

Pre-service teachers' perceptions of LAMS as a teaching tool



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This paper reports on one component of a recent study which examined pre-service teachers' use of the Learning Activity Management System (LAMS) to facilitate their professional learning. Over a period of two semesters, seventeen pre-service teachers took part in an in-depth study of their professional development as a result of authoring a learning design and implementing it during their practicum. This paper reports on the pre-service teachers' perceptions of LAMS' usability, flexibility and potential for use in K-12 classrooms.

Keywords: teacher education, learning designs, learning design authoring, LAMS.

Introduction

This study investigated the efficacy of situating pre-service teachers as learning design authors and examining how the process of authoring and implementing a contextualised learning design might help 'build bridges' between theory and practice in their Education courses. It explored the value of teachers creating their own web-based learning sequence using a learning design authoring system and how they can use, and reflect upon, these contextualised designs during their teaching practicum. In this study, the term *learning design* (LD) refers to a coordinated, web-based learning sequence that makes accessible effective learning strategies, supported by appropriate structures and resources to provide guidance and feedback to learners (Oliver & Herrington, 2003). For example, *multimedia-supported predict-observe-explain (POE) tasks* (Kearney, 2002a) used the well-researched POE learning strategy (White & Gunstone, 1992) to effectively scaffold students' learning in an e-learning environment, presenting digital demonstrations set in real-life contexts as stimuli for their learning. The online environment gives students extra control over the pacing of these POE tasks and facilitates peer discussions. Indeed, the use of digital media to present demonstrations has significant affordances for students' observation processes (Kearney, 2002b). The tasks created by participants in this current study would typically take learners 40-50 minutes to complete

The overriding research question guiding this study was: *How does pre-service teachers' authoring and use of contextualised online LDs enhance their development as teachers?* The scope of this paper does not enable full discussion of all findings. Reported elsewhere (Kearney, Prescott & Young, in press) are findings related to the ways in which pre-service teachers developed new understandings of online and face-to-face teaching approaches and sophisticated insights into the specific learning strategies informing their designs. Also, Kearney and Young (in press) have discussed a generic learning design based on analogical reasoning (Harrison & Treagust, 2006) that emerged from the study. However, this paper will focus on the pre-service teachers' perceptions of the usability of LAMS from a 'teacher-as-designer' perspective and their perceptions of LAMS as a teaching tool in K-12 contexts.

Background

Research into how teachers might adapt and use LDs is in its infancy (eg. see Bennett, Lockyer & Agostinho, 2004; Cameron, 2007; Kearney, 2006) and has mainly been confined to tertiary teachers. This study endeavoured to expand this body of knowledge by researching prospective primary and secondary teachers as stakeholders in the LD movement, and introduced school-based classroom contexts to the LD research agenda. This study used LAMS (Dalziel, 2003) as a 'test-bed' for these teachers to contextualise and implement their specific LDs. LAMS (version 1.0) was chosen as the learning design authoring system in this study primarily because its intuitive drag and drop authoring environment was considered user-friendly for novice participants; it was freely available as open source software; provided local support and has shown positive signs for engaging the teaching community (eg. Masterman & Lee, 2005).

Many studies have focused on technical aspects of LDs and associated authoring tools in great depth but only recently, an important new focus has emerged on pedagogical and procedural issues associated with

teachers designing – and occasionally ‘enacting’ (Earp & Pozzi, 2006) – their own online learning tasks. Hernandez-Leo et al (2006) investigated three tertiary teachers using a LD authoring tool to design collaborative learning experiences for their students, while Griffiths and Blat (2005) investigated issues relating to enabling teachers to participate in the LD process and also ways of representing LDs to teachers. Earp and Pozzi (2006) discussed two European projects (*Netform2* and *Remath*), including initiatives with novice teachers authoring and re-using LDs to support pedagogical reflection. Indeed, Gibbs and Philip (2005) investigated a range of ten teachers across both tertiary and school sectors using LAMS and found positive teacher perspectives about opportunities for teacher reflection on pedagogy, as well as student collaboration, motivation and engagement. Dennis (2007) reported similar positive findings relating to the use of LAMS as a tool for reflective thinking in teacher education while Cameron (2007) reported positive findings relating to the use of LAMS as a scaffold for lesson planning in pre-service teacher education. Finally, Lam, Au Yeung and McNaught (2007) used pre-service and in-service teachers in their trial of LAMS in authentic (university-based) teaching and learning settings.

