Using reflective self-assessments in a learning management system to promote student engagement and academic success

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***Abstract*—Learning management systems have the capabilities of creating, fostering, delivering, and facilitating learning at anytime and anywhere, allowing students to engage in online discussion and collaborative activities. However, many researchers feel that the online space essentially remains a repository for content. However, the fact that some academics use such systems as a content dumping site cannot be generalized. No, such a blanket statement would be a grave injustice to those few academics that are trying to improve the teaching and learning process, especially through reflective practice. The purpose of this paper is to highlight how an academic in electrical engineering has effectively used Blackboard™ to promote student engagement and academic success through online reflective self-assessments. An ex-post facto study is used with descriptive statistics of the quantitative data. Two groups of students enrolled for different electronic communication modules were asked to complete biweekly online reflective self-assessments via Blackboard™. Results indicate that those who completed more than 50% of these self-assessments were almost twice as likely to achieve academic success as compared to those who completed less than 50% of them. These results tend to suggest that some academics are using educational technology more effectively than other academics, to the benefit of students and higher educational institutions.**

Keywords*—Reflective practice, Blackboard™, university of technology

I. Introduction

“By three methods we may learn wisdom: first, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest.” These words, by Confucius, clearly suggest that personal reflection is one of the noblest, if not most critical, pedagogical methods for acquiring wisdom. However, one must reflect, or meditate, on knowledge that is accurate, be it either scientific or spiritual, and then act upon it to become truly wise. In fact, wisdom may be defined as “the application of tacit as well as explicit knowledge as mediated by values toward the achievement of a common good” [1]. Explicit knowledge is often conveyed to students by means of prescribed textbooks, journal articles or conference papers which have generally been peer-reviewed by experts in the relevant field of study. However, simply granting students’ access to this explicit knowledge does not guarantee that they will be able to understand or even apply it in their everyday lives. More is required from academics to ensure that students graduate from university with the right graduate attributes in order to make a significant contribution to the socio-economic development of their communities. A key pedagogy that academics need to use in achieving this mandate is that of reflective practice!

Reflective practice is defined as the ability to focus on beliefs and values that inform an individual's actions [2]. Another definition states that it is “the cognitive processes and an open perspective that involves deliberate pause to examine beliefs, goals and practices in order to gain new or deeper understandings that leads to action that improves the lives of students” [3]. Both these definitions include the words “beliefs” that inform one's “actions”. Correct student beliefs or perceptions regarding any fundamental theoretical principles must be acquired if students are to act wisely to the benefit of themselves and the society at large. Students must therefore be encouraged to reflect, or meditate, on their newly acquired theory, or explicit knowledge, in order to correctly apply it in practice. This in turn leads to tacit knowledge. Transforming tacit knowledge into assessable learning may be achieved through reflective assessments [4]. An example of reflective assessments includes online self-assessments which are included as one of the many features in a learning management system (LMS) [5].

Although a LMS may possess many advantages, many academics believe that this online space has essentially remained a content repository for syllabi [6], for handouts [7] and for traditional assignments [8]. Furthermore, student enthusiasm for the web has burst the banks of LMS, such as Blackboard™, and flooded onto myriads of different social networking platforms. Subsequently, Álvarez et al. [9] states, that despite the advantages of LMS for supporting the process of teaching and learning, the true potential of LMS have not yet been fully utilized by academics or students. This tends to suggest that many of the integrated features and functionalities of a LMS are often underutilized, including their online self-assessment feature.

Subsequently, the purpose of this paper is to highlight how an academic in electrical engineering has effectively used an institutional LMS, called Blackboard™, to promote student engagement and academic success through online reflective self-assessments (ORSA). An ex-post facto study is employed along with descriptive statistics involving quantitative analysis of the collected data. The importance of a LMS and reflective practice is firstly discussed. The research context of the study is then provided, followed by the research methodology and results.

