Exploring a technology-facilitated solution to cater for advanced students in large undergraduate classes

R. Oliver
Faculty of Communications and Creative Industries, Edith Cowan University, Perth, WA, Australia

Abstract
Often with large classes of students it is difficult to cater for individual needs. Large classes hold many students, some of whom may be under-prepared for the course they are taking and some who will already have a high degree of familiarity with much of the planned content and learning outcomes. In catering for the diversity of students, teachers often teach to the lowest common denominator, catering for the former, but failing to provide a challenging and fulfilling learning programme for the latter. This paper describes a project undertaken in an Australian university where students enrolled in a large class were provided with the opportunity and incentive to undertake a technology-facilitated individual authentic learning project in place of the more structured coursework pathway. The purpose of the activity was to enable advanced students to extend their learning through an independent project. An inquiry was undertaken to explore the effectiveness of such an approach as a means to cater for diversity in the cohort and to investigate the factors influencing the learning outcomes that were achieved.

Keywords: higher education, large classes, teaching and learning, technology.

Individual differences among students
Students entering university come from a variety of backgrounds, and it is no longer the case that the large majority of students in university classes will be school leavers. At Edith Cowan University in Western Australia in 2005, for example, 30% of the entering cohort came from previous tertiary studies, 26% were school leavers, 11% came from vocational education, 12% were mature age students entering through a standard tertiary admissions test (STAT), and 21% came from other pathways. The variation in entry pathways leads to a diversity in background, and it is often a difficult process for institutions to plan courses, that can adequately cater for the learning needs of all students and cohorts.

Teachers have always been confronted by individual differences among their students and have actively sought ways to redress the issues (e.g. Medici & Montgomerie 2001). The individual differences that are often confronted among students in university classes include differences in:

- prior learning experiences and background knowledge;
- preferred learning styles;
- levels of learner metacognitive skills and learning independence; and
- differing levels of motivation and enthusiasm for learning (e.g. Hong & Kinshuk 2004).

Dealing with diversity in mainstream teaching is a challenge that all teachers face. Some schools and
colleges cater for diversity in the student population through the provision of special classes. Often students are removed from their normal classes and made to attend classes designed to meet their special needs, for example, special programs for students with learning needs and for those deemed gifted and talented (e.g. Siegle 2005).

There are a variety of strategies that teachers can employ to cater for diversity in a student group without necessarily creating distinct classes. High on the list of possible actions is the provision of a curriculum that is student-centred and enables students to make choices and decisions in the learning activities they undertake. Such student-centred curricula can come in many forms, for example, problem-based learning, project-based learning, online learning or combinations of all of these (e.g. Sluijtsmans et al. 2002). In such settings, students are able to undertake projects that can be attempted within their own limits and capabilities, and as a result are seen as potentially more able to cater for their individual needs.

At the same time, in large classes, teachers are often reluctant to employ such measures across whole cohorts (e.g. Jonassen 2001). Studies of problem-based learning in university classes have demonstrated the need for participating students to be able to manage their own learning, and to have developing levels of metacognition (e.g. Oliver 2001), skills which are often underdeveloped in students in their early years of tertiary studies. As a consequence, teachers often restrict the use of student-centred approaches with problem-solving requirements for more senior cohorts, and those that are smaller and more manageable.

Technology-facilitated learning

Technology is often proposed as a potential solution for catering with individual differences in educational settings (e.g. Laurillard 1993). Technology provides many affordances that can be used to provide meaningful learning settings for learners and appropriate learning supports. Many universities today employ large-scale technology supports for their teaching programmes and use these to support the needs of individual learners (e.g. Collis & Moonen 2001). But despite these systems, we still often see a curriculum where ‘one size fits all’ and students end up studying the same course despite significant differences in their backgrounds and needs (e.g. Bonk & Cunningham 1998).