The study

Methodology

This study falls under the interpretive paradigm because the researchers were interested in uncovering the participants’ understanding and experiences during the learning process (Mason, 1996). A qualitative design enabled substantive exploration into the participants’ development over time. This resulted in intricate detail about the participants’ experiences and allowed a comprehensive and descriptive account to emerge (Merriam, 1998).

Participants

To enable an in-depth investigation into the experiences of the participants throughout the year-long project, seventeen pre-service teachers formed the collective case. Ten students were in their final year of the Bachelor of Education (Primary) and seven students were completing a Graduate Diploma in Education (Secondary). Participation in the study did not affect coursework or grades and no background technical knowledge was required, indeed, more than half of the participants declared themselves ‘novice ICT users’ in the initial survey. No participants had used LAMS before this project.

Methods and procedures

A broad range of qualitative data collection methods were utilised over the course of one year to collect sufficient relevant data. This triangulation of data sources enabled the developmental changes of the participants to emerge and evidenced key moments where connections between theory and practice were apparent (discussed in more detail in Kearney, Prescott & Young, in press). As outlined in Table 1 below, the data collection methods included: e-journal; initial survey; researcher observations; informal interviews; LAMS artefacts; written rationale; focus group interviews; final survey and open-ended questionnaire.

Table 1: Data collection procedures

Phase	Activity	Data collection
1	Familiarisation with LAMS and learning strategies	initial survey; e-Journals
2	Design learning activity	e-Journals; informal interviews written rationale
3	Implement learning activity	e-Journals; observations informal post-lesson interviews
4	Reflection on process and learning	Final focus group interviews; Final survey; Evaluation of LAMS artefacts

The pre-service teachers were encouraged to create specific online learning tasks underpinned by one of three well-researched learning strategies which aligned with the constructivist philosophy underpinning their maths and science education subjects, ie

- the *analogical reasoning* (AR) strategy (Harrison & Treagust, 2006). This strategy supports learners’ use of a familiar analogue to explore a ‘target’ concept;

- the *predict–observe–explain* (POE) strategy (White & Gunstone, 1992). This strategy scaffolds students' engagement with key demonstrations as stimuli for their learning;
- the (broader) 'interactive teaching' model (Biddulph, 1990), or *learners' questions* (LQ) approach (e.g. see Baird & Northfield, 1995, p.240). This approach elicits learner questions as a basis for further investigations.

There was ample literature available to the participants on these three strategies, including research authored by lecturers within the participants' programs (eg. Aubusson, Harrison & Ritchie, 2006). Participants were given sufficient time to become familiar with the learning strategy that would provide structure to their LD.

The participants were also supported in becoming familiar with LAMS as an authoring tool. At the time of the project, only version 1 of LAMS was available. In order to develop confidence and competence with the LAMS software, a range of strategies were employed. The researchers placed several LAMS sequences on the 'public' section of our project's LAMS account (viewable only to project participants), thereby allowing the participants to engage in existing sequences from a student's point of view (ie. learner mode); de-construct the sequences from a design perspective (in author mode); and also learn about the particular learning strategies informing each design. This approach is consistent with the principle of teachers needing to experience novel learning environments as learners themselves to consider changes in their teaching (Loughran, 1997). Two introductory workshops were conducted to introduce some of the authoring tools and associated LAMS resources, and a learning management system was used (Blackboard) to support students with links to relevant articles and relevant resources.

Once acquainted with the LAMS tool and their chosen learning strategy each participant independently created their own contextualised learning design. These designs were developed specifically to be used during each participant's professional experience in second semester, hence following a similar 'virtuous circle' approach discussed by Dalziel (2006) whereby teachers firstly use the LAMS environment as learners, followed by the design of their own sequences, followed by implementing their sequence as teachers with their own students. Participants shared their draft and final designs with their peers in the 'public' section of our LAMS project space.

