USING VIDEO FEEDBACK AND ANNOTATIONS TO DEVELOP ICT COMPETENCY IN PRE-SERVICE TEACHER EDUCATION

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Abstract

This paper presents the findings of a study that focused on developing Information and Communication Technologies (ICT) competency in pre-service teacher education Units of Study. The study adopted a collaborative-learn-technology-by-design conceptual framework. One-hundred and twenty pre-service teachers participated in the semester-long study. The study involved students in Science Education and ICT in Education Units of Study. Data sources included annotated video feedback, reflective journals and pre- and post-tests. Initial findings demonstrate that the design process deepened the pre-service teachers' understandings of the affordances of Internet technology and that pre-service teachers increased their technological, pedagogical and content knowledge at the end of the semester.

Key Words: Collaborative learning, pre-service teacher education, ICT education, learn-technology-by-design, authentic learning

Introduction

How to prepare pre-service teachers for technology use in the classroom is an enduring issue. It is commonly agreed that pre-service teachers would benefit the most from exposures to technology integration that is modeled by curriculum subject faculty members. Yet, in reality, practical reasons often make it difficult for teacher education institutions to take this approach. As a result, stand-alone technology courses continue to exist as an important venue for pre-service teachers to be prepared for technology integration in the classroom.

A frequently asked question is how stand-alone technology courses can best prepare pre-service teachers for classroom use of Information and Communication Technologies (ICTs). Mishra and Koehler (2006) advocate an approach of learn-technology-by-design for preparing technology integration, in which pre-service teachers 'propose software and hardware solutions to their specific contexts and problems' (p. 1034). In this approach, rather than focusing on teaching technical skills or mastery of a program or application, tutorials and workshops are design to support pre-service teachers in developing both technical and pedagogical knowledge. Mishra and Koehler (2006) advocate an approach wherein pre-service teachers have 'spontaneous and short tutorial sessions - both student to student and instructor to student driven by the immediate requirements of the groups' (p. 1034). In this respect, a learn-technology-by design approach presents educators with an opportunity for the symbiotic development of these technical and pedagogical skills in both standalone ICT in Education Units of Study (UOS) and curriculum area UOS. In this study, we used a collaborative approach in both the design of the tasks and the critical feedback through a peer review process. Design-based learning activities, which are usually carried out in groups, have been shown to be of benefit to students learning how to use technology effectively in a range of educational content (Howard, McGee, Shin, & Shia, 2001; Kali & Ronen-Fuhrmann, 2011). Research findings have

indicated that pre-service teachers develop deeper understanding through the experiences of both dialogue and reflection in action (Mishra & Koehler, 2006). Learn-technology-by-design tasks are accomplished in the environments where students, and in this instance pre-service teachers, are encouraged to use ICT tools to build a learning environment.

In this paper we present the results of a research study that used EVA (Educational Video Annotations). EVA is a web-based teaching and learning platform that consists of video streaming, indexed video cue-segments, and an associated list of users' annotations to facilitate collaborative peer evaluation and feedback. The aim of the research study was to investigate the following questions:

1. How effective is EVA (the Faculty's Educational Video Annotation tool) as a tool to help self-reflection of teaching practice?
2. Does using a tool like EVA assist students to critically self-reflect on meaningful feedback provided by peers?

Background

This research has been undertaken in the Faculty of Education and Social Work at the University of Sydney as a way to increase the knowledge, skills and understanding of a range of ICTs of the undergraduate pre-service teacher education students. Recent investigation of programs, individual units of study and student outcomes reveal that our graduates are at risk of not meeting the new national graduate teacher standards, which must be achieved in order to gain professional registration as teachers. National graduate teacher standards: Graduate Standard 2.6 'Implement teaching strategies for using ICT to expand curriculum learning opportunities' (AITSL, 2011. p.4) and Graduate Standard 3.4 'Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning' (AITSL, 2011. p.6). The importance of explicitly developing professional competencies in ICT within pre-service teacher education has been highlighted through research, including studies conducted by Faculty members (see, for example, (Hu & Fyfe (Galstaun), 2010; Kennedy-Clark, 2010; Markauskaite, 2007; Markauskaite, Goodwin, Reid, & Reimann, 2006).