There are a raft of Web-based supports that have been shown to provide opportunities for supporting student-centred learning modes (e.g. Dabbagh & Kitsantas 2005). Web-based tools that provide communications capabilities and interactivity that can extend teaching and learning strategies and opportunities beyond those achievable through conventional means exist. These include collaboration and exchange tools, and content and creation tools. The capacity of such tools to cater for the learning needs of advanced students comes from their ability to scaffold learner-centred individual and group-based learning. These tools can provide strong scaffolds in instances when students are able to take the initiative for their own learning in project and inquiry-based settings. In such cases, the technology provides support for students to be monitored in their activity, to have various scaffolds provided to guide and inform their learning (Collis & Moonen 2001).

As well as software and systems, contemporary technologies provide teachers and learners with a range of powerful mobile communications devices for learning, including portable digital assistants and laptops with seamless wireless Internet and network connectivity. Many projects have reported the success of such mobile devices being used to support teaching and learning across all sectors of education (e.g. Kennedy 2003; Hill et al. 2003). In a number of settings, mobile laptops have been shown to provide enhancement for student-centred learning, in the form of scaffolding and support and access to a rich information and content base (e.g. Hill et al. 2003).

Authentic learning

Selecting a technology-facilitated learning experience that might enable advanced students to deepen and develop their understanding and skills is a very open-ended activity. The extant literature suggests the need for a learning environment that is problem-based (e.g. Jonassen 2001). Problem-based environments can be developed in a number of forms depending on the intended learning outcomes and the nature of the student cohort (e.g. Gijbels et al. 2005).

In describing the characteristics of effective learning environments for higher education, Boud and
Prosser (2002) argue that the setting must demonstrate specific attributes. The setting must provide a motivating and engaging context for learning that acknowledges the learner’s contexts and needs. It must challenge the learner and be cognitively engaging, while providing opportunities to practise and use the application of the knowledge, skills, and understandings being developed. Consideration of these factors can provide strong guidance in the design of learning tasks.

A learning approach that incorporates the characteristics described by Boud and Prosser (2002) within a framework that can guide the design of appropriate learning activities is authentic learning (e.g. Oliver & Herrington 2003). Authentic learning describes a learning approach that situates the learning experience in real-life tasks and activities that reflect workplace and contextual applications. The basis of authentic learning is that students learn through an active process that involves problem solving and inquiry within multiple information sources, reflection, and collaboration in the development of a product or artefact (e.g. Herrington et al. 2003).

A combination of the understandings and assumptions drawn from previous research, led to the assertion that a potentially powerful environment for catering to the needs of extended students in a large undergraduate first-year class in a university could be one designed with the following features:

- an authentic learning setting where learners would choose a complex and real-life authentic problem to explore and solve; and
- with strong technology support to guide and scaffold the student learning experience.

Research questions

With these thoughts and ideas in mind, a learning experience was planned for students in a large undergraduate first-year class with a diverse student demographic, where a large degree of individual differences was known to exist among the cohort. An authentic learning activity was devised as an extension activity that would provide volunteering students with the opportunity to learn in a project-based mode. A strong technology support was to be provided to the students in the form of an individual technology kit comprising a wireless and Web-enabled laptop computer and a digital camera. An online environment was also planned to help the learners form a collaborative learning community as they participated in the project.

As there were many novel and unexplored aspects to the project, an action research inquiry was planned to accompany the conduct of the project to explore its outcomes. The research project used a design-based research approach (e.g. Reeves et al. 2005) to seek answers to the following questions:

- How well can an extension project cater for the learning needs of advanced students in a large undergraduate class? and
- What factors influence the learning outcomes that can be achieved from such an extension activity?

The Methodology

The extension project was conducted in a large first-year undergraduate class of 350 students studying a unit in communications and digital technology. This first year unit aimed to develop students’ skills in visual design and communication. The unit centred around learning the fundamental principles of visual design using various productivity tools, that is, a word processor, a presentation tool, and a tool for building Web pages. The course aimed to develop students’ abilities to apply visual design elements and principles in the design and development of documents and pages. The conventional course was delivered around a series of topics, which students completed on a weekly basis. While the course involved a strong technology basis for its delivery, the learning outcomes were all intended to be demonstrated in the design and development of creative products rather than the demonstration of information technology skills per se.