Data analysis

As evident in Table 1 above, data was collected on an ongoing basis throughout the course of the year and at each phase of the project. The interpretive philosophy underpinning the design of the study enabled data to be analysed according to emerging themes across all data sources and across the collective case. In the first instance, each researcher individually examined all of the data from either the primary or secondary teachers. Themes were independently established from the perspective of each researcher. The research team then came together and, through a process of negotiation and critical collaborative reflection (Bullough & Gitlin, 1991), identified common themes that were capable of capturing the experiences of the participants.

Findings

Analysis of data related to the pre-service teachers' perceptions of LAMS as an authoring tool and as a K-12 teaching resource was useful in understanding elements of the tool and the processes which facilitate or impede teachers in designing and implementing effective online learning experiences.

Pre-service teachers' authoring experiences with LAMS

Two themes emerged relating to participants' authoring experiences with LAMS, raising issues about the system's flexibility and its ability to integrate new media and other web-based resources. These findings draw mainly on data from interviews, surveys and journals and evaluation by the researchers of the participants' actual LAMS tasks.

System flexibility and user-friendliness

An important factor which influences teachers' decisions to use technology in the classroom is the experiences they have in familiarising themselves with the technology and its ease of use to create effective learning experiences. Final survey results and other data revealed the primary and secondary education pre-service teachers found the LAMS authoring software to be user-friendly. Their score on the final survey question: *I found the Lams software easy to use*, reached an average of 4.3 (on a 5-point Likert scale); 14 of the 17 participants either agreeing or strongly agreeing with the statement. Only one

participant (Kim) found LAMS difficult to use and strongly disagreed with the statement. The remarks of Kim in her survey demonstrated her personal experiences with the tool: "Student teachers need to be aware that it really is a trial and error process... For me, the building process was very demanding and a great learning experience and implementing it with 6 students was very rewarding." However, the majority of participants talked about an initial 'learning curve' followed by a user-friendly authoring experience. Eleanor appreciated the ease of editing and used the preview mode to 'check' her work:

I found the authoring stage of the project much easier to complete than what I had anticipated. It was pretty much a case of dragging and dropping and inserting your questions or ideas for the task. The fact that you could then preview it meant that you could check the task's sequence and alter as needed (Eleanor, survey).

In his class presentation, Nick emphasised the flexibility of the authoring system, especially the ability "to adapt tasks 'on the fly', changing questions etc." (researcher notes). Novice ICT users such as Yasmine, Alice and Naomi agreed: "... after a small amount of time training, it was a very easy tool to use. I really enjoyed putting it together" (Yasmine, survey) and "I really like the different options you can use with this program. The program seems easy to use and well-structured" (Alice, journal, 03/07/06); and "I feel as though I am a novice when it comes to computer technology, however, I found LAMS to be incredibly functional and flexible with a variety of learning tools that could be incorporated into the design" (Naomi, survey). Lucy demonstrated a similar appreciation in her journal. At the start of the project, she recorded the following: "I'm still really cynical about ICTs and doubtful that they can do much that can't be done with more traditional methods and good teaching." She later recorded a contrasting journal posting mid-year after her immersion experiences with LAMS:

I'm beginning to realise just how wonderful LAMS is! It has an amazing array of tools available, all encouraging learner thought and feedback. Eg. I love that students can enter their own ideas and then read what other students have to say! (Lucy, Journal, 06/06/06.)

The LAMS author mode also effectively acted as a storyboard for pre-service teachers, allowing them to view their sequences in detail on the screen, enabling easier conceptualisation of their emerging task. For example, Eleanor mentioned in her survey:

I think that as a student teacher, the process of designing and building my task ...really got me to think about the most appropriate sequence of learning and the LAMS creation tool really allowed me to see that on a computer screen – making it easier to conceptualise.

Some students such as Hope went a step further and used annotated 'screen shots' of their sequence in the authoring and learner modes, to include in their rationale.

Analysis of students' final LAMS tasks demonstrated that pre-service teachers clearly developed a high level of competence with the various tools available through LAMS to create an effective and educationally sound learning task. The research team were initially concerned that providing 'sample LAMS tasks' (see Methods section) might result in the participants simply replicating the examples and seeing them as some kind of 'recipe' for their own designs, stifling their creative thinking about how best to use and sequence their chosen LAMS tools. However, the pre-service teachers exploited the flexibility of the system by experimenting with these tools, and often used their own students' feedback on their tasks to decide on their 'ideal sequence'. Elizabeth, for example, experimented with a range of tools before giving a post-lesson 'verdict' on the best combination of (LAMS) tools in her final survey.