The role of ICTs in education is characterized as a complex and dynamic relationship that is impacted upon by the technical capabilities of an institution and its educators, the beliefs and self-efficacy of the educators, and the needs and capabilities of the students. There is an expectation that educators should use ICT in innovative and pedagogically sound ways (la Velle, Wishart, McFarlane, Brawn, & John, 2007). However, many factors impact upon how educators integrate ICT into their teaching. There is now a significant body of evidence that suggests it is educators' *attitudes* in relation to ICT and their pedagogical beliefs and style of teaching, that most influence whether and how ICT will be embraced (Kennedy-Clark, 2011; Phelps, Graham, & Watts, 2011). The impact of a positive attitude and ICT is clarified by Teo (2008, p. 421), who argues that there is:

> a need for teacher educators to provide a conducive and non-threatening environment for pre-service teachers to experience success in using the computers, with a view to allowing pre-service teachers to gain competence and confidence in using computers for teaching and learning

In this respect, the importance of pre-service teacher training that focuses on the development of novice teachers' skills and positive attitude in using ICTs is garnering increasing attention (Hu & Fyfe, 2010; Kennedy-Clark, 2011; Markauskaite, 2007; Markauskaite, Goodwin, Reid, & Reimann, 2006). In Smarkola's (2011) research into technology acceptance by teachers and pre-service teachers, she found that pre-service teachers acknowledged the value and usefulness of computers within the classroom for student learning and that this value was impacted upon by both internal and external motivators. She explains that internal motivators were the compatibility of computers and work, the need for students to learn how to use computers, and the value of students developing digital literacy for the 21st Century workplace. She found that the external motivators were increased employability and the perceived social value of being an ICT proficient teacher. Thus, using ICT in education is not a decision based on the perceived ease of integration, but other factors, such as value for the students, benefits for the pre-service teachers and positive attitudes all play a role in a pre-service teacher's decision to use ICT in a classroom.

Overall, as Hennessy (2005) articulated, ICT training needs to build on and extend current teaching practice rather than being seen as a replacement for existing classroom pedagogies. This view is supported by Urhane (2010), who suggests that the ICT training of educators should begin with an assimilation of ideas, and the development of an appreciation of the limits of both the technology and the educator's current skills. It is through this acknowledgment of limitations to ICTs and existing practices that pre-service teachers may be able to recognize their own needs, whether they are technical or attitudinal, such as a fear of change or failure. As Smarkola (2011) found, it was apparent that educators felt more comfortable using technology in the classroom when they had support. Consequently, the context of both the training and the use of ICT need to be presented to pre-service teachers as integral to teaching and valuable for both students and teachers.

Procedure

Two groups of students from different UOS were given different tasks using EVA. EVA was designed for pre-service teachers to critically reflect on their teaching practice using ICT as well as to be used as a tool for peer feedback. Group 1 used EVA in the context of a science curriculum UOS. In this group, EVA was used as a tool to help prepare pre-service teachers for their first professional experience in schools. In this context, ICT was used in a content specific UOS. In Group 2 EVA was used in an ICT in Education unit of study. This group was required to design a web resource and critique the effectiveness of this using EVA. In this instance, technology was used in a standalone ICT in education UOS.

The study was conducted in Semester 2, 2011 between July and November. Both groups were administered a twenty-nine item TPACK pre- and post-test and seven item post assessment EVA evaluation survey consisting of open-ended questions. The TPACK pre-test was administered at the beginning of the semester. The TPACK post-test and the EVA survey were administered at the conclusion of the semester. The Groups completed different assessment tasks. A description of the participants, assessment task and data analysis is outlined.

Group 1

In Group 1, the task carried out by the pre-service science teachers required them to work in pairs to design a lesson that would fit into a unit of work about environmental sustainability from Stage 5 of the Australian Science Curriculum (ACARA, 2011).

Participants

In this group twenty-two participants completed the pre-test and twenty-seven completed the post test. Twenty-seven reflective journals were analysed. There were fourteen female students and thirteen male students with a combined average age of 24.08 years and a standard deviation of 6.44. There was a relatively even balance of female and male pre-service teachers. Students from the undergraduate Bachelor of Education secondary combined degrees and the Master of Teaching were combined. This was a core (mandatory) UOS.