The extension project was designed as an independent learning activity. The project required students to explore and develop a Visual Design Guide for Dummies, in a setting of their choice. In keeping with the intention to develop an authentic setting, the extension project was planned to comprise the elements described by Herrington, Oliver and Reeves (2003) as indicative of this form of learning setting. These included an open-ended ill-structured task, with relevance to settings beyond the classroom, providing an opportunity for a diversity of solutions,
offering the ability to accommodate multiple perspectives and supporting collaborative learning and learner reflection.

While the project was planned to be independent from the mainstream class, some scaffolding and support was built in. Across a 6-week period, students were required to choose a topic and to share their ideas virtually with other members of the extension project group. After approval from the lecturer, they would then be required to follow a weekly schedule involving set activities:

- to research and explore their topic;
- investigate contemporary practice;
- develop some guiding design principles in generic and then in contextual forms; and
- develop the final booklet as a polished product and guide for others.

These activities were scheduled and involved weekly deadlines. A series of bulletin boards were used to enable students to post their work, and a requirement was that group members would also review the work of other members and provide brief peer feedback in the form of public online postings. The completed booklet was assessed and the resulting grade and mark used in place of the assessment activity undertaken by the other students in the unit.

At the commencement of the first lecture, all students in the unit were introduced to the aims and intentions of the learning programme. They were advised of the learning process, which involved a weekly 1 h lecture accompanied by a 2 h workshop. Students were informed about the extension project and those with previous experience and background were encouraged to think about applying to participate. Interested students were asked to nominate their interest by sending an e-mail to the lecturer. Students were informed that selection would depend on the fact that there were limited technology kits available and would be based on the following criteria:

- The level of previous visual design and computing experience;
- Levels of previous computer and applications software expertise; and
- The suitability and novelty of the proposed area of investigation.

A meeting was planned to enable interested students to attend and ask questions about the project ahead of providing an expression of interest. Twelve students attended the meeting, and by the time submissions closed 1 week later, 18 expressions of interest had been received.

Participants

The number of students who expressed an interest in participating was significantly lower than was anticipated. With 350 students, it was expected that at least 10% would be interested in this project. The 18 expressions of interest meant that the project would be far smaller in terms of participation than was originally expected. With the small numbers, little difficulty was encountered in selecting the students. Among the 18 expressions of interest, four students were found to have limited previous experience and were removed from the list. Letters were sent to the remaining 14 students inviting their participation. Among these students, six students had selected similar topics to other students and they were asked to consider alternative topics. Several students had chosen Web design as their topic and they too were asked to choose another area of inquiry, as this topic was the focus of classwork and not likely to lead to any extension on the part of the students.

Students were invited to come and collect the machines, and by the end of the second week of the unit, 12 students had selected a topic and received approval to proceed and had collected a technology kit and detailed instructions of the extension activity.

Data collection

A number of data gathering methods were used to collect information to provide feedback on the conduct of the project and learning outcomes achieved. Students completed two online questionnaires during the project, one in Week 3 and one at the end of the project, Week 7. The postings students made to the online discussion boards were reviewed, as were the submissions and postings of the materials being gathered and developed. On completion of the project, the booklets were also used to explore the quality of the submissions and as a measure of the learning achieved. The following sections describe the progress...
Findings