I tested using the *Share Resources* [LAMS tool] followed by a *Q&A* tools as well as the combined *Resources and Forum* tool. The first worked much better. [My] Students found the step by step sequence easier to navigate. I would change the next time to have a *Q&A* [LAMS tool] following. (Elizabeth, final survey)

Almost all pre-service teachers commented on the usefulness of the *Q&A* tool setting that facilitates the 'exposure' of users' responses to other students and many rationalised use of the *Journal* and *Notebook* tools to support learner reflection. However, due to project time constraints and possibly lack of initial instruction, there was little use of the teacher 'monitor' mode. Also, for similar reasons, students found it too time consuming to consult the LAMS community to either download and 'de-construct' sample sequences or upload and share their own.

Integration of web-based resources and new media

Students easily integrated web-based resources and rich media into their LAMS tasks. Most pre-service teachers carefully selected and embedded external web-based resources such as applets, wikis, and online drawing tools, to provide extra interactivity. For example, this was of prime concern for Mike, who embedded a maths applet that helped students develop their knowledge of angles: “The relevance of the relationship between angles is seen clearer and easier than drawing many forms of the relationship by hand to get the same effect.” (Mike, rationale). Similarly, Natalie included an interactive graphing tool from an external website to help students manipulate changing slopes on a graph. She also included a range of other resources and recognised the efficiency benefits in being able to ‘wrap’ these experiences into one task for learners:

My task makes use of web links, applets and video in one package, giving students the opportunity to use resources that they wouldn’t have in a class environment and enabling them to be involved in discoveries through the technology that wouldn’t be achieved as quick in a paper environment. (Natalie, rationale)

Participants utilised relevant LAMS tools to include external sources of media and provide rich context to their tasks. For example, Naomi recognised that inclusion of appropriate media (in her case, videos of recent cyclones), allowed her students to view rich, out-of-class and possibly very current contexts that would not be possible to observe in traditional resources such as textbooks:

LAMS allows children to access ... class contexts, such as cyclones, that they otherwise would not be able to access in real life circumstances and also allows kids to have the opportunity to view or learn about very recent occurrences or concepts (that textbooks would not yet include). (Naomi, survey)

Interestingly, some participants created their own media. Anastasia, for example, created a car racing video-based demonstration to provide rich stimulus material for the boys engaging in her Year 9 Mathematics task on ‘rates’. Similarly, Eleanor used photos of her students’ work in her task designed to help her Year 2 children learn about animal habitats. She reasoned that this would not only help her students to visualise the analogy used in her task but also create learner ownership of the task.

This creative use of media, and indeed the whole authoring experience, helped participants to develop their confidence and competence in using technology in creative ways (Resnik, 2002). For example, Alice reported in her survey, positive development in her confidence levels:=.

The use of the LAMS program has increased my confidence in using a program for educational purposes and using other technologies to create the program, for example, including digital photos into the program and inserting pictures from the Internet.

Indeed, all 17 participants either agreed or strongly agreed with the following statement on their final survey: *The process of building my online learning task has helped me to develop my own technical competence*. The average score for this item was 4.6 (on a 5-point Likert scale).

Pre-service teachers’ views of LAMS as a K-12 teaching tool

Fundamental to the pre-service teachers’ emerging perceptions of LAMS in a K-12 school context was their (self-initiated) evaluation of their task on practicum. This process helped them understand how the different features of their LAMS task were received by school students and their benefits and limitations to facilitate learning. It also enabled them to reflect deeply on the usefulness of their LAMS task in their discipline area or within the grade level they were teaching. They developed positive views of LAMS as a tool to scaffold student learning and promote self-pacing but there also were some perceived procedural and technical issues. These findings draw mainly on data from interviews, surveys and journal entries.