Assessment task

There were three phases in the assessment task. In phase 1, the pre-service teachers selected a 10 minute section of a lesson that they would be teaching on their practicum to perform in front of four of their peers as a micro teaching exercise. The presentation of this section of the lesson was videotaped and the video was uploaded onto EVA. In phase 2, the micro teaching videos were then critically analysed on EVA by a minimum of four classmates. The pre-service teachers were provided with a rubric that scaffolded comments on aspects of their peer's presentation skills, such as pace, clarity, posture, engagement, humour, presence, voice modulation, confidence and questioning techniques. In phase 3, the pre-service teachers were then required to critically analyse their own video and peer feedback. They then had to write an individual reflection about their lesson and presentation skills using the peer feedback provided. At the conclusion of the assessment, the survey instrument was administered to the participants.

Data Analysis

The data collected from Group 1 were analysed in three stages. Firstly, the survey data were analysed. The qualitative data were analysed using grounded theory and the quantitative data were measured for effect size (Cohen's *d*). The second stage of the data analysis involved an examination of the participants' videos and reflections. The video data and written reflections were coded using selective coding based on themes, such as professional development, collaboration and student feedback. These themes were identified from the examination of the qualitative survey data (Glaser, 1992). The data were coded independently by two members of the research team, the results were discussed and final agreement rates ranging from Cohen's Kappa k = 90 to 95% were achieve, which is a satisfactory level of agreement (Banerjee, Capozzoli, McSweeney, & Sinha, 1999). The third stage of the analysis involved a construction of a narrative based on the themes arising from the data analysis.

Group 2

In Group 2, the task was carried out by students from the Bachelor of Education, in the standalone ICT in Education UOS. In this UOS, there were students from primary and secondary teaching areas across the curriculum subjects, such as History, English, Science, LOTE and Drama.

Participants

Eighty-one students completed the pre-test and ninety-three students completed the post-test. All of the participants were undergraduates. There were seventy-two females and twenty-one male students with a combined average age of 21.89 and a standard deviation of 1.20. The UOS for primary students is an elective while the UOS for secondary students is core.

Assessment task

The task required students to develop a teaching and learning web resource. This task was staged over five phases and was based on the ADDIE (Analysis, Design, Development, Implementation and Evaluation) Model (Dick & Carey, 1996; Dick, Carey, & Carey, 2001). In order to accomplish the design task, pre-service teachers would need first to become familiar with the school curriculum and subject area. As part of the task students were required to identify a specific topic or concept that they believed to be difficult for teachers to teach and for students to learn, this was the analysis stage. Given that students were from a range of curriculum areas, students were paired with a peer from the same discipline area to complete the task.

Collaborative Learn-by-design

Individual ongoing reflection and evaluation of process

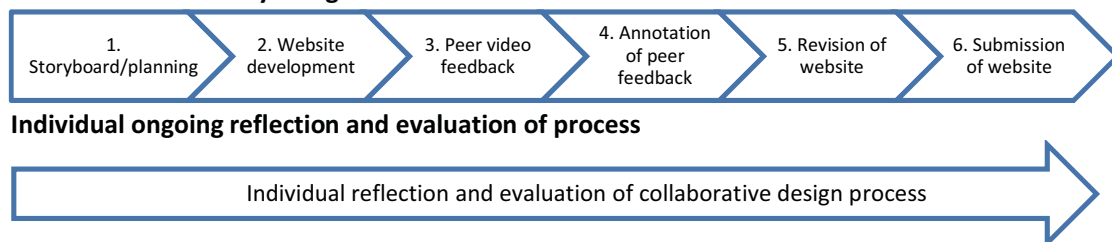Individual reflection and evaluation of collaborative design process

Figure 1. Workflow of collaborative and individual components of the assessment

The design and development stages were carried out via two separate activities that were completed in pairs (Figure 1). In the design stage, students had to design a storyboard of their website. There were several steps to the development stage. Students had to develop content, develop teaching resources and develop a website using Google Sites tool. The implementation stage occurred when students published their website for peer review.