Topic selection

In order to apply to become involved in the extension project, students were required to nominate a project area in which they would work and explore. The topic was closely related to the unit objectives in relation to design, but aimed to provide students with the opportunity to explore design issues in areas outside the communication area. It was apparent in the choices made that students tended to select a topic based on an area of interest to themselves rather than a topic that might easily fit the requirements of the exploration and inquiry. In reviewing the students’ topic choices, many of the topics were not well suited to the project requirements. A number of the topics had extreme depth and breadth, and it was clear that it would be difficult for the students to provide discrete design guidelines without a more focused approach. While the students had experience and expertise in the subject area, it was clear from the start that many had limited experience in independent project work of this form and they would require a degree of monitoring and mentoring in the inquiry process if they were to achieve the goals of the project in the time frame available. This finding supports work by others exploring student success in project-based and independent activities, which indicates that students who are often high achievers in structured face-to-face work often lack the necessary skills in self-regulated learning for independent project work (e.g. Whipp & Chiarelli 2005). The four students with broad project proposals were encouraged to focus their proposal (within the chosen area) on more discrete aspects. None of them were able to really develop this focus and their projects commenced with what appeared to be quite broad areas for exploration.

Scaffolding and support

A number of Web-based scaffolds and supports were provided in the extension project. A series of Web boards was established to which students were required to upload progressive components of their research and inquiry. The schedule that students followed required these uploads on a weekly basis and required students to read the submissions of two other students and to provide some feedback to their peers through the provided online forms. The purpose of this structure was to encourage students to keep to the schedule and to provide feedback from a variety of sources to assist them in the development of their booklets. The tutor was also able to use this process to monitor students’ progress and to provide regular feedback.

Across the first 2 weeks of the project, all students submitted their documents and provided feedback to their peers. The feedback that peers gave and received tended to be very positive and encouraging, but there appeared to be little feedback that provided strong contextual information or critical insights. The instructor provided more detail to students in his responses and the named postings enabled the students to see from whom the advice was coming.

As well as the weekly feedback gained from the responses to the submitted work, the instructor also sent a broadcast e-mail to the students to advise them of the tasks that were scheduled for the week. The weekly reminder, the weekly tasks, and the peer assessment activities all acted to keep the project in the students’ minds throughout the busy first weeks of the semester. The extent to which the students kept up with the schedule and the weekly postings diminished quite quickly as is evident from Table 1.

It became apparent that some students derived little educational or social benefit from the posting activities and that there appeared only a scant sense of community established among the full cohort. Sense of community was assessed by the extent to which the student activity demonstrated such attributes as reinforcement of needs, sense of membership, sense of influence, and shared emotional connection among members of the extension project (McMillan & Chavis 1986).

In terms of learning support, some postings were shallow in their content and lacking in any meaningful feedback in relation to improving the submitted work. It appeared evident in the brevity of the postings and minimal discussion and dialogue that, for some students, the process did little to help them grow any cohesion or unity with other members of the cohort. A number of students commented in several forums that the feedback and peer-assessment activities were time consuming and difficult to complete given the
newness of the field and their lack of previous experience with the topics. Within the postings, it was possible to see two main forms of feedback: supportive and constructive. The supportive comments gave moral and social support while the constructive comments sought to provide feedback related to the actual content and intended to improve learning opportunities (Table 2).

By the end of the second week of the project, students had submitted examples of their inquiry and the feedback and comments given at this stage contained a significantly higher level of constructive feedback than was evident for the previous submissions. Within the postings for the second week were a number of pieces of advice able to help colleagues develop a better product (Table 3), and very few comments did not contain constructive advice. The increase in constructive advice appeared to stem mainly from the fact that the students, by the end of the second week, were becoming more accustomed to the aims of the project in relation to the recognition of visual design examples.