Feedback during practicum

What appears to have had the most impact on participants’ perceptions of LAMS as a teaching tool came from their students’ feedback about their learning experiences and also the feedback provided by supervising teachers. Pre-service teachers chose a variety of methods to evaluate their students’ learning and the effectiveness of their LAMS task, including student surveys (paper or LAMS-based), formal and informal interviews, observation during class, artefact collection (eg. school students’ online, LAMS-based responses to tasks), supervising teacher (written or verbal) feedback, and post-session, whole class feedback session. Some students used a combination of methods. For example, Eleanor looked to see that her Year 4 students were not distracted and demonstrated collaborative behaviour. She also read the

students' responses and these demonstrated thoughtful and engaged behaviour. Laura used an informal interview and observed the students' (face to face) discussions to evaluate whether her task was able to "capture a child's curiosity and allow them to enjoy themselves whilst learning" (Laura, journal). Hope used a LAMS-based survey to get feedback from kids: "... it's important to test it to see how kids react to what you have done." (Hope, final survey). Elizabeth appreciated the rich feedback from her students:

...the implementation and feedback was the best. It taught you many unexpected things. I would encourage getting a feedback survey from students too. It added to the learning experience and taught you more about how students think. (Elizabeth, final survey)

Naomi was one of the few pre-service teachers who had the opportunity to conduct an informal post-session, whole class feedback session, wherein the school students provided some useful insights into their collaborative learning experiences with the LAMS task. Her students discussed the collaborative pairing arrangements and their preference to engage in small group discussion before recording their answers individually at the computer.

LAMS as a tool to support learning

Many participants perceived the main affordance of LAMS as enabling their school students to work independently, providing scaffolding and self-pacing , with implications for new facilitatory teaching roles (see also Kearney, Prescott and Young, in press). Many pre-service teachers discussed the affordances of self-pacing in their rationales, interviews and surveys. Natalie, for example, valued this aspect of her online design: "... they can go back and look at parts again (potentially) as a point of revision to start again... Then continue on to new work at their own pace." (Natalie, final survey). Others thought the self-pacing aspect encouraged more school student ownership of task responses, and also supported less didactic teaching methods: "The fact the kids were able to work at their own pace on the computer meant there wasn't a teacher at the front doing all the teacher talk." (Eleanor, focus group).

However, there were contrasting views on the optimum level of scaffolding. For example, Lucy and Eleanor critiqued the level of student flexibility: "It's hard for students to have input in the direction the task takes ... There is not as much room for lateral movement in the task." (Lucy, final survey)

They [the students] get no choice in the sequence of events, nor a chance to investigate any misunderstood concept any further than the information presented to them. The program seems to speak to them, but cannot read their answers/responses and adapt the following sequence accordingly like a teacher could. (Eleanor, focus group)

They questioned the potentially constraining, structured nature of their LAMS tasks and the limited opportunities for school students to influence the direction of their task. Natasha emphasised the key role of the teacher here: "... you can't have it so the kids are in total control ... you need teacher input to give them stimulus and direction" (Natasha, focus group); while Anna advocated a balanced approach:

I have found that such [LAMS] activities need to ... be designed to guide, but not excessively constrain, the students' exploration... promoting lines of inquiry that help students develop their understanding of the important concepts. (Anna, rationale)

Participants also valued the recording features of LAMS, especially the automatic collation of individual student's responses: "... the ability to review every student's feedback since in class most of the views would not have been exposed" (Elizabeth, final survey). Many participants also valued the diagnostic role of their LAMS task to provide information to them about their students' current level of understanding, especially at the start of a unit. In her final survey, Elizabeth stressed that she could better tailor follow up (face to face) discussion [after her task] because of the great variety of responses she received. Mike concurred: "...one of the strengths ... was being able to collect and store student's responses for further scrutiny at a later date ..." (Mike, final survey); while others were enthusiastic about summative assessment purposes: "... I will definitely be using the LAMS tool as a culmination of a unit of work in the future. (Eleanor, final survey)

The pre-service teachers perceived LAMS as yet another tool in their growing repertoire of teaching tools. Eleanor was typical here: "... the teacher has another tool to further engage students in their own learning... I particularly liked the adaptability of the software in terms of using it in different ways as a teaching tool." (Eleanor, final survey). They felt that their student participation levels were enhanced because their LAMS tasks provided a 'safety valve' or a more 'risk-free' environment, which was less confronting, especially when anonymous postings were allowed. This enabled their school students to

express their personal Science and Maths beliefs more openly and freely “give answers without the fear of being ridiculed if they are incorrect” (Laura, final survey). Indeed, Natasha could see the advantages for shy, quiet students: “quiet students require an opportunity to ask questions in a more private arena. Using LAMS provides that arena while also allowing students to share their questions with other students” (Natasha, final survey).