The evaluation stage had two phases. The first phase was peer review evaluation wherein pre-service teachers working with their partner evaluated two of their peers' websites. Students were provided with a rubric for providing meaningful and effective feedback to their peers about their web resource. The rubric was based on Mayer and Moreno's multimedia design principles (2003). The

evaluations were recorded using *Camtasia* screen capture software, which recorded the audio, webcam and onscreen movements. The recordings were uploaded to EVA. The second phase of the evaluation was self-evaluation, in this phase the pairs then annotated the feedback and explained how they would address the feedback in their final design.

The final stage of the task was implementation. In this stage, pre-service teachers published their final version of the website and submitted their individual reflections.

Data Analysis

As with Group 1, there were three stages of the data analysis. Firstly, pre-and post-test surveys were administered and were measured for differences. Secondly, students' reflective journals were analyzed using a constant comparative method. Thirdly, the video recordings were transcribed and then coded to determine patterns and themes. On the basis of the preceding steps, the results of the analysis of the two groups was combined and examined and a narrative of the main results was constructed.

Results

The results of the preliminary analysis of the data are presented here for the purpose of providing an overview of the main findings. The data reported on incorporates feedback on the use of EVA as a tool for reflection from the EVA survey. Note that as the participants did not respond to all of the survey questions, *n* is provided in brackets following the percentage. Student comments have been de-identified.

Critical Reflection

In the EVA survey, participants were asked what critical reflection was and when they would use critical reflection in their teaching practice. With regards to critical self-reflection, in general, forty-one percent (*n*=50) of participants indicated that they had experienced some type of critical reflection task in all of their classes. Twenty-three (*n*=28) indicated that they used critical self–reflection whilst on their professional experience placement to review lessons they taught. Twenty percent (*n*=24) indicated they used critical reflection during professional practice and also lessons at university.

Students were asked in what type of educational contexts they would use critical reflection. Thirty per cent (*n*=23) of students said they would use it during all teaching and learning practices that they undertook. Thirty-two per cent (*n*=24) of respondents indicated they would use critical self-reflection to improve their teaching practice whilst another thirty-two per cent (*n*=24) of the respondents explained that they would ask their classroom students to reflect on lessons to help develop better pedagogical practice.

A majority of students found the use of peer feedback extremely valuable to their teaching practice. Forty-nine percent (*n*=55) of students found the peer feedback informative and twenty-one percent (*n*=24) very informative as demonstrated by the following comment:

> *Having the time to talk another critical pair allowed me to explain our progress in words which allowed me to clarify what I was trying to say. By going through the process of identifying what we have and haven't done really set the pace for the following lessons as we understand the areas that needed to be completed. Kim B.Ed student (Secondary)*

Similarly, forty per cent (*n*=46) of students found viewing their own teaching video useful and thirty-two per cent (*n*=37) found it very useful for critical reflection as demonstrated by Kim's comment. These findings suggest that pre-service teachers see the value in using ICT innovations in supporting individual, peer and student feedback to improve pedagogical practices.

Use of EVA as a critical reflection tool

Participants were asked to respond to questions on the effectiveness of EVA as a tool to support critical reflection. Overall, the pre-service teachers reported that EVA was a helpful (43%; *n*= 49) or very helpful (27%; *n*=31) tool in helping them to critically reflect on their work or practice as seen in Figure 2.
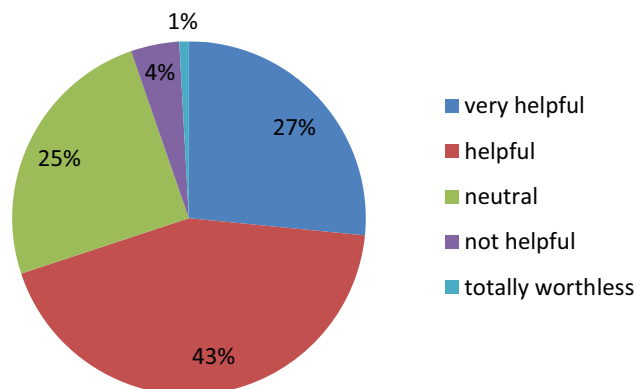
Figure 2. Effectiveness of EVA as a critical reflection tool (n=113)