As the project progressed, the quality of the constructive postings was retained, and the students who participated in these activities recognised and acknowledged the benefit that came from reviewing others’ work and receiving feedback on their own. There were four students in the cohort who failed to give feedback at the end (and received none). This was caused mainly by the delay of their submissions and the fact that others in the group had moved onto the next stage and failed to add any comments to the late postings (Table 4). From the tone and expressions in the postings, it appeared that a sense of community appeared to have developed among those who provided feedback, but it was not developed among those who submitted late and were often left out of the discussion. The findings are consistent with those of Brook and Oliver (2004) who found that in online settings, a number of factors can act to mitigate against the development of a sense of community in online settings and often the mitigating factors are caused by systemic and process factors that often will require deliberate teacher intervention to resolve. The findings also reinforce those of Watters and Ginns (2000) who found that learners exposed to collaborative and authentic learning settings really need to learn ‘to have a will to contribute, to cooperate, to develop

### Table 1. Submission postings.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Proposal development</th>
<th>Exploration of examples</th>
<th>Feedback from an expert</th>
<th>Design principle planning</th>
<th>Production of booklet</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-time submissions</td>
<td>12</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Late submissions</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Peer responses</td>
<td>20</td>
<td>14</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 2. Examples of students’ feedback for proposal document.

**Supportive**

- I like the psychological approach plus you work in a hotel being upgraded. Get lots of pics
- You have a lot of good content that can be expanded upon. Q’s are mainly guidelines i think . . .
- Sounds cool that picture is disgusting (not the one of pamela anderson) if u include pictures of tatoos from historical cultures such as romans and samurai’s that would be awesome
- Nice content, tie in lots of examples but change the font/itall Caps. It makes it very hard to read.
- Sounds really interesting, i like the inclusion of local places, brings a better understanding to the topic

**Constructive**

- I think that’s a really good start to the project. i just wanted to know whether u are doing fashion design in general as in all types of clothing? if u are i thought maybe u could include how certain materials or colours work together . . . but its just a thought
- Is a little brief, touches on the topics (such as the importance of the field) but then doesn’t go on to say what the importance of the field is
- Hey that’s a good start, i like how u have pointed out the basic design elements that we all need to show what attracts our attention. i was also wondering if u wanted to add topics like the effects of Text or fonts that may attract our attention

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curiosity and to seek and support when needed and share experiences with teachers and peers’ (p. 318).

Levels of self-monitoring and goal setting

The schedules and timelines were intended to assist students self-monitoring and goal-setting processes in the arduous process of an independent project at a time when they would be facing a myriad of competing elements for their time. The benefits to be derived from a structured approach here are well argued by a number of researchers in distance education (e.g. Moore & Kearsley 1996). In this project, students were encouraged to follow a schedule that was intended to keep them working at a reasonable pace at a time when it was quite easy to be distracted by the raft of other activities occurring at that time. The schedule appeared to work well for a number of reasons:

- the participants were all keen and interested students and the schedule provided a means to organise and structure the task;
- the students were all recent school leavers and few had experience with independent learning projects. The schedule with its various activities and connections provided a strong support for what was potentially a difficult learning environment; and
- the schedule included online asynchronous communication at various waypoints, which provided an incentive to keep to the planned tasks and provided a means for feedback on progress and achievement.

The schedule was intended to set a pace that students needed to follow if they were going to complete the project in the given time. The task, in fact, overwhelmed three of the students who found the pace too rapid and who were unable to keep pace with the project. These students withdrew from the project, but it was a graceful withdrawal rather than a last minute fail. The three students who withdrew cited workload as their main reason. Interestingly, the extent of their actual workload they reported was not significantly higher than that of the majority of other students studying the mainstream course, although the mainstream students did have some flexibility in submission deadlines, which the extension students lacked. The findings suggest the need to be flexible in relation to the way in which goal-setting support is provided. Help that is overly prescriptive can limit students’ abilities to demonstrate and develop their own goal-setting and self-monitoring. On the other hand, the
results also show a clear need for the inclusion of some form of support for self-monitoring and goal-setting (e.g. Dabbagh & Kitsantas 2005).

