Project-based learning and assessment of an IT module in an ODL context

L. Goosen*
e-mail: gooseL@UNISA.ac.za

D. van Heerden*
e-mail: vheerme1@unisa.ac.za
*School of Computing
University of South Africa
Pretoria, South Africa

Abstract
This article introduces project-based learning and assessment in an information technology (IT) module offered in an open distance learning (ODL) context. The literature review explains the main arguments relating to project-based learning and assessment in terms of the module researched. The methodology used (an e-mail survey) to investigate the influence of an intervention to enhance student success is described. The findings presented show that the majority of respondents experienced an increase in the effectiveness of teaching for successful learning in an ODL context. Most students believed that sufficient information had been provided to complete their projects successfully, which also helped improve their self-confidence. The article also includes recommendations and implications for the possible future use of project-based learning and assessment in similar modules. In conclusion, the way in which project-based learning and assessment assists in solving problems experienced in a vocational IT module offered in an ODL context is summarised.

Keywords: project-based learning, assessment, information technology, open distance learning

INTRODUCTION
Recently, rapid advancements in modern information and communication technologies (ICTs) have had a dramatic impact on the delivery of open distance learning (ODL). This has happened specifically in the way they have helped educators to meet the challenge of providing students with ‘the tools needed to access a virtually unlimited array of information’ (Herselman and Hay 2005, 393). Jacobs et al. (2003, 16–17) indicate that ICTs can be used not only to bring about active and successful learning in an ODL context, but also to provide well-trained and qualified professionals. In addition, these technologies make it possible to supply student ‘training to rural areas that would otherwise not receive it’. Such populations, which are typically separated by large distances, often ‘face geographical barriers to access’ if, indeed,
they have access at all. Although findings by Brown and Czerniewicz (2007, 743) suggest that a nuanced interpretation of the so-called ‘digital divide’ is needed in the context of South African higher education, access remains a barrier for many.

Frank, Lavy and Elata (2003, 273) implemented project-based learning in an academic engineering course. Accordingly, their study displays some similarities with the current study, which presents students’ perceptions of project-based learning. The latter was used in conjunction with project-based assessment for a first-year Information Technology (IT) module offered in an ODL context.

Many lecturers who are responsible for teaching vocational modules experience problems with finding appropriate learning and assessment strategies for their students. Such modules usually focus on teaching students skills that will prepare them for a particular job, traditionally considered to be non-academic training. If these modules are offered in an ODL context, however, students cannot be assessed practically, as happens at traditional contact institutions (Lorenzetti 2005), because logistical arrangements place limitations on the ways in which assessment can be implemented. It is simply impossible to assess large numbers of students practically across the country in computer laboratories.

Alternative methods have, thus, to be considered in order to ensure that students have achieved their module outcomes. When using non-traditional ODL assessment methods, as opposed to what is usually referred to in discourses around proctored examinations, a number of issues are involved, such as authenticity and validity (Olt 2002). As the module considered was already using project-based learning, it naturally followed that assessment could also incorporate these same principles. However, Barron and Darling-Hammond (2008, 34) warn that project-based learning demands strong assessment.

Research context

The ICT1512 module presented by the School of Computing at the University of South Africa (Unisa) introduces students to computer programming. Accordingly, students are able to extend their knowledge, skills and values through meaningful engagement with the introductory programming language, JavaScript (Ellery 2011, 1077). On completion of the module, students are provided with an opportunity to articulate their acquired mastery of logical thinking skills and creativity by designing and developing a working program with interactive functionality, using structured object-oriented programming (Bozalek, Rohleder, Carolissen, Leibowitz, Nicholls and Swartz 2007, 812). Such programs have to be completed to solution-specific standards and to the satisfaction of the client. This module is compulsory for the National Diploma Information Technology.

The research population for the current study included all students registered for ICT1512 during the first semester of 2010 – a total of 824 – of which the majority were male (605; 73%) and in their twenties. Most students were African, and had an African home language, with English (the language of tuition) being their second or third language. Although large numbers of these students lived in the urban areas
of Gauteng, students from all over South Africa, including more rural areas, register for this module.

