INTERACTION WITH A DIGITAL LEARNING ENVIRONMENT OF A UNIVERSITY

Emily Bagarukayo and Theo P. van der Weide
Faculty of Computing & IT, Makerere University, Kampala, Uganda
Radboud University Nijmegen, Nijmegen, Netherlands

Keywords: Digital Learning Environment, Blooms Digital Taxonomy, Interaction, Higher Order Cognitive Skills.

Abstract: We discuss the position of the Digital Learning Environment (DLE) in a general architecture for an educational institution, and discuss its efficiency and effectiveness. Then we discuss the related generic educational approach in terms of the architectural model of competence and Blooms Digital Taxonomy when using a DLE. We discuss the completeness of such a methodology by relating the DLE to the methodology framework. As a case study and proof of concept we look at the DLE of Radboud University, Nijmegen by studying how it was implemented and how it has made the learning process more efficient. We show some figures that give an impression of the effects of the DLE on learning.

1 INTRODUCTION

Digital learning environments (DLEs) are technical solutions for supporting learning, teaching and studying activities (Suhonen and Sutinen, 2006). DLEs offer features like chat rooms, discussion boards or forums, digital testing, online grading, virtual classrooms, feedback, authentication, collaboration tools and content areas to communicate, interact and collaborate. DLEs are interactive, engaging, stimulating and assess students, therefore, impact on teaching and learning. DLE effectiveness is dependent on information presentation, learning process, learning methods and instructional strategies supported, and not on information or technology itself (Khalifa and Lam, 2002). Instructional strategies supported should be examined to choose the best strategy for learning. The DLE is responsible for facilitating students' ability to interpret the multiple perspectives of the domain context, be guided to conduct and manage their personalized learning activities, and encourage collaborative and cooperative learning for critical thinking and problem solving (Liu and Sun, 2002; Sun *et al*., 2003). We investigate the impact of the DLE on teaching, learning and assessment processes to give recommendations for other institutions.

2 DLES & THE ENVIRONMENT

Students' perceptions showed that the interactive environment offered a more enjoyable, active, interactive, explorative learning process, more effective in supporting the learning methods and a higher level of learning was achieved (Khalifa and Lam, 2002).

The need for Higher Order Cognitive Skills (HOCS) is acknowledged (Bagarukayo *et al*., 2011). The number of learners is expected to continue growing; therefore an effective way to handle this is imperative. The DLE enables instructors to quickly and easily develop online course material, interact with students, monitor their progress and learning at a distance. If well founded on a learning methodology, the DLE enhances performance of users. A learning solution independent of student numbers for course delivery, content management, and community engagement is needed. A DLE embedded in an organizational environment is the perfect solution to meet the student demands of ubiquitous learning.

Given the changing landscape, the institution should offer an efficient, auditable, highly accessible training facility for a broader audience to support hybrid learning. The strategy is a well equipped DLE to play a central role as main facilitator for distance education. During DLE implementation, visions, goals, principles and objectives, expertise,

Bagarukayo E. and P. van der Weide T..
INTERACTION WITH A DIGITAL LEARNING ENVIRONMENT OF A UNIVERSITY.
DOI: 10.5220/0003956802590264
In *Proceedings of the 4th International Conference on Computer Supported Education* (CSEDU-2012), pages 259-264
ISBN: 978-989-8565-06-8

digital learning materials and ICT infrastructure of the institution have to be in balance (Kennisnet, 2010). Cooperation, support of staff, leadership and pedagogical use of ICT for learning are needed (Tondeur *et al*., 2010).

2.1 DLE Benefits and Measures

"ICT is very suited to offering subject matter in multiple ways, e.g. visually, with audio, and interactively" (Kennisnet, 2010). Providing content via a variety of channels makes learning more effective. The DLE benefits in this context include the following: DLEs are built to support different learning styles and preferences since they use multimedia; it provides material in different forms. DLEs make the teaching and learning process flexible coz of access of content and information from anywhere, at anytime and pace.

DLEs are interactive, collaborative, simulative, and adaptive for communicating and sharing digital content. DLEs provide real time assessment of both formative and summative courses. One DLE goal is to cater for increasing student numbers therefore it is a success measure. DLEs usage involves quality of the delivered product. The success on adaptation, improved student performance, learning habits, communication, interaction, are success indicators.

Surveys determine how students rate DLE success at Radboud University (RU). The teacher sees added value like change in users behavior. By looking at functionalities used, DLE success can be measured e.g. changing from easy to complex functionality, shows DLE interaction improvement.