Several reasons were given as to why the students found EVA effective. Firstly, a proportion of students (55%; *n*=57) commented that EVA enabled the students to view the comments about their work or practice numerous times allowing for thorough analyse and discussion about their practice or teaching resource. Some (5%; *n*=5) also found the use of the cue points helpful in terms of its specificity in marking the exact areas feedback is given. Lastly, some students (10%; *n*=10) commented on how helpful it was for their own reflection to view people using the resource they have designed and then critiquing. This is confirmed by Rebecca's comment:

> *The EVA technology made it easy to provide our critical friends with feedback by linking annotations to particular sections of their micro teaching. I was certainly able to gain the valuable perspective of my critical friends in their assessment of my micro teaching. One of their suggestions added in the EVA annotations has since been integrated into our project. Melissa and I found EVA to be an excellent tool for self reflection. We were able to evaluate how our vision works in reality and were able to reflect on how well our web based resource is when used by participants other than ourselves. It was also great to be able to watch the video of our micro teaching and reflect on elements of our teaching/instruction that we would not normally take notice of. Rebecca. B.Ed Student (Primary)*

Eighteen per cent (*n*=19) of students found EVA not to be an effective tool for self-reflection. A variety of reasons were given for this but the two main causes were that written feedback is just as good as EVA (7.5%; *n*=8) and that technical difficulties with audio or video download prevented it from working properly (6%; *n*=6). The remaining twelve per cent (*n*=12) of the total students recorded a neutral response to this question.

In terms of the use of EVA for teacher critical reflection, forty-seven per cent (*n*=35) of students said they would use the tool for tasks involving peer analysis and commentary. Sixteen per cent (*n*=12) of students said they would use EVA for self-reflection and thirteen per cent (*n*=9) for collaborative resource development. Twenty per cent (*n*=15) of students indicated they would not use a tool like EVA for self-reflection.

The overall findings of this inquiry suggest that students perceive the value of using tools, such as EVA, in their ability to enable pre-service teachers to view themselves teaching prior to professional experience and to be able to re-visit and reflect upon their peers' feedback.

General Use of EVA

The pre-service teachers were asked about the usability of EVA. Overall, sixty-eight percent (*n*=79) of students found EVA to be easy or very easy to use as an ICT tool as demonstrated in Figure 3.
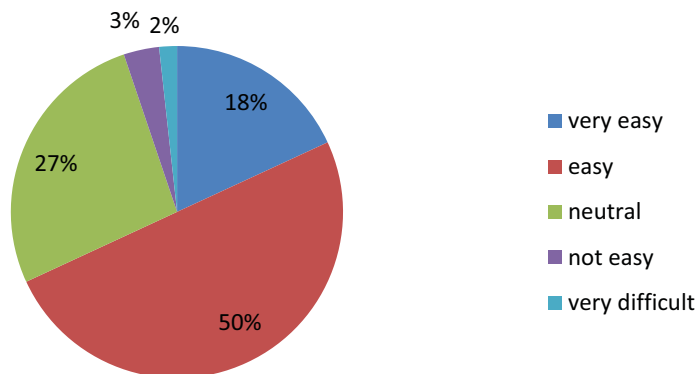
Figure 3. Ease of use of EVA (n=116)

It was evident that fifty per cent (*n*=58) of students found it easy to use as a tool, in that EVA was easy to navigate and the instructions were easy to follow as established by Marnie's comment:

> *The program was effective because it was easy to navigate and allowed a variety of people to provide feedback. As you watched the video you were able to stop and create cue points, which then allowed you to write a comment. We used a feedback guideline, which gave us a variety of headings to structure our comments under. This was useful as it allowed us to reflect on certain aspects that were relevant and important for the task. Marnie. B.Ed (Primary)*

A proportion of students (32%; *n*=37), indicated there were problems with EVA in terms of general technical issues such as slow upload of videos, problems with audio volume and clarity and confusing instructions. The general ICT skills that students indicated they developed using EVA included, annotating, basic computer skills and video uploading. A majority of students (57%; n=48), reported that they would feel confident using EVA during their classroom teaching as demonstrated by Marnie's observation. Nine percent (*n*=6) of students responded that they felt confident using EVA during lessons but that they probably would not use the innovation in their own teaching and thirty-three per cent (*n*=28) indicated that they did not feel confident in using EVA without ICT support. Reasons given as to why pre-service teachers would not use EVA in the classroom included problems with using the annotation tool and the time involved.