Since this module tends to have a very low pass rate (29% in the period under review), the teaching method has been adapted to suit a first-year IT module and presentation in an ODL context. In agreement with Subotzky and Prinsloo (2011, 189), who refer to the complexity of such ODL environments, we acknowledge that there are many variables impacting on student retention and success in an ODL context such as that of Unisa. An ODL environment requires students to study using mainly print-based materials. Students doing this module receive a single printed tutorial letter and they have to purchase the prescribed book. There is usually limited face-to-face contact between lecturers and students for modules offered in an ODL context – in this module, no face-to-face sessions are presented. Students also have little regular access to computer laboratories to gain experience and be assessed during supervised practical sessions. Lecturers therefore need to find ‘authentic ways of implementing ODL instructional design good practice ... The focus must be on providing students with the best learning experiences that’ can be offered in an ODL context (Mitchell, Smith, Louw, Tshesane, Petersen-Waughtal and Du Preez 2007, 694).

One of the ways in which students are supported, including with regard to cognitive, administrative and affective aspects, is by using the university’s virtual learning environment (VLE). Students doing this module are therefore required to register on the VLE. This provides them with ‘ample interactive learning opportunities that supplement the learning content’ (Herselman and Hay 2005, 393) by defining social, cognitive and teaching presence in online environments, as referred to in the Community of Inquiry Framework (Garrison, Anderson and Archer 2010, 5). Using online communications media, such as the asynchronous, text-based group discussion forum in the VLE, allows for interaction and collaboration between the lecturer, the students and their peers. Students are given guidance and assistance not only by the lecturer, but also by fellow students; they share ideas on practical applications; and they help each other to clarify any problems they might be experiencing.

Thomas (2000) indicates that a blog tool can give students the opportunity to ‘reflect on the creation of’ their projects (Doppelt 2005, 7). Richards (2009, 1) points out that once students have reflected on their learning, they can integrate it into their current knowledge ‘to construct meaning and create’ new knowledge (Bezuidenhout and Alt 2011, 1062). Therefore the third assignment that students submit formally requires them to write blogs about the work they studied during the week. Accordingly, interacting through the VLE not only enhances the learning experience, but also enforces the importance of the curriculum they are studying for the module and the qualification.
Formative and summative assessment

Like Olt (2002, 3), in this module several short practical projects make up 50 per cent of the formative assessment mark. Students have to complete formative self-assessment tasks for each of the nine chapters they study in the prescribed book. These represent authentic applications in everyday contexts, some of which are project-based. The second assignment that students have to submit formally requires them to design and develop web pages in accordance with user specifications.

Summative assessment, where students have to show that they have mastered all the module outcomes, consist of two parts, namely: students’ involvement in an independent, practical project website; and their completion of a written examination paper (Ellery 2011, 1077). In addition, a tutorial letter available on the VLE gives the requirements for both the examination paper and the practical project, including the assessment rubric for the latter. In this letter students are also informed that they will be examined on their practical projects.

The practical project contributes 30 per cent to the examination mark and is submitted on the day of the written examination. The development tool used is JavaScript, as this is the programming language taught in this specific module. The scope of the website is very limited, owing to the level at which the module is presented.

Barron and Darling-Hammond (2008, 64) ‘found much higher achievement on complex performance tasks for students who experienced ... instruction focused on active learning in real-world contexts’. Students are therefore required to integrate their ‘everyday knowledge into more abstract scientific knowledge’ by contacting a school in their area and obtaining permission to develop a website for them (Ellery 2011, 1077). This could be a pre-school, nursery school, primary school, high school or any institution where tuition takes place. This service to their community also develops students’ inter-personal skills, and enables them to apply the skills they have learnt, as well as resulting in positive attitudes towards learning, and increasing their self-esteem and ability to problem-solve (Thomas 2000).

The written part of the examination takes place at the end of the semester, and contributes the remaining 70 per cent of the semester mark. To ensure the authenticity and validity of projects, the topic and content of the project is determined by the lecturer and two questions in the examination paper are based on the practical project. Hence, students who have not developed their own projects will not be able to answer these questions.