II. The Import and Benefits of LMS

Watson and Watson [10] define a LMS as an infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning goals, traces the progress towards meeting those goals, and collects and presents data for supervising the learning process as a whole. However, LMS cannot replace traditional face-to-face instruction, especially within an engineering context as students need to spend time within a practical laboratory under the guidance of an experienced academic. This practical instruction is vital if students are to fuse their theoretical knowledge with their practical work [11, 12]. Subsequently, LMS play a major role in supporting or complementing traditional teaching pedagogies used in classroom or laboratory environments [13]. The implementation of e-learning by means of a LMS makes educational content available to students at any time from any location through web access [14]. This is maybe the singular most important benefit of a LMS, as it provides 24-hour student access to the course content. Additional benefits of a LMS include:

- Increasing student motivation to learn and supporting active learning and problem-solving of real-life problems [15];
- Enabling students and academics to seamlessly integrate real-world authentic activities within class schedule leading to interactive environments [15];
- Allowing students to organize information, contribute content, and engage in learning activities [16];
- Facilitating various kinds of student-academic and student-student interactions [14],
- Supplying a number of synchronous and asynchronous communication tools while furnishing tools that scaffold and support reflection on the learning process [17];
- Delivering intelligent agents to provide feedback on student work and help an academic monitor student progress [18];
- Expediting student feedback on submitted assignments or self-assessments for examination purposes [19, 20];
- Supporting social learning and student engagement [21];
- Creating, fostering, delivering, and facilitating learning at anytime and anywhere [22] which alludes to the advantage stated by Chu et al. [23] in that it allows students to "time shift" and "place shift"; and
- Reducing printing material which enhances efficient delivery [24].

III. The Import, Benefits and Applications of Reflective Practice

The seminal work of Schön [25] identified three types of reflective practices, namely reflection-in-action, reflection-on-action and reflection-for-action, as shown in Table I. All three practices find application within an engineering education environment, and especially so within a laboratory where practical instruction is completed. A key pedagogy of promoting reflective practice among students is by using reflective assessments. Reflective assessments are a formative process through which students can experience assessments as part of the learning process, rather than as a separate evaluative process [26]. Daniels and Bizar [27] suggest that the habit of being actively metacognitive can be developed by students doing reflective assessments, which may include strategies for problem structuring, problem solving and creativity [28].

TABLE I: REFLECTIVE PRACTICES AND THEIR DEFINITIONS [25] WITH POSSIBLE APPLICATIONS

Reflective practices	Definitions	Practical applications	Theoretical applications
Reflection-in-action	Thought process that occurs as an experience unfolds, guiding action with the experience	Students thinking about what step or procedure to follow next while engaging in a laboratory experiment	Students are helped to think about how newly acquired theory may be explained to specific individuals today
Reflection-on-action	Thinking back on an experience to gain new knowledge or gain a better understanding	Students thinking back on a completed laboratory experiment in order to draw appropriate conclusions	Student are helped to think about how specific theory may have been explained to individuals in the past
Reflection-for-action	Drawing inferences from one's past experiences to create possible action plans for the future	Students thinking about mistakes which they made in their laboratory experiments so as to avoid them in the future	Students are helped to think about how specific theory may be explained to certain individuals in the future

Thinking, whether creative or critical, is a cognitive achievement, something which the mind must work to attain [29]. Creative thinking involves a process of making or constructing whereas critical thinking involves a process of judging or assessing. Both critical and creative thinking is involved when engineering students are requested to explain engineering related concepts to non-engineering orientated individuals. This is due to the fact that engineering students first need to think critically about the meaning of the engineering concept, judging or assessing it. Then students need to think creatively in terms of how to link it to a frame of reference or idea which is clearly understood by non-engineering orientated individuals. Here, Gunderman [30] makes a very noteworthy statement about teaching subject matter. He states "In explaining it to others, we see it better for ourselves".

For example, take the engineering related concept of time division multiple accesses (TDMA). TDMA is defined as a digital transmission technology that allows a number of users to access a single radio frequency carrier at a specified time slot by allocating unique time slots to each user. Now the question arises "How would you explain TDMA to a person who must invigilate an examination?" Critical thinking is involved in meditating on the meaning of TDMA and then creative thinking takes over to try and link its definition to something which is familiar to invigilators. A possible answer could be "Students must be in the same exam venue but be allocated their individual seats". In other words, the invigilator is helped to see the link in that a number of students within a specific singular venue are equated to a number of users within a specific singular frequency. However, just as each student is allocated his or her own seat, so each user is allocated its own time slot. One way of promoting such reflective assessments includes the use of self-assessments.

Students report that self-assessments help them understand the nature of their perceptions, attitudes and behaviors [31]. It further helps them to develop a mastery attribution of success that ultimately motivates them to self-regulate their own learning, thereby becoming more autonomous learners [32]. Self-assessments can further facilitate professional growth [33], guiding students to learn that mistakes are opportunities for learning [34], while at the same time helping students to improve their self-knowledge and self-regulation skills [35]. These assessments can further help students to take ownership of their learning [36], serving as motivational tools for students which lead to conceptual change in a student's scientific knowledge and understanding of the natural world [37].

