Employing technology to facilitate empowered and critical learning for pre-service teachers

P. Mannix-McNamara¹ and R. Lynch²

¹ Research Centre for Education and Professional Practice, Faculty of Education and Health Sciences, University of Limerick, Ireland
² Technology Education Research Group, Department of Design and Manufacturing Technology, University of Limerick, Ireland

Real progress for the development of lifelong learning can be achieved through more flexible forms of educational provision [1]. According to the Organisation for Economic Co-operation and Development (OECD), in order to provide more responsive pedagogical engagement to enhance the student experience, changes of values, attitudes, institutional organisation, modes of teaching and the provision of resources and facilities are needed [2]. This chapter advocates for the potential of technology to provide more flexible and student centred education that will meet the needs of diverse learners. Technology can greatly enhance project work and problem based learning. The use of technology to promote peer feedback and self assessment can make a significant contribution to broadening the cognitive and affective development of the student teacher. This chapter will examine in detail the potential for technology to enhance the critical thinking of students and facilitate them to adopt more empowered and autonomous learning behaviours. Drawing on a two year project the chapter will demonstrate the effectiveness of the use of ICT in encouraging higher order thinking. It will make the case that exposure to this form of education may encourage future teachers to challenge traditional understanding of the teacher’s role and encourage the development of teachers who are committed to empowering education for their students.

Keywords critical learning, problem based learning, technology

1. Introduction

The context of pre service teacher education has changed significantly in recent years. Traditionally, the subject area of pre-service teachers of technology education was primarily focused on vocational needs, with specific emphasis on preparing students for industrial employment or future trades [3]. Changing public need, with a greater emphasis on a knowledge and concepts-based society [4], has resulted in the emergence of apposite educational goals to meet these needs [5]. As a result much more is expected from students and teachers than ever before [6]. This chapter discusses the potential of integrating technology and pedagogy to develop students’ critical-thinking skills, with a particular focus on the decision-making and problem-solving aspects of critical thinking through project based modular teaching. It explores the reciprocal and transformative interaction between pedagogy and technology [7] through the use of blogs to promote critical-thinking and engagement amongst pre-service technology teachers. Technological advancement means that teachers now have at their disposal a range of innovative technologies that can aid them in adopting more responsive pedagogies that encourage a broader range of skills development. Contemporary societal needs require autonomous learners with the appropriate decision-making and problem-solving skills to work and adapt within an increasingly capricious environment [8]. The current pace of technological advancement requires graduates to have the skills of analysis, synthesis, and complex problem solving [9]. There are now more complex expectations of graduates, and this is particularly the case for initial teacher education students who graduate as the technology teachers of the future. There is increasing pressure on higher education institutions to prioritise the development of critical thinking amongst students and this is linked in no small part to the information society/knowledge economy ideology that students are expected to play a part of post-graduation. Indeed, they are expected to operate in “an increasingly technologically complex and information rich society” that requires them to be able to “critically analyse the source, content, and quality of the information provided, as well as use that information effectively” [10]. In effect the expectation is for empowered autonomous thinkers who can engage at a sophisticated level of critical thinking.

2. Context

Students need to develop cognitive skills and strategies to achieve specific desirable outcomes, where the ‘desirable outcome’ is often defined by the individual themselves [11]. The development of students’ critical thinking skills is increasingly prioritised in initial teacher education which is appropriate given the unique position of their graduates to influence future learning outcomes. However, the current matriculation system in Ireland prioritises summative examination grades and as a result subject pedagogy is often predicated on the contracted aim of preparing students to pass these exams [12]. Teachers tend to teach the way they have been taught themselves [13, 14], a process Lortie [15] has identified as the apprenticeship of observation. This becomes problematic if the pedagogies that teachers have been
exposed to are predominantly didactic, which may lead to continued reproduction of less than optimal learning experiences for students. In Ireland the focus on summative assessment has meant that a reproduction model of knowledge which is tailored predominantly for a final exam, regularly results in surface learning [16]. Coupled with a didactic pedagogical approach this potentially results in less autonomous students who later struggle in the development of critical thinking because this practice prioritises the reward of recall and reproduction of information [17]. The prevailing focus on exam performance not only influences but dominates the pedagogical strategies employed by teachers in post primary schools and also those employed by teacher educators in higher education settings [18]. Consequently, there exists a significant challenge for teacher education programmes working within the dichotomy of a matriculation system with a narrow and ever increasing focus on summative examination results, and conversely the broadening societal needs from its graduates [19]. In order to address this, it is essential that student teachers develop critical thinking skills that can empower them to; identify potential deficits in their own knowledge structures, determine sources or methods of addressing such shortfalls, analyse and evaluate diverging arguments or positions, develop and verify conceptual solutions to complex problems, and to present and defend ones position or solution. Ronau, Rakes and Niess [20] make a strong case for the pedagogical value of technology and that the effects of technology on student learning needs to be explored in order to better determine the effectiveness of technology as a pedagogical tool. Employing technology strategically can greatly enhance the pedagogical practice of teachers in higher education. In doing so it is possible to expose prospective teachers to modes of learning that are dynamic, interesting and that can actually enhance the development of critical skills. Exposing initial teacher education students to technology enhanced pedagogy can encourage them to challenge their traditional understanding of the teacher’s role [11] and encourage the development of teachers who are more committed to empowering education for their students. In an attempt to promote the development of these requisite skills within an initial teacher education programme, the authors turned to contemporary technology and the use of web logs (blogs). The use of such technology for the enhancement of pedagogy has been well documented with Hernández-Ramos [21] advocating for the incorporation of web logs in initial teacher education as a successful means of promoting reflective practice among pre-service teachers.