The results are in line with extant literature in the field on pre-service and classroom teacher use of ICT. While the pre-service teachers can appreciate the benefits of using a tool such as EVA for critical self-reflection and that they would find it helpful to enable peer-feedback and reflection. This is in line with research on technology acceptance, such as Teo's (2008) and Smarkola's (2011) studies, who both found that pre-service teachers perceived the computers to be useful in their work, which is reasonable given the increased attention placed on the use of ICT in schools for teaching and learning. However, nearly half of the respondents indicated that they would not use the technology in their own classroom practice, which is consistent with the findings of studies, such as Kennedy-Clark (2011), who found that pre-service teachers were unlikely to use a technology in the classroom if there was a possibility of technical problems or issues, such as bandwidth, regardless of the potential learning benefits.

Discussion

The pre-service teachers viewed EVA as a tool for critical reflection positively. They saw it as effective as it allowed for self and peer reflection of teaching resources. The way in which EVA allowed specific points to be analysed and reviewed made it different from written tasks pre-services teacher had completed. Critical reflection was viewed positively by pre-service teachers in the study. The pre-service teachers discussed the ways in which critical reflection was used in many of their classes at university for assessments and on professional experience. In response to exposure to many

varied forms of critical reflection during their studies the pre-service teachers made suggestions as to how this could be used with their own teaching to improve the way they planned and carried out lessons. They also commented on the value that critical reflection may have for school students to improve their learning.

The use of EVA encouraged the development or strengthening of communities of practice. The pre-service teacher could see the value of working in groups to prepare teaching resources. Being part of a community and the collaboration and interaction with peers is perceived to be one of the factors that enriches the learning experience of pre-service teachers – this engagement with other members of a community is the community of practice (Lave & Wenger, 1991; Wenger, 1998). Hence, through being situated in a learning experience a participant becomes a member of a community that is engaged in that shared experience. EVA allowed these resources to be critiqued by other groups and improvements made. The pre-service teachers also commented on the benefit of having peers review and actually use a teaching resource they had developed and how this allowed them to make effective modifications to the resource. The peer review process provided pre-service teachers with opportunities to visit their peers' videos, and, at the same time, to have their own videos reviewed. Such formative evaluation can offer a practical way of determining the quality or potential quality of a newly developed learning resources and/or skills before it is put into classroom. However, it was necessary to provide a rubric to guide pre-service teachers in providing collaborative critical feedback.

The pre-service teachers using EVA for professional experience preparation were very positive about the way in which it allowed them to see how they present themselves in front of a class. They thought it was a very effective way in helping them as a group to improve their presentation skills and because of this they felt more confident going into their first professional experience. Pre-service teachers viewed the use of ICT's such as EVA as a way of integrating the use of ICT into their classroom practice. It provided opportunities for pre-service teachers to develop basic ICT skills, like uploading videos and annotation, which help to build general ICT competencies. Moreover, pre-service teachers were able to see the value of the tool and its potential for use in the classroom if they have appropriate role modeling of the application in a context that can be transferred to a school situation. This is in line with research on the benefits of modeling technology use in pre-service teacher units of study (see, for example,(Gill & Dalgarno, 2008)).

We found that the peer review process provided pre-service teachers with opportunities to visit their peers' websites, and, at the same time, to have their websites reviewed. Such formative evaluation offered a practical way of determining the quality or potential quality of a newly developed web-based learning resource before being implemented into the classroom context. Pre-service teachers displayed engagement in the activities of recording evaluations and watching peer videos for the peer assessment task. The capturing of peer assessment in the form of video and audio created a 'novelty' aspect of the task that was reflected in the pre-service teachers' engagement in the task. Pre-service teachers were able to access the video evaluations off campus and this garnered a positive response. The way ICT was integrated in the teaching and learning processes of the course meant we were able to demonstrate its effectiveness. Moreover, pre-service teachers were able to experience the tools and pedagogical strategies firsthand, which is supported by Merrill's (2002, p. 43) assertion the learning is best promoted when new knowledge is demonstrated to the learner.