**Technology support**

Two main forms of technology support were provided in the project, the technology kits and Web-based support tools. Access to a personal wireless-enabled laptop and camera provided many options for the students to assist them in the project. It facilitated their collection of resources and materials and provided a workbench upon which their booklet could be developed. All the students commented on the value of the laptop and the support its use provided to them. They all used the computers for much more than this project alone and made use of the technology to support other subjects they were studying. The majority of the students commented that they felt they were able to develop a better product with the laptop because it provided such supports as follows:

- being available at all times, they tended to work on the project with the laptop at odd times they would have missed otherwise;
- the laptop supported the production of the work in progress and was a tool that facilitated many of the required activities; and
- the camera provided a great source of examples and ideas to explore and use in the inquiry.

The wireless capability was used less than was expected. The students found the wireless connectivity was not as reliable as it was intended because of gaps in the wireless mesh on campus, and many had no access to wireless at home. The majority of the students connected their machines to the university network through the cables when on campus and in laboratories. They used the modem facility at home and, in general, the bulk of the development work was undertaken without using the Internet. Having unlimited access to an Internet and wireless facility would appear to add a new dimension to research and inquiry and it would appear that it is important to find a solution to students connectivity problems. This would greatly enhance the prospect that the technology would provide even further support to learning in an extension-type project of this form.

**Learning outcomes**

Students’ final projects were assessed according to a number of set criteria that included:

- the scope and quality of examples chosen to demonstrate strong/weak design;
- the scope and extent of the investigation of design principles;
- the synthesis and analysis of design principles;
- the quality of design and presentation of the report; and
- the quality of feedback and advice provided to others.

The final products were found to be of a relatively high level when judged against these criteria. As the groups were self-selecting, and chosen on the basis of previous experience and background, it was possible that some of them may not have had the self-regulated learning capability to complete an independent project. It was possible that working alone, some would head off on tangents that might see them develop a product not in accord with the stated requirements. Interestingly, all students maintained a strong focus and produced a booklet of a high standard. The submissions were characterised by the following:

- A very high quality production of the booklet in terms of the layout, design and presentation. The majority of students demonstrated a high level of skill in the use of word processors as presentation tools; and
- Strong selections of examples of design activities as the basis for their inquiry. The students recognised the importance of having information within which to ground their inquiry. Many of the examples were drawn from their own experiences and collected from grounded investigations, as distinct from secondary sources such as books and magazines.

The elements within the booklets that were least developed across the group included the development of guiding principles and the production of guidelines. Both these activities necessitated a degree of higher-order thinking and synthesis of ideas and concepts. While the students tended to create reasonable entries in their booklets for these elements, it was evident that the level of abstraction required to conceptualise principles from products was an activity that was be-
yond a number of the students at this stage of their development and their understanding within the visual design area. It is difficult to consider how this might have been better scaffolded. Perhaps the use of models and examples would have helped. For some, it appeared evident that they were unable to demonstrate the forms of higher-order thinking required to develop the guidelines and principles, but it is not clear whether this required further scaffolding or may have been a premature activity at this stage of their course and cognitive development. This is one of the difficulties that teachers face when creating independent learning environments. Students need to be able to recognise areas where they require further learning and to have some means to seek help. Where students do not recognise a gap in their knowledge and understanding, it is difficult for a remote teacher to assist.

**Student satisfaction**

Student feedback was gained at various stages during the project to gain an understanding of their motivations and outcomes so that the project might be refined for future instantiations. When asked what made them join this project, the majority of students responded that it was the chance to do something different and challenging that interested them. They were interested by the ability to choose a topic and to be able to extend themselves rather than being constrained to coursework. Only one student gave as a reason the fact that the project came with a laptop.

Most students thought that the project would require more work, but were still happy to become involved. Doing the extension project meant that they could skip doing other elements of the coursework, but still half the students kept up with the coursework as well as the extension project. As it turned out, the students indicated that on average they spent 5–6 h per week on the project, which was considerably more than others in the class were spending on the coursework. They indicated the open-ended nature of the project and the interest they derived from the activity led them to spend this amount of time. Clearly the authentic nature of the task was a factor in creating this level of interest. The tendency of the extension project to cause some students to steal study time from their other units is an issue that has been identified in other examples of open-ended project work (e.g. Luca 2002).