### 3. The Use of Web Logs as a Pedagogical Resource

The use of information and communication technologies as a tool for the development of empowered and autonomous learners has been established [22, 23]. Enhancing education through pedagogically appropriate technology can serve to greatly develop critical learning. It is possible to create learning environments that encourage critical thinking and that promote active learning through feedback that facilitates students to challenge their current conceptions of knowledge through interaction with other students [24]. In this chapter the authors ground their discussion in empirical research conducted in a teacher education programme in which a module in the area of process technology education was adapted and restructured to include a significant problem and project based learning (PBL) element as well as a supporting ‘blog’. As part of this module third year pre-service technology education students were required to design and manufacture a model motorbike. Students were encouraged to design the model around a specific theme of their own choosing. They were required to provide a rationale for this theme, as well as all subsequent design choices through an online web log. All elements of the design ideation and manufacturing process were logged online through students’ own individual blogs. In the previous year students completed a similar project but without the use of blogs to track their design process and share feedback and ideas, instead students previously handed up a summative report upon completion of the project. The following year the use of blogs was adopted to enhance inter-student communication as all students could access each other’s blogs and were encouraged to provide critical and constructive feedback throughout the module via this online resource. In this context, web logs were employed to empower students in their interpersonal communication, encouraging reflective practice where deficiencies in knowledge and areas of difficulty could be identified and through a process of peer support and feedback could often be resolved. In addition, this module also experientially provided students with a model for incorporating an element of web 2.0 technology into their future classroom practice, a model that Greenhow [25] argues is central to any effective implementation strategy employed in initial teacher education.

#### 3.1 Facilitating Reflection

From the beginning of the module students employed their blogs as an introspective reflection tool communicating concerns about their designs with their peers and asking for advice, for example this student sought advice from his peers via the blog:

I originally had chosen design 4 for my seat but when I sketched it out in the overall design for the bike I am not sure it fits with the vintage theme. Could I please get people’s opinions on the best seat design for my bike? (Student 30)
Interestingly, the web logs facilitated the empowerment of students to communicate ideas and information through a variety of media, with many students choosing to present solutions to problems encountered throughout the module in graphical form, which may otherwise have been difficult to convey. This flexibility of the web log provided the freedom to explore ideas from the very initial stages of work. For example, students were able to present their peers with the overall design for their model initially through sketches. Upon receipt of feedback the students could then develop these designs and ideas through the use of Computer Aided Design software, which once again could be shared with their peers and tutors through the web log for further comment before proceeding to manufacture a tangible model motorbike (as shown in Figure 2). By harnessing the ‘wisdom of crowds’ [26], students were able to utilise the web logs to test concepts and assess the potential for their creative designs, through peer support and feedback.

3.2 Facilitating Feedback and Collaboration

Students were also able to share their ideas and provide feedback and advice in person during their workshops as they worked on the manufacture of their individual models throughout the module. In this respect, although students worked autonomously on their own projects, it became very much a collaborative experience. The development of this collaborative environment was germane to the process as it is cognate of the future teaching environment in which the students will be working, where the teacher is an intrinsic part of the wider school community but often works in isolation within the classroom [27]. The use of web logs proved to be a strong foundation for the development of a collegial environment, providing students with a space not only to share ideas outside the workshop but also with a mechanism of tracing ownership of ideas and design, as each post was date stamped. A key strength of the web logs was that they were a constant source of support and encouragement as the following extract demonstrates:
The frame came out very well. No doubt took time, but was well worth it in the end. Best of luck with the finishing touches (Student 56)

Brake discs look very good. Looking forward to seeing the end result (Student 31)

Student 2: Is the CNC milling machine difficult to use?
Student 22: No it’s not hard at all, would only take 5 minutes to show you if you ever need a demonstration?