Research questions

The purpose of the current study was to investigate students’ perceptions of project-based learning and assessment for a vocational IT module. Subsequently, an analysis of these perceptions could result in an ‘understanding of the underlying mechanisms that contribute to’ related issues in this regard (Lam, Cheng and Ma 2009, 566). This, in turn, could be helpful to lecturers ‘who are concerned about enhancing student learning motivation in project-based learning’. Although the ‘claim that rubrics can
promote learning and achievement has intuitive appeal’, Andrade, Du and Wang (2008, 3) warn that ‘there is only limited empirical evidence to support’ such a claim. The study could therefore make a valuable contribution in this regard.

The following research questions were formulated for the study:

1. What are students’ perceptions of completing a project as part of their summative assessment?
2. What improvements and refinements could be made to the implementation of project-based learning and assessment when attempting to enhance student success in this and other vocational IT modules?

As an overview, the remainder of the article is organised as follows:

- The second section presents a literature review of the main arguments for implementing project-based learning and assessment when offering an IT module in an ODL context.
- The third section provides a description of the specific methodology applied in this research. Qualitative techniques were used to gather and analyse data on students’ perceptions. Subsequently, the measures applied to ensure that the data collected were trustworthy, reliable and valid are described.
- The fourth section reports on the findings of the study in terms of the student feedback provided. These findings include various aspects related to their perceptions of project-based learning and assessment.
- The fifth section contains recommendations and suggestions, including those put forward by the students themselves.
- The article concludes by summarising the way the current research on project-based learning and assessment contributed to the solving of certain problems experienced in a vocational IT module offered in an ODL context.

**LITERATURE REVIEW**

Thomas (2000, 1) provides a brief definition of project-based learning as ‘a model that organizes learning around projects’. Barron and Darling-Hammond (2008, 3) extend this definition to include ‘completing complex tasks that typically result in a realistic product’. In terms of the set of guiding criteria offered, project-based learning projects should be focused on ‘driving questions that lead students to encounter’ concepts that are central to the curriculum and ‘on problems that occur in the real world and that people care about’. Such projects are student-driven to a significant degree and ought to ‘involve students in a constructive investigation’ (Thomas 2000, 3–4).

In implementing these criteria students are enabled to build their knowledge practically, starting with the basics; as their knowledge expands, so do their projects. One of the ways in which this can be accomplished is by ‘requiring students to relate
the subject matter to their’ personal real-life experiences, and/or apply it to real-life situations (Olt 2002, 5). This is in line with the opinion expressed by Barron and Darling-Hammond (2008, 3): ‘students learn more deeply and perform better on complex tasks if they have the opportunity to engage in ... learning ... projects ... that require them to employ subject knowledge to solve real-world problems’.

To ensure that project-based learning and assessment are applied successfully, they should be aligned ‘with the curriculum being taught in order to be valid’ (Andrade 2005, 30). For the ICT1512 module, the prescribed book (Gosselin 2008) not only suits the curriculum, but also project-based learning. Accordingly, it ‘combines practical and theoretical knowledge’ in order for students to fully grasp each theoretical concept by explaining and applying it practically, thus ‘building’ it so that eventually it becomes the students’ existing knowledge (Doppelt 2005, 7). All the practical applications are based on real-life scenarios, creating interactive web pages such as can be seen all over the World Wide Web. On completion of each chapter, students are guided through the creation of more such pages, applying all the concepts they have learnt in that particular chapter. Finally, they are provided with a case study based on the work contained in the chapter and are required to build a website that conforms to the instructions given in the case study. Hence, the curriculum for this particular module is suited to project-based learning.

According to Frank et al. (2003, 273–274), both project-based learning and vocational training are based on constructivist teaching principles. They substantiate this judgement by quoting Vygotsky, stating that students ‘construct knowledge or understanding as a result of thinking and doing in social contexts’. Their view of constructivist theory ‘suggests that the human being is an active learner who constructs his/her knowledge on experience and on his/her efforts to give meaning to that experience’. In the module described here, students’ project-based learning requires them to take an active role in constructing their own knowledge by means of experience (Barron and Darling-Hammond 2008, 44).

This construction of knowledge was done using authentic tasks while interacting with others and their world, thus focusing on so-called ‘social constructivism’. Modules using this constructivist approach concentrate on concrete, rather than abstract, aspects. Such a student-centred approach also requires students to use and apply what they learn practically, actively engaging in the learning process and developing problem solutions. The lecturer therefore needed to allow students to construct their ‘own knowledge by experiencing and interacting with the’ learning environment that they created (Frank et al. 2003, 274). Project-based learning, and the module studied here, can thus be considered as having their roots in constructivism (Doppelt 2003).