DLE success can be measured by analyzing questions teachers ask; complex questions indicate improved DLE use. The growth of DLE usage at course level can be monitored by viewing how depth and richness of content increases. The more the number of active courses the more successful the DLE is. An engaged student is likely to be more successful therefore a measure of DLE's success. The popularity and high adoption rates of collaboration, interaction and communication tools can be used to measure DLE success because they impact significantly on students' engagement.

An important measure is availability of education with similar / less resources i.e. more efficiency. The quality assurance / control and information embedding is an important DLE success measure.

3 BUILDING COMPETENCES WITH DLE

The educational approach aims at building competencies, which are the ability to perform a task adequately and deliver the desired outcomes (Bartram & Roe, 2008). We identify the role DLEs play in building competencies, which relates to Blooms Taxonomy (BT) since it aims at developing Knowledge, Skills and Attitudes (KSA). Students cannot gain competencies without putting KSA into practice by learning by studying, practicing and doing. The KSA represents BT's domains that categorize cognitive processing levels of learning; which have to be built from a solid infrastructure. In Roes architecture we see how personal qualities relate to competences via KSA.

3.1 Learning in Relation to DLEs

Learning is a process where students interaction with learning materials, peers and lecturers results in change in behavior and thinking. The learner retains information within their own knowledge base when the relationship between information, learner and environment, created by learning theories in educational design, occurs (Jones and Jo, 2004). We concentrate on BT, an effective learning theory that can be applied in many different LEs and situations. It categorizes learning behavior to assist in the design and assessment of educational learning (Bloom, 1956). The rationale behind BT is that it is the most widely accepted educational taxonomy (Parham, 2009) and has been used by many researchers to evaluate students' development of HOCS required at the work environment. Finally, there is a revision Blooms Digital Taxonomy (BDT) incorporates new advances in technology for learning purposes and therefore ties in very well with our research on the DLE integration and interaction (Anderson and Krathwohl, 2001).

3.2 BDT and the DLE

Students need to put KSA into practice and therefore educators need to raise the level of learning effectiveness based on BT (Bagarukayo *et al*., 2011). BDT uses tools to facilitate learning to let the learning process benefit from modern technology and new insights, since technology is important for realizing learning skills in today's knowledge economy (Anderson and Krathwohl, 2001). We aim at discovering how DLEs help students to improve learning, in particular HOCS. For the creative

teacher, a LE has the opportunity to encourage student inquiry from knowledge to evaluation level. For example at the creating level of BDT, Sites that encourage cooperative learning activities that use a variety of materials to create new products can be used as the resource, and an example is Think Quest for creating interactive, content-rich Web sites, Web Quest is inquiry-oriented activity designed to use learners' time well, to focus on using information rather than looking for it, and to support learners' thinking skills. Collaborative wikis, blogs, workshop, assignment based uploads, mind maps, upload video, pod casts, publish documents, lesson plan.

3.3 BDT as Solution for Changing Landscape

Today's students are accustomed to digital technology, therefore with the available tools, instructional designers can create lesson plans that integrate modern technology with BT (Hobgood *et al*., 2011). BT offers a way for both learners and instructors to systematically analyze levels of understanding into a hierarchy of thinking levels that indicate progress towards content mastery. It gives the teacher a method of student work evaluation that allows them to differentiate for student needs. The teacher can outline both objectives and activities for each level of BT with regard to the lesson, to give students clear expectations Therefore, since digital native learners can outine learning objectives and outcomes using the BDT, it is relevant for the DLE as a guide for learning outcomes and assessment methods that teachers can use.

With recent advances in technology, assessment of understanding has become a necessary part of these trends in new LEs. In particular, learners need to conduct self-assessment of their own learning to monitor their progress, in addition to instructor feedback.

3.4 DLE as a Support for Learning Process

The DLE supports the learning process by providing support for students to set their own learning goals, manage the content, learning process, and communicate with others to achieve learning goals. DLE tools encourage students to share knowledge ideas and experiences thereby enhancing development of critical thinking, problem solving and decision making skills which are at the higher levels of BT i.e. HOCS. The teacher acts as a facilitator and the students take responsibility for the learning process, thereby promoting active learning. The higher levels of BT emphasize ability to apply skills in a novel situation; therefore students can attain HOCS by taking charge of their learning.

4 THE METHODOLOGICAL FRAMEWORK AT RU

The methodology framework (Seligmann *et al*., 1989; Proper, 1994) distinguishes the following aspects of a methodology: way of thinking, way of modelling, way of working, way of controlling and way of supporting. We consider the learning strategy in the context of the methodology framework and evaluate whether all the relevant aspects of the methodology are addressed sufficiently well and discuss to what extent these aspects are covered. We then relate the learning methodology to the various aspects of the methodology framework. We position the approach at RU from the methodology framework point of view.