In relation to the posting activities, all students claimed to enjoy and value the opportunity to view other students’ work. Most were happy to provide feedback, although some felt they did not want to spend the time responding to others when they could be working on their own projects. Interestingly, those students who said they enjoyed giving feedback, also realised considerable benefit from the feedback they received, suggesting students might need to be coerced initially but would become positive once they saw the benefit in the feedback they were consequently receiving. Several of the students commented on the lack of feedback they received from particular students, and felt that had everyone been compelled to give feedback, it may have been more useful and beneficial to the group. The capacity for this form of activity to build a sense of community was not as strong as anticipated and appeared to stem from students lack of previous experience in group-based activities (e.g. Van Weert & Pilot 2003).

All students were very positive about the laptop, describing how it gave them freedom to work between classes in cafes and libraries and to store and manipulate their images. Two students already had laptops, but enjoyed learning to use the alternative operating system on the Macintosh. When asked if they felt they would have still learned as much and enjoyed the same levels of motivation had there been no laptop, all but one of the students responded positively. The laptop appeared as a bonus but not an essential tool for their motivation and success.

At the end of the project, students were asked to discuss what were the most enjoyable aspects they experienced. Clearly, the most enjoyable aspect mentioned was the ability to choose one’s own topic and the interest derived from the tasks they were undertaking. All students commented on how this created interest and provided the relevance associated with personal choice. The feedback confirmed our previous experience with authentic tasks as strong motivators for student engagement and learning (Herrington et al. 2003). A number of students asked why such options are not available in other units, describing how they often see situations where students with some background and knowledge can get quite bored and often gain little from learning in other core subjects. All students indicated that they would seriously consider doing another extension project if
given the chance. None said that they would not volunteer again, suggesting positive impressions overall.

In terms of negatives, several students thought the timeline was too tight and would have preferred more time. The open-ended nature of the project meant these students could have done more work and delved more deeply had they had more time. In terms of advice for the instructor running this project in the future, the advice all related to technical issues concerning file uploads and wireless connectivity; there was no advice forthcoming about changing the structure or nature of the task itself.

Individual differences
An important aspect that the project looked to explore was its capacity to cater for individual differences. In the cohort that undertook the project, many individual differences were observed. It was expected that the project would cater for a homogeneous group of students with a strong background in this field, previous project-based learning experiences, and perhaps levels of work experience. In fact the group was quite heterogeneous in its makeup. The students had differing academic backgrounds, differing life experiences, and differing expectations of learning. Perhaps the only consistency within the group was the motivation and enthusiasm of the students. The capacity of the extension project to cater for individual differences could not be objectively studied with the subjects who had volunteered.

Instructor costs
One of the important considerations in this activity was the amount of extra work an extension activity would create for the instructor, and this was monitored closely during the project. It has to be said that adding a project of this form to an existing unit does create many overheads for an instructor. For the small number of students that chose to participate, the set-up costs were very high. The implementation of the project involved many activities over and above those already undertaken in the running of the unit.

Given that the activities were extra to the work associated with the running of the actual unit itself, the extension project did involve substantial amounts of extra instructor time. Had the number of participants been higher, for example, 20 students, the instructor’s time and effort would not have changed much, but the benefits in terms of the return of investment in instructor workload against learning outcomes would have been greater. The planning and delivery of ICT-based projects frequently demonstrates tensions involving instructor time and effort (e.g. Carnevale 2004).

Summary and conclusions
This paper has described a research project that sought to explore student-learning outcomes in a technology-facilitated authentic learning project presented in the form of an extension project for advanced students in a first-year unit in an undergraduate degree. The project aimed to explore the capacity of the extension project to cater for the learning needs of the advanced students in a large undergraduate class and to explore the factors that could influence the learning outcomes from the activity.