**Project-based assessment**

Doppelt (2005, 7), however, warns that using projects as the basis for a module ‘not only requires changing the teaching methods and learning environment’. New ‘assessment methods for project-based learning activities in a computerized
environment’ also need to be adopted (Doppelt 2003, 255). In order for assessment to serve as a learning scaffold for students, it needs to be geared to promoting ‘cognitive processing that requires complex, contextualised thinking’ (Bezuidenhout and Alt 2011, 1062).

Rubrics are ‘used as part of a formative’, student-centred approach to assessment, offering ‘a means of communicating expectations for an assignment, providing focused feedback on’ work in progress and marking of the final products (Andrade, Du and Wang 2008, 3). This helps students to ‘develop understanding and skill, as well as make dependable judgments about the quality of their own work’. Andrade (2005, 27) agrees that such ‘feedback on students’ progress toward the goals ... will help them learn and demonstrate their learning’.

In this way, rubrics have the potential to enable students to plan, design and produce high quality projects (Doppelt 2005, 7). They are available to students in advance, as they help students to ‘understand the goal of an assignment and focus their efforts’ (Andrade 2005, 29). This not only ensures that students know what the assessment criteria are, but also safeguards impartiality throughout the marking process.

DESCRIPTION OF RESEARCH METHODOLOGY

In agreement with Frank et al. (2003, 273), in the current research the ‘qualitative paradigm was found to be suitable ..., mainly because the study focused on ... students’ ... thoughts ... Data were collected by means of an email survey of students’ perceptions of the possible advantages of project-based learning and assessment. Some of the ethical issues taken into consideration were that all students registered for this module were invited to participate voluntarily, and that the survey was sent out only once students had written the examination in this module. Although 64 per cent of students registered for the module wrote the examination, only 29 per cent passed. This might go some way to explaining why a response rate of less than 10 per cent was obtained: e-mail replies to the module address were received from 65 students and an additional 17 students posted their responses on the VLE discussion forum. Consequently, this low response rate does not produce a representative sample, and thus denotes one of the limitations of the study in terms of the generalisations being made.

Maree and Van der Westhuizen (2007, 38) point to the importance of paying attention to dimensions related to data trustworthiness. In a qualitative study such as this one in particular, it is essential to ensure reliability. Since reliability can be improved by using peer examination ‘to solicit the opinions of colleagues’, questions were discussed with them. Measuring procedures used needed to ‘pass a test of reliability by resulting in similar ratings when used by different people’. If not, researchers would be unable to draw satisfactory conclusions or make claims about the generalisability of the research. We therefore ensured reliability in relation to the ‘accuracy of the judgments we make about students and their’ opinions.
Validity is concerned with the consistency with which researchers are able to
gauge such measures. In line with McMillan and Schumacher (2010, 330), the
validity of the qualitative design refers to ensuring that interpretations had the same
meanings for both the participants and us as researchers. Our claims with regard to
ensuring ‘validity rest on the data collection and analysis techniques’ used. Data
analysis is ‘essential before the researcher can make interpretations’. As researchers,
we therefore asked a range of questions of the data as we induced interpretations.

Since causal conclusions were not drawn, internal validity refers to the care we
took in terms of conducting measurements in this study. With regard to construct
validity, inadequate preoperational explication of constructs was enhanced by asking
colleagues, showing questions to other lecturers and comparing these to published
standards (Andrade 2005, 30). However, mono-operation bias, in terms of only using
a single version/intervention as regards project-based learning and assessment, ‘may
limit the way the results are interpreted’ (McMillan and Schumacher 2010, 115–
116). As only ‘a single way of measuring variables’ was used, interferences were
also limited in terms of mono-method bias.

External validity referred ‘to the applicability of the results to other situations’
(Maree and Van der Westhuizen 2007, 37, 39). We facilitated external validation
by using ‘descriptions of the participants and contexts’. This directed decisions
concerning ‘the use of various strategies’ required in qualitative research to enhance
the design validity of the data collected (Maree and Van der Westhuizen 2007,
38). For instance, as recommended by McMillan and Schumacher (2010, 330), we
present literal statements and quotations direct from the data to illustrate respondents’
perceptions.