However, research has indicated that students find the process of reflection challenging, with some students going as far as resisting reflective assessments [38]. Accordingly, care must be taken to ensure that students are taught how to engage with reflective practice. In the current study, time was set aside each week to explain to students how they must go about completing the ORSA which focused primarily on explaining engineering related concepts to non-engineering orientated individuals. Students were encouraged to first define and explain the relevant engineering related term or concept too themselves. They were then taught how to identify a specific task or objective of the non-engineering orientated individual which is similar to the definition. Finally, they were urged to tell a little story in which they link the definition to the specific task or objective. This was done in both engineering related modules which were used for this study.

IV. Research Context of This Study

Electronic Communication Systems 4 (EKS4) and Electronic Communications 4 (EKM4) are optional offerings or modules for the Baccalaureus Technologiae (BTech: Engineering: Electrical) qualification in South Africa [39]. Students have to obtain a minimum of 120 credits to successfully complete this qualification. The majority of modules in this BTech programme have a credit value of 12 (this means that students should dedicate at least 120 notional hours to this module), with the exception of a capstone module (termed Industrial Projects 4) which has 36 credits attached to it requiring a full year of work [40]. The Central University of Technology operates on a semester basis of roughly four months during which time BTech students attend one classroom session per week (five periods, each of 45 minutes in duration with three periods dedicated to practical work in a laboratory) over a 12-week period. Electrical engineering students need to be in possession of a National Diploma (minimum of three years to complete) before they can register for the BTech programme which can be completed within a year of full-time study.

The syllabus of EKS4 and EKM4 is primarily aimed at telecommunication based students as they focus mainly on digital communication, where the entire transmission and reception path is covered. The learning outcomes in these modules incorporate illustrative verbs such as define, describe, sketch, analyze, calculate, design, determine and evaluate. The last five verbs are used extensively in the assessments as it places particular emphasis on the higher levels of learning listed in Blooms Taxonomy which contribute to deep learning and critical thinking [41]. These modules expose students to a number of new fundamental theoretical principles that they have not encountered before. ORSA were therefore incorporated into the modules to help students assimilate this new information through the use of reflective practice. These ORSA required students to describe how they would explain specific telecommunication principles to non-engineering related individuals. This required a student to first know and understand the scientific definition of the principles and then reflect on the working environment of the non-engineering individual. Students had to then use creative and critical thinking to align the telecommunication principle with a key aspect of the non-engineering individuals' work environment.

No more than five fundamental theoretical principles were selected from each classroom discussion and then incorporated into bi-weekly ORSA. This resulted in a total of six which were completed by the students over a 12-week period. The practical work (which included five laboratory assignments) incorporated one homework assignment which covered all the ORSA completed by the students. A maximum of 18 marks (three marks awarded to each of the six ORSA) may be collected by students which contribute to roughly 4% of their total course mark. It must be noted that students have to answer all the questions in the ORSA, to obtain these marks. This would require students to have read through the prescribed material, reflecting on its meaning with regard to the self-assessment questions, thereby promoting student engagement. Students must obtain a minimum course mark of 40% to gain entry into the final examination. Any contribution towards this 40% is usually welcomed by students, even if it is only 4% as contributed by the ORSA. Results of the ORSA were shared with the students in order to clarify any theoretical principle misconceptions that existed and to encourage the students to complete the remaining assessments.

V. Research Methodology

An ex-post facto study is employed along with descriptive statistics involving quantitative analysis of the collected data. An ex-post facto study is a type of non-experimental research in which the exploration of causal relationships is performed 'after the fact', meaning after variations of the independent variables of interest have already occurred [42]. The independent variable of interest is the ORSA which may have an impact on the dependent variable of interest, namely student academic success. Descriptive statistics, rather than inferential statistics, were used as the results were interpreted with regard to specific engineering students enrolled at a University of Technology.

Quantitative analysis is important as it brings a methodical approach to the decision-making process, given that qualitative factors such as "gut feel" may make decisions biased and less than rational [43]. The target population was restricted to all engineering students enrolled for the module EKS4 during 2014 and for EKM4 during 2015 and therefore negates the use of a sampling technique. Final student grades for these two modules were also correlated (Pearson correlation) to the number of ORSA completed by the students. A ratio was determined by dividing the total number of students who completed more than 50% of the ORSA by those who completed less than 50% of them. A key criterion for this ratio is that the relevant students had to pass the module by achieving 50% or more for their final grade, thereby indicating student academic success. A ratio is typically calculated by dividing a number of respective calculations above a threshold by the total number of calculations [44].