The study found that the extension project was successful in terms of providing a meaningful and effective learning environment for the advanced students in the class. It was interesting to note that not all the advanced students in the class chose to participate and not all those participating had the same levels of previous skills and experience. The level of participation was much lower than anticipated; suggesting the perceived need for the project was far greater than the actual need.

The participants all indicated that they enjoyed the project, and would consider volunteering again if given the chance. In terms of learning outcomes, the products developed to demonstrate learning were generally of a high standard both in terms of content and the presentation of the material. While there were varying levels of higher-order thinking demonstrated by the students in the various learning activities and products, the students were all judged to have completed a successful inquiry and were able to demonstrate developed visual design skills and understanding.

In relation to the factors that were seen to influence the learning outcomes, the inquiry revealed strong drivers motivating the learners, and the outcomes were the authentic nature of the inquiry and the tasks, the online technology and supports used to scaffold and guide student activity, and structured timeframe and schedule. The inquiry demonstrated strong learning supports being provided by the Web-based support.
tools, but that the use of the tools differed among the learners.

In terms of information that might guide others looking to explore similar projects, the outcomes suggest a number of issues and cautions for others:

- Before embarking on such a project, it would be useful to objectively assess student interest and enthusiasm. There are many factors that can limit students’ choices to extend themselves, and students in this project showed themselves to be very wary of strangers bearing gifts;
- Such a project requires students to commit considerable time and effort and such open-ended projects run the risk of distracting students from other less demanding subjects they might be studying (e.g. Luca 2002);
- Project-based learning is a strategy that requires careful delivery and management to overcome potential problems. Successful project-based learning often requires learners to have the necessary self-regulation capabilities for self-monitoring, self-evaluation and goal setting (e.g. Dabbagh & Kitsantas 2005). It would seem important in determining the scope of projects to allow for the time students must spend developing these skills and abilities;
- Independent projects conducted with students whose skills sets are not yet developed can place unreasonable demands on the learners as they develop the required skill sets to enable them to manage their own learning, to set goals, to self-evaluate. Teachers need to recognise these overheads in their expectations and demands (e.g. Whipp & Chiarelli 2005);
- The success of Web-based online support systems as a means to encourage collaboration and to establish a sense of community among learners will return different levels of advantage and opportunity to different learners in the cohort (e.g. Brook & Oliver 2004). Often learners need to develop skills to effectively participate in authentic and collaborative projects (e.g. Watters & Ginns 2000);
- Access to technology will facilitate the learning process and different learners will use the technologies in different ways. Web-based tools can provide particular forms of support for the learners;
- Like other technology-based projects, the establishment and conduct of such projects places considerable demands on instructor time, and time commitment needs to be considered in light of the scope and extent of the enhanced learning outcomes that might be gained (e.g. Carnevale 2004); and
- The choice of the learning task is critical to the success of the project. The tasks need to provide opportunity for inquiry, but to ensure students are not able to selectively choose a level to function, which limits their opportunities for learning that is too much choice in their student-centred activities. Encouragements to reflect and to view issues from an alternative perspective help to ensure the task is attempted at the appropriate level (e.g. Herrington, Oliver & Reeves 2003).

One of the limitations of this study in terms of exploring a method for using a technology-facilitated learning approach was caused by the fact that the subject of study had a technology focus and there could have been difficulty isolating the use of the computer as a learning tool from the use of the computer as the subject of study. The problem-based learning design minimised the influence of this conflict by ensuring that the technology the students used was in fact a means to an end in their learning, more than an end in itself. The exploration focused on technology as a support for learning, but further study is needed to really ensure the findings are generalisable outside the context of technology-oriented disciplines.

Armed with the information gleaned from this project, and in keeping with the design-based reach approach, we intend to run some similar technology-facilitated projects with other cohorts and other areas of study. We will use these to explore unresolved issues relating to the most appropriate academic level to offer such courses, ways to increase community development, and technology supports that can be used to develop students self-regulation learning skills and abilities in the process of independent and group-based projects.

References