Andrade (2005, 29–30) finally reminds researchers that since ‘assessments are
not exempt from the demands of validity’ and reliability, these issues also apply to
rubrics.

RESULTS AND ANALYSIS

In this section, we report on the qualitative results obtained from student feedback in
answer to the following five questions regarding the examination project:

- How did you experience the examination project?
- Do you think it made any contribution towards your studies?
- Did you enjoy or dislike doing the project?
- Would you like to be examined through a project for any of your other courses?
- What was the most difficult thing you found about the project?

In most cases, examples of the students’ comments are provided to illustrate the
opinions expressed.
Students’ positive perceptions

More than three-quarters (66; 80%) of the students who responded to the survey indicated that they felt that doing the project as part of their summative assessment was a positive experience:

At the beginning of the project I was a little bit not finding my steps right, but as it went on I loved every step of it, … I had access to everything I needed.

Only five (6%) of the students revealed that they did not think doing a project as part of their summative assessment was a good idea. The remaining 11 (14%) did not submit their projects – this will be discussed in more detail later on.

Close to a third of the students (25; 31%) confirmed that they would prefer being assessed through projects in all their more practically based modules, as this enabled them to apply what they had learnt practically. Doing the project also showed students how the different modules they do as part of this qualification fit together. Almost a quarter of the students (19; 23%) said that doing the project helped them study the module material and even assisted them in their preparation for the written summative assessment:

Yes, I’d like to be examined through a project for any of my other courses for reasons such as:

a) One gets an opportunity to apply what he learns and link it with real life,

b) It stimulates and unearths project management qualities in the process.

c) It teaches one to management time effectively whilst striving to produce quality work which is what the corporate world out there demands.

Just less than a third of students (24; 29%) stated that doing the project taught them how to apply what they were studying to a real-life situation, thus preparing them for future employment in the field of Information Technology. Being able to interact with their local community was also considered a positive experience for some of the students and it made them feel proud of themselves to be able to be part of the community and in some small way contribute to it:

Yes it did, doing the exam project contributed much to my studies, the more I was reading my web design book, the more ideas I got to use on my exam project: how I want my project to look like, and for me when I was reading web design first then JavaScript I will understand some of the procedures used.

The overwhelming majority of responding students (65; 79%) reported that they had accomplished something by doing the project:

You know when you do something practical you are 100% sure that even if you
get work somewhere you will be able to convince your employers. Like myself I am confident that I can create a beautiful website for a company after gaining the experience while I was doing my project.

The students’ responses corresponded closely to Barron and Darling-Hammond’s (2008, 5) findings, where ‘students engaged in project-based learning demonstrated’ increased self-confidence and learning (Thomas 2000, 10, 13). According to Lam et al. (2009, 566), project-based learning is ‘widely believed to be a powerful teaching strategy that can enhance student motivation and promote self-directed learning’. It therefore came as no surprise when students’ indicated that their self-image and motivation were also enhanced (Doppelt 2003, 255).

**Students’ negative perceptions**

Although the lecturer for this module was unable to provide individual support for the development of individual projects with such a big class, a number of students felt that the topic of the project was very limited and a wider field of choice should have been given:

> It was (a) difficult thing to me ... about the project ... to (access) the school so that I can design (their website).

Students studying with the intention of seeking employment in the field of IT have to learn how to manage their time effectively. However, many students felt that as they were employed on a full-time basis, they were constrained in terms of visiting schools to conduct interviews:

> The most difficult thing for me was time ... I definitely did not have enough time, considering that some of the components required in the examination project were only available towards the end of the material.

Some students indicated they did not understand what was required of them. What might have contributed to this is the fact that these students had never before interacted with a rubric and thus did not know how it should be applied. Another factor to consider is that, as first-year students, they had never had to design any application before and therefore did not know or understand the terms used in the rubric.

**Students’ perceptions on non-submission of projects**

Thirteen (16%) of the responding students did not submit their projects during the summative assessment period. Four (5%) of these students indicated that they had experienced administrative problems with their registrations and therefore either did not have the study material on time or did not realise that they qualified for the summative assessment in time to complete the project.
Seven (9%) students shared a problem that has already been mentioned: time management. They indicated that they had either registered for too many modules during the semester, or had work or family commitments that kept them from spending adequate time on their studies.