VI. Results and Discussion

Fig. 1 and 2 presents the student profiles of the majority of students (not all students wanted to divulge this information) who registered for EKS4 during 2014 and for EKM4 during 2015. The majority of students fall in the 25 – 29 years of age bracket. This suggests that the majority of the registered students for EKS4 and EKM4 have just completed their National Diploma, seeking to upgrade their qualification. The predominant home language is Sesotho, which is indicative of the Free State province in South Africa [45] while males outnumber females on average by 2:1.

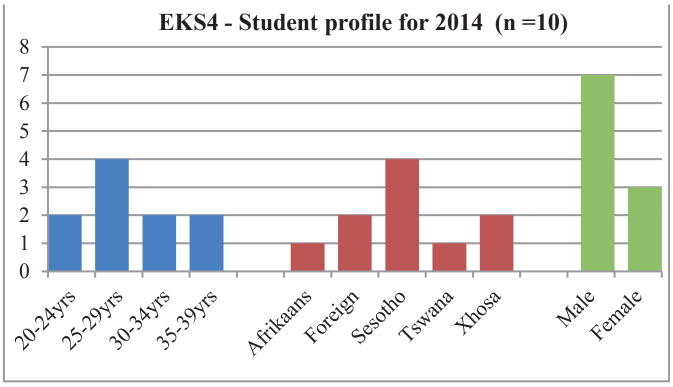

Fig. 1: Student profile for EKS4 during 2014

Fig. 3 and 4 presents a combinational graph, where the area graph (Grey background) indicates the number of ORSA completed by the specific students (six ORSA were scheduled with a mark of three awarded to each completed one). The black column bar graph presents the final grades of those specific students. The anonymity of the students is guaranteed by giving them a random number instead of their student numbers. Student anonymity must be ensured to maximize validity of student responses [46] and to prevent embarrassment on the part of the student.

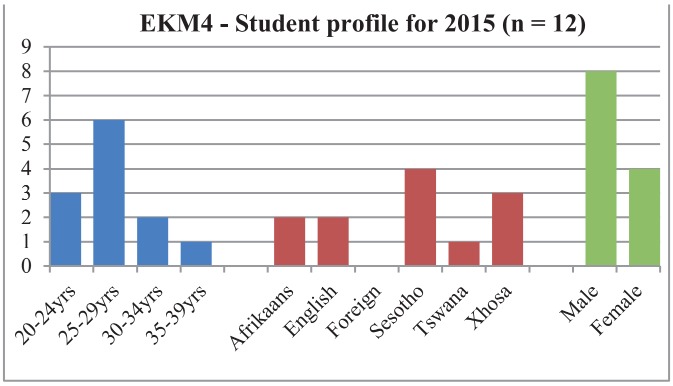

Fig. 2: Student profile for EKM4 during 2015

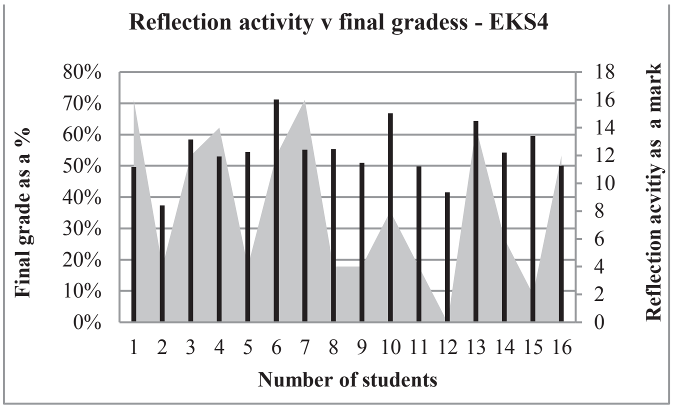

Fig. 3: Reflection activity in GREY versus the individual final student grades for EKS4

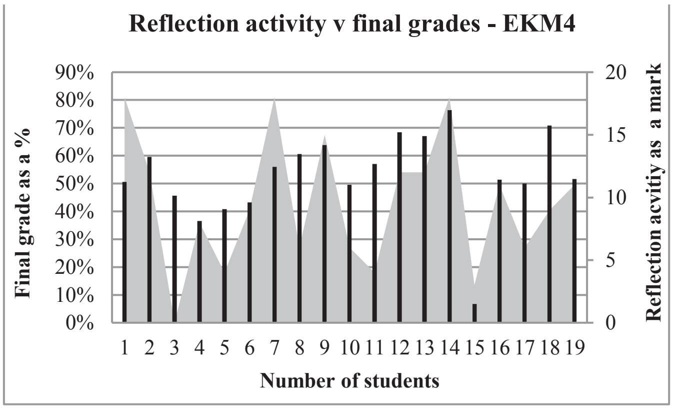

Fig. 4: Reflection activity in GREY versus the individual final student grades for EKM4