Procedural and technical constraints

The primary concern raised by the pre-service teachers about LAMS centred on ‘time’ constraints. They expressed some concerns about the time to create a rigorous online learning task which often would only form a small part of a lesson or unit of work. Some participants also found the process of previewing and making final adjustments laborious. For example, Lucy highlighted the meticulous nature of this work in her final survey, particularly making instructions clear to students: “It’s taken more time than I expected ... Finalising all the steps, previewing them, making minor adjustments, previewing again ... most of the corrections were just making sure it was clear to students what they had to do.”

There was recognition that when full time teaching they would have little time to spend on looking for media and other resources and constructing a LAMS sequence. For example, the preparation time was a major concern for Natalie and Anastasia: “you can’t just scope together a few screens of information and have it work.... I would say it has probably made me a little more clear on how much preparation will be needed.” (Natalie, final survey) and

Given all I've heard about teacher's workloads in the first few years, I don't see myself taking the time to create too many lams-style lessons. Maybe I'm just feeling a little defeatist at the moment.... Overall, I still like the idea of LAMS for Maths. (Anastasia, journal 15/08/06)

However, there was also a recognition that next time would be quicker due to their familiarity with LAMS and also what is created now could be re-used and adapted. Amy also saw the process of participating in the project as “great practice to help me understand the workload that needs to go into completing a task in the computer classroom” (Amy, final survey). This is an important issue for many prospective teachers who have often spent more time in the traditional classroom on practicum and have not had the opportunity to create computer-mediated learning tasks in their lessons.

It became apparent to the pre-service teachers that including online tasks in a lesson can also take more time than first expected. In their final focus group interview, Elizabeth and Anastasia emphasised the importance of ‘follow up’ discussions and lessons to facilitate learning outcomes. Lucy acknowledged therefore, that LAMS tasks take more time than some other conventional tasks, while Hope emphasised the time it takes to read student responses, “more than if you had conducted a f2f class.” (Hope, final survey q3). There was general consensus that these ‘time issues’ made it imperative for teachers to be selective about when to ‘do’ (design or implement) these types of online tasks.

There were some login and other network problems experienced which affected some participants’ views of LAMS. One major impediment was that, in many cases, the videos that formed a major part of participants’ LAMS tasks did not work. Some school networks either prevented the downloading of videos or were unable to manage a whole class ‘downloading’ at the same time. This was unsatisfactory because of the time involved in finding these videos, but more importantly they were a major component of their tasks. In Anastasia’s case the attraction of students working at their own pace was lost because the video had to be shown to a whole class when all students were ready to watch it. However, Anastasia saw the positive side of such difficulties: “Student teachers designing and implementing online tasks benefit by experiencing technical issues that are likely to hassle them when they are new teachers.” (final survey. Q14) Indeed, Elizabeth M. believed “you have to be prepared for technical problems” (post-lesson interview) while Lucy emphasised the importance of a ‘back up’ lesson. It was these types of problems (as well as some difficulties with the ‘html noticeboard’) that explained the lower average of 3.3 (on a 5-point Likert scale) on the final survey question: *I found the technical part of this project challenging*; with 7 of the 17 participants either agreeing or strongly agreeing with the statement. Improvements in school networks and improvements made in version 2 of LAMS should address many of these difficulties for the prospective teachers.

Finally, there was a general consensus, particularly from the pre-service primary teachers, that Years 4-6 children would be better able to deal with the language and general technical and typing skill requirements of LAMS-based tasks, than the younger primary children. For example, Alice talked about the heavy dependency on text for her Kindergarten children doing her task:

The program is highly dominant in written text, which will be quite difficult for the children as they can only read common and small words at this stage and still do not always gain much meaning from reading unless it is very repetitive. (Alice, journal: 20/07/06)

Natasha's journal entry was typical of these K-6 prospective teachers' views: "It will mainly be useful in a primary classroom for Year 3 up as it would require a fairly good level of language as well as computer literacy skills" (Natasha, journal: 13/06/06). Another common concern from these participants was making the LAMS task visually appealing to children. Yasmine mentioned in her survey: "The only thing I would like to see added is the visual side of the program." (Yasmine, survey), while Naomi found it time consuming to address this issue: "Making the information look appealing to kids is what is taking me ages to do" (Naomi, journal: 15/08/06). Again, improvements made in version 2 of LAMS, such as the web-based html editor for most tool activities, should address some of these concerns.