Despite numerous communications having been sent to students to encourage their participation, and to provide additional assistance throughout the development process, the remaining two students indicated that they had not read their study material and were thus unaware of the fact that a project was required of them.

**RECOMMENDATIONS**

‘Feedback and comments from the students revealed that’ they did not understand the exact requirements of the projects (Bozalek et al. 2007, 812), especially the rubrics which were not entirely self-explanatory (Andrade 2005, 29). As it seemed that some students ‘had never seen a rubric before’, they needed ‘help in understanding rubrics and their use’. The rubrics therefore needed to be explained better, as did certain information that the students required. Students were also provided with an approximate time frame within which to complete their tasks in order to assist them with time management. Another way in which students’ suggestions have already led to action is that a detailed layout of the documentation they need to submit is now also provided.

When students were asked whether they would recommend that more modules should use project-based assessment, they replied positively. Accordingly, students’ recommendations in this regards, together with those from the literature, should be taken into account. It is suggested that anyone considering the adoption of, or who is currently using, project-based learning and/or assessment, also incorporate these.

Very few of the students who submitted their project-based assessments included any of the planning or design documentation, thus indicating that they were missing some of the basic and extremely important steps in computer programming: Richards (2009, 1) indicates that thoughtful ‘and detailed planning, understanding of the stakeholders and their needs’, and a good design can maximise the benefits obtained from projects such as these. It is therefore recommended that the qualification syllabus be revisited to ensure these essential skills are included.

As suggested by Olt (2002, 5), students should be required to submit ‘rough drafts so that they can see the project grow’. Andrade (2005, 29) recommends that such hand-ins be staggered throughout the semester, so that students can ‘use the feedback to improve on their assignments’. According to Lorenzetti (2005, 2), this would encourage students ‘to organize their understanding of material before they even finish the assignment’. It could also ensure that students know what their projects lack, and how they should go about improving these (Lam et al. 2009).

Other lecturers could become involved in project-based assessment in order to repeat this research study using different module content. Combining different modules, resulting in having one project-based assessment covering the syllabi of
several of the first-year modules, should also be considered. A study could also be done once these students reach their final year to determine whether this project, which they complete in their first year of study, resulted in improved final-year projects.

These findings suggest an approach for lecturers to respond to many of the challenges they face daily: the integration of project-based learning and assessment, as described here, can support educational professionals when offering vocational modules in an ODL context. The current investigation revealed students’ perceptions of implementing project-based learning and assessment, making these recommendations relevant to lecturers in any field.

**CONCLUSION**

The article has demonstrated the significance of the topic and provided findings based on data gathered in a qualitative study. It could therefore make an important contribution to the literature by bridging the gap between the theory and practice of project-based learning and assessment for IT modules offered in ODL contexts.

Project-based assessment was favoured by the majority of students and they would prefer being assessed in a similar manner for some of their other modules. Having experienced the satisfaction of seeing a product they created for their community resulted in students feeling more motivated to make a success of their studies. This has not only encouraged the lecturer to continue using project-based assessment, but also to incorporate some of the students’ other modules into a single project-based assessment.

One of the final-year modules for this particular qualification requires students to develop a fully functioning system of high complexity. It is therefore our opinion that students who have successfully completed this smaller project in their first year of study will be better prepared in their final year. Having better prepared students in their final year should result in a higher quality student producing a higher quality project and, consequently, in a higher throughput rate for the qualification.

It has come to light that providing students with clearly stated guidelines and not assuming that certain knowledge and abilities are in place are essential to ensuring the success of the project-based assessment offered in an ODL context. Clearly stating when and how certain tasks should be accomplished should assist students with their time management issues. Explaining the requirements and giving examples should also ensure that students do what is required of them, thus enabling them to submit the documentation as required.

Along with Jacobs et al. (2003, 17, 21–22), we believe that project-based learning and assessment offer students enhanced opportunities for success by providing a more realistic experience within a student-centred learning paradigm. We would therefore like to end the article by posing a question for the reader to ponder: How can project-based learning and assessment be used to enhance (vocational and/or IT) modules offered in an ODL context?
REFERENCES


L. Goosen and D. van Heerden