3.3 Facilitating Autonomy

The cyclical and reciprocal nature of critical reflection and providing feedback, as well as the shared experience of students, facilitated the development of peer supported learning. Simultaneously, students were also developing autonomous and lifelong learning skills that should serve them well in their future careers. Students set individual goals for their project, outlined their timelines to achieve these goals, identified areas of difficulty, researched possible solutions, evaluated conflicting feedback, requested clarification, and provided a rationale for their chosen solution all through the medium of the online blog. This not only promoted the development of the requisite skills for completion of this module, (i.e. progressing from the initial design ideation stage to complete model motor bike as shown in Figure 3 and 4), but students also developed the broader skills of consultation, reflection and problem solving, in effect the critical thinking skills desirable and necessary for future teachers. The project encouraged student creativity through working on individual projects, a skill that the authors believe should be central to facilitating learning in the classroom. As emphasis by Sawyer [28] and Egan [29], student interest and motivation is predicated on creative lessons, the design of which the subject teacher alone is directly responsible for. It is therefore important that student teachers are exposed to analogous pedagogy within initial teacher education programmes. The employment of problem based learning and the resulting structure of the learning activities facilitated the transfer of prior skills in new and less well-defined situations as promoted by Halpern [11]. However, it was technology in the form of web logs that helped promote greater critical thinking and reflection, encouraging self as well as peer assessment, thus elevating the short-term learning outcomes of an individual module to the development of the requisite life-long skills for teaching.
4. Transferability into Teacher Pedagogy

As highlighted by Dabbagh [7] and supported by the results of this project, technology has a key role to play in promoting enhanced pedagogy. It provides unique opportunities to develop the self-esteem and self-efficacy of students, and in particular to facilitate students to learn at different paces and to become more autonomous learners. The effectiveness of technology to enhance pedagogy is of course dependent on the teachers’ epistemology, and their commitment to the facilitation of critical thinking. Technology that can enhance pedagogy can be appropriated by teachers as a tool to develop problem solving techniques. This project resulted in a module that provided pre-service teachers with an experiential model for the integration of technology and problem based learning into their future professional practice. It highlighted the benefits of web logs in promoting peer supported learning and self reflection, as well as developing the necessary skills required to transfer this knowledge beyond initial teacher education into their future careers. However, the pressures of working within the summative assessment paradigm of many second level education systems can present significant challenges for teachers as highlighted by Hennessy et al [12]. The dichotomy between espoused teacher pedagogy and the demands of the education and matriculation system can create conflict. An often overloaded curriculum [30] and increasing time constraints on teachers [31] can impede teacher pedagogy and the embracing of contemporary technology. However, teachers do not need to feel that they have to choose between deepening critical thinking or prioritising exam performance in contexts that are heavily exam driven as is the case of the Irish post primary schooling system. The strategic use of technologically supported pedagogy can enhance the quality of student thinking, which as highlighted by Black and William [32] can improve student performance in summative examinations. As a result, both critical thinking and performance success can be achieved simultaneously, with the potential to significantly mitigate the pressures faced by teachers and in the process provide students with an innovative, exciting and contemporary learning environment.

5. Conclusions

The use of web 2.0 technology and in particular web logs presents the potential for a more participative learning environment within initial teacher education, especially when supported by appropriate pedagogy such as problem and project based learning (PBL). However, if the benefits of this technology are to be experienced in the school classroom, pre-service teachers must be presented with authentic learning experiences that encourage not only the use of web logs but that also highlight their pedagogical value as a future teaching resource. Through the formal incorporation of web logs as a formative feedback and reflection tool within an undergraduate teacher education module, students were presented with an experiential model for the implementation of similar structures in their future practice. The use of web logs can help promote collaboration and peer supported learning, as well as autonomous learning through continued reflective practice. Within this context, web logs also raise the potential to support the development of critical thinking skills as students are encouraged to identify and reflect on problems encountered, assess possible solutions and evaluate feedback, develop concepts and expand on initial designs ideations, as well as offering constructive feedback to their peers. These are all important skills, cognate to those required in their future careers as teachers.

References