Issues surrounding the use of EVA were generally technical issues when pre-service teachers were using the tool. These issues included, slow internet response times, low audio quality, large file size of videos. Those pre-service teachers that did have these problems were quite negative to the prospect of using EVA in classrooms with pre-service teachers. These problems are not isolated to EVA but with all integration of ICTs there needs to be some technical support provided to ensure that the users of the tool are familiar with the capabilities of the tools and that there is someone there to provided assistance with its introduction and initial uses. Overall, for the barriers to implementing ICT, such as technical problems, to be overcome pre-service teachers need ongoing support from the organisation (Guskey, 2002). Teacher training is not a cure-all for the problems surrounding the implementation of ICT into classroom situation, it must be pre-service teacher and curriculum driven and not driven by the technology itself (Kalogiannakis, 2010).

This study was restricted in that it only collected data from pre-service teachers before they went on professional experience. It would be worthwhile to investigate if the pre-service teachers

thought the EVA experience was helpful to them during their professional experience and to what extent it assisted them. Adequate and appropriate support needs to be built into effective uses of EVA. What support and who provides it needs to be carefully considered when considering how EVA will be used and for what purpose it will be used. Clear articulation of who provides support in the classroom for the technical aspects of the tools and who provides support about the pedagogical approaches in using the tool needs to be established before pre-service teachers are engaged in its use. Is it the technician or the educator? The technician provides support on the technical aspects of the application and its functionality. The technical educator provides support with pedagogical aspects of the tool and how it can be used in the context of the learning experience. But this can only be done once the technical aspects of the tools are known.

Conclusions

The units of study described in this paper tried to prepare pre-service teachers to be fluent in both pedagogy and basic design theory so that they may use newly acquired ICT skills to produce educationally sound web-based learning resources (Hu, Wong, Fyfe, & Chan, 2010). This study extends earlier research by Hu et al. (2010), who found that the pre-service teachers became too familiar with their products to detect the inadequacies of their design. As shown in this study, the feedback obtained from peer assessment helped pre-service teachers to modify their design. The process worked as a source of support, ideas and encouragement crucial for the accomplishments of the set task. Such an experience should encourage pre-service teachers to value peer review for both pre-service education and future professional growth.

In light of the above findings the following recommendations are made to further enhance the use of video annotation tools for collaborative peer review and self-reflection to effectively improve teaching practice: (a) Provide timely and specific training and support on both the technical knowledge of the tool and the pedagogy appropriate for specific curriculum teaching, (b) Ensure staff are trained to model the tool in the context of their curriculum area, and (c) Include a component of video-recorded micro teaching for peer review and self-reflection as part of pre-service teacher professional experience where critical reflection is standard graduate attribute or standard.

As shown in this study, the feedback obtained from peer assessment helped pre-service teachers to improve their design and/or focus on skills or teaching strategies to improve their lesson or resource. This process worked as a source of encouragement and input, which supported pre-service teachers in the accomplishment of the task. Such an experience may encourage pre-service teachers to value peer review for both pre-service education and future professional development. There is a need for further investigations into more accessible technologies that are open source so pre-service teachers are able to use these tools for improving teacher quality once transitioned into the school environment. Further studies need to be conducted into developing more sustainable approaches to developing ICT skills and knowledge to drive systemic change in ICT in education curriculum and pedagogy. This may involve following pre-service teachers into in-school professional teaching experiences and surveying pre-service teachers after their professional experience to monitor growth and development in professional practice and the use of ICT.

Above all, we have been able to evaluate the integration of ICT approach adopted in the design of the courses. This research is noteworthy on a practical level because it demonstrates successful pre-service teacher engagement with ICTs to support and enhance learning.

Acknowledgements

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