implementation strategies and purpose. They suggest that often this issue is negated by providing schools and teachers with more strategy guides and software, without addressing the need for time to learn to plan for new software or new methods of instruction.

Conclusion

Each initial teacher education provider is different, each teacher is different, and each school is different. Due to the wide variation of situation and severity of influential factors, it is impossible for any strategy to be a 'silver bullet' or a one-size-fits-all solution to remove barriers from schools and teachers. However, an in-depth understanding of the mitigating factors surrounding the challenge of meaningful ICT integration can better prepare pre-service teachers to engage with them openly and work with others to try to overcome them in their own specific context. Initial teacher education providers can use the literature to inform their own practice and development of ICT resources for trainee teachers. Sustained and relevant professional development in schools as well as follow-up mentoring and classroom observations can make a difference in school culture surrounding the use and meaningful integration of technology in a school-wide context. Technology has progressed rapidly in recent years, and will continue to do so in the future. Part of future-focused education is to prepare our students for the world they will be entering once they finish schooling, and technology is a big part of that world. Approaches like TPACK, that integrate a need for meaningful learning experiences that *can* include the use of technology in a way that *enhances* the learning that is occurring within traditional teaching and learning settings, are a great tool for keeping teaching and learning current as well as meaningful.

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