Discussion

Pre-service teachers found the LAMS authoring software to be an easy to learn and flexible system. The LAMS author mode effectively acted as a storyboard for pre-service teachers, allowing them to view their sequences in detail on the screen and enabling easier visualisation of their task design. Instrumental in the pre-service teachers' emerging perceptions of LAMS as a teaching tool in a K-12 school context was the school student and supervising teacher feedback they received on practicum. They developed positive views of LAMS as a teaching tool, centred around affordances relating to scaffolding and self-pacing (similar to the Lam, Au Yeung and McNaught, 2007 study), and also into their new teaching roles. Other concerns raised centred on making tasks visually appealing to young children, 'time issues' relating to the preparation and implementation of LAMS tasks and also inevitable technical issues relating to school networks. Although not discussed in this paper, the pre-service teachers also developed sophisticated insights into blended learning issues and how to utilise the affordances of an online environment to promote active, collaborative learning. They thoughtfully critiqued their chosen learning strategy which informed their design and the implementation of their LD in a real-life, school context encouraged thoughtful analysis of related pedagogical issues (see Kearney, Prescott & Young, *in press*). A draft generic learning design based on analogical reasoning has also emerged from the study (see Kearney & Young, *in press*), including a visual sequence (Agostinho, Harper, Oliver, Hedberg & Wills, *in press*) depicting this beta design as a graphical representation.

The study has implications for support structures needed, in this type of e-learning design exercise, to promote pre-service teacher reflection on pedagogy. If possible, the design of an online learning task should not be treated as an isolated exercise in teacher education courses and needs to be embedded in the authentic context of school practicum. The process of implementing their design gave the pre-service teachers in this study greater opportunities for reflection and evaluation of their role as a designer and a learning facilitator in a blended learning environment. Furthermore, pre-service teachers need time to read about and 'test' their new LDs, time to learn how to use LD authoring tools and opportunities to reflect on their school-based implementations. If new and sophisticated tools like LAMS are not explored during pre-service teacher education courses, they are unlikely to be adopted by new teachers because the time-pressures of novice practitioners do not allow for such experimentation. It would be useful to introduce LD authoring systems early in the degree so that pre-service teachers have opportunities to create and 'test' several LDs, further developing their expertise to readily create, adapt and re-use LDs. This expertise would make it more likely that LDs were actually integrated into their classroom practices once they commenced teaching full-time. Also, the time issues raised by the participants in this study highlight the importance of promoting the online LAMS community in teacher education as a forum for shared resources and ideas.

This study promotes teachers as important stakeholders in research on LD. It is important for the LD research agenda to further explore this area and continue a strong focus on practical and pedagogical issues, especially in the crucial area of pre-service teacher education. To build on this study, future projects could follow these teachers as they enter the profession and observe how they represent, document and re-use their LDs in their own classrooms, with their colleagues and across the K-12 education community. Also important are ways in which they share and discuss their LDs with larger audiences, such as the LAMS online professional community. The practice of creating, implementing and sharing LDs has enormous potential to reduce the traditional isolation of teachers and it would be useful for research to explore how, when and why teachers use their LDs to remove some of the barriers to professional collaborations across disciplines. Indeed, such a longitudinal approach to study the development from (early) pre-service to practising teacher would provide important insights into changes

in the level of sophistication of the LDs and their use of authoring and editing tools such as LAMS. Also, it would be useful to document changes in the teachers' abilities to overcome some of the issues they identified as constraints.

Conclusion

This paper has reported on findings from one component of an in-depth study investigating the efficacy of pre-service teachers using a LD authoring tool to facilitate their professional learning. Findings indicate that this is a valuable process for prospective teachers, developing their understanding of issues associated with new e-learning approaches (see also Kearney, Prescott & Young, in press). LAMS acted as an effective 'test-bed' for the teachers' designs and implementation of these tasks during the participants' practicum.

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