Considering student number "12", in Fig. 3, shows that a zero (0) number of ORSA were completed, while the final grade was 42%. On the other hand of the scale, student number "13" obtained a final grade of 64% while engaging with more than 50% of the ORSA (five out of the scheduled six, or 15 marks out of the possible 18 on offer). The same pattern is observed when considering Fig. 4, where the highest final grade of 76% was achieved by student number “14”, who engaged with more than 50% of the ORSA (all six completed). These visual observations tend to suggest that a statistical significant relationship exists between the completed number of ORSA and the final grades of the students. This is indeed confirmed by making use of a Pearson correlation, where the results are shown in Table II.

TABLE II: CORRELATION BETWEEN THE NUMBER OF REFLECTIONS AND FINAL STUDENT GRADES

Module	Year	Module	Year
EKS4	2014	EKM4	2015
Number of online reflective self-assessments versus student final grades			
n	16	n	19
Pearson	0.365	Pearson	0.533
Significance	1.466	Significance	2.597
p-value	0.082	p-value	0.009
Students who completed **more than 50%** of the online reflective self-assessments			
n	7	n	11
Passing	***7***	Passing	***10***
% Passing	100%	% Passing	91%
Students who completed **less than 50%** of the online reflective self-assessments			
n	9	n	8
Passing	***7***	Passing	***4***
% Passing	78%	% Passing	50%
Ratio 7 to 7	1	***Ratio 10 to 4***	2.5

Table II indicates a statistically significant relationship (p = 0.082) between the number of completed ORSA and the final individual student grades for EKS4. The relationship is even stronger (p = 0.009) for EKM4. This indicates that a higher number of completed ORSA would result in academic achievement. Noteworthy too is the ratio, which is an indication of how many students were more likely to achieve academic success based on the fact that they completed more than 50% of the ORSA. The ratio for EKS4 was 1 while that for EKM4 was 2.5, resulting in an average ratio of 1.75. Students completing more than 50% of the ORSA are therefore almost twice more likely to achieve academic success than those who did not. Improved academic success is an indication of more student engagement [47].

VII. CONCLUSIONS

The purpose of this paper was to highlight how an academic in electrical engineering has effectively used a LMS, called Blackboard™, to promote student engagement and academic success through ORSA. An ex-post facto study was used with descriptive statistics of the quantitative data. Two groups of students who enrolled for EKS4 and EKM4 were asked to complete biweekly ORSA via Blackboard™. Results indicate that those who completed more than 50% of these self-assessments were almost twice as likely (exact ratio of 1.75:1) to achieve academic success as compared to those who completed less than 50% of them. Students who completed more than 50% of the ORSA have again proved that students who engage more with the course content on a regular basis (assessments were completed every second week) have a higher chance of academic success than those students who complete less than 50% of them.

Although this study was limited to only electrical engineering students within the electronic communications field, it clearly highlights the benefits of reflective practice. A key recommendation would be to encourage ALL academics to promote reflective practice among their students by making use of ORSA. Initial setup time of the self-assessments by the academics is required. However, only a small measure of maintenance time is then required per semester to activate the self-assessments or to modify a question or two! Academics only need to select a small number (less than five) of key theoretical principles from their syllabus that they may use to prepare weekly (or even biweekly) ORSA. These assessments should adhere to the following two important principles: first, they must be manageable in that students should complete them within 20 minutes or so; second, they must be made available on a regular basis to help create a study routine for the student.

These results tend to suggest that some academics are using educational technology more effectively that other academics, to the benefit of students and higher educational institutions. Using the self-assessment tool under the assessment feature available in a common LMS has promoted student engagement and academic success, resulting in students being able to acquire more credits towards obtaining their higher qualification. It has also enabled the institution to maintain a higher throughout rate which will impact positively on future teaching grants awarded by the Department of Higher Education and Training in South Africa. These results further tend to support the words by Confucius, whereby personal self-reflection is one of the noblest, if not most critical, pedagogical method for students not only to acquire wisdom, but also to achieve academic success.

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