The way of thinking for a learning methodology is its general idea of knowledge and skill transfer in a broader context. It describes obtaining competencies as the essential part of knowledge and skill transfer, where enhanced ICT's enable the requested separation of time and place in the educational process. The way of modelling is not clearly communicated to Bb participants. Courses focus on getting hands-on experience and presenting best practices. We see BDT as the way of modelling.

The way of describing at RU, the LE is looked at from an educational perspective. What makes students happy and how to improve in educational sense.

The way of working management checks the quality by letting students evaluate the teacher. In our context, the implementation of the learning program into the DLE, leading to the composition of teaching material, is described by the way of modelling. Courses for introducing teachers to use Bb exist.

The way of controlling at RU, the teacher determines how they teach and management steers the process at a general level.

The way of learning consists of special trainings derived from the way of modelling to empower teachers to use the LE. The best practices and information sharing is how learning can continuously take place, taking benefit from past experiences. Learning focuses on the best way to use modern technology in a changing society.

We conclude that from a methodological point of

view, a DLE per se should be seen as a way of supporting. The DLE acts as the *way of supporting* for the learning method, where teachers upload instructional materials and content that students access. It enables students to achieve competencies and KSA by supporting the learning process. The DLE addresses the new demand of anywhere anytime learning and educating masses. The ease of use, support, global standards, open systems, high scalability and implementation options are key selection criteria for any DLE. The educational processes like posting notes are left under teachers' control. The entire process is automated, so teachers do not have to request for courses to be setup.

The university policy may be seen as a decentralized top-down approach trying to gradually define this view in a field of emerging philosophy and technology as a result of experiments from its teachers.

5 USAGE EXPERIENCES

Radboud University Nijmegen (RU) introduced Blackboard (Bb) as its DLE in 2000. Bb offers digital testing, discussion forums, advanced statistics tracking, wikis, and chat rooms, among others. Initially, it was introduced as a tool to support teachers with tasks in the learning process such as distribution of teaching material, providing assignments and results submission to improve the teaching process. The initial expectations of Bb from the administration were that it provides easier administration, proper documentation, information sharing, and a close interaction system to improve communication. The Bb and other administrative systems, such as student administration were integrated to improve functionality and user friendliness. New requirements were formulated such as guaranteeing security of data in Bb and privacy over the systems. The management is satisfied that initial expectations are met. The students' expectations are determined by surveys, to determine if they are satisfied with the system.

The infrastructure itself is no guarantee for successful ICT introduction in the educational process (Kennisnet, 2010). For a successful DLE, the institution policies and how they are effectuated is essential. But at the time of DLE introduction these policy issues were still very open. Teaching models and material were hardly available, and mostly had to be developed from scratch. Teachers were seen as pioneers in this emerging educational landscape, and were encouraged to share their best practices to learn from teachers close to them which lead to answers about the new *way of thinking*.

Bb usage is not compulsory from a central level; the actual policies vary over various faculties. Teachers have different degrees of freedom per faculty to decide whether to use Bb but some basic use is mandatory. The university expects results that assume the advantages of Bb. DLEs usage for interactive and collaborative teaching can be used to handle large student numbers with few resources.

5.1 The Central Infrastructure System

RU has chosen the general infrastructure as displayed in figure 1. There is no central system at RU; there are sub systems interconnected for information sharing. The central administration is automated, and therefore management observes the way instructors and students use Bb, to determine if it is successful. The systems in the figure are:
RBS is relationship management and administration system where new staff and students are created.
ISIS contains all course information and students enrolled. The information from RBS and ISIS is stored into Bb.
Bb Content System stores all the content that can be accessed and used by students in the system.
LDAP/IDM contains the authentication protocols used to ensure that the right users access the system.
The central infrastructure system is connected to the *Bb server*.

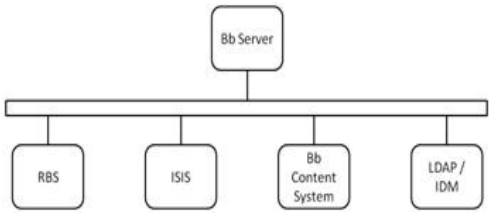

Figure 1: The central infrastructure system.

Bb is synchronized with administrative systems issues at the central level like course, examination, and programs registration. Bb accounts and courses are automatically created for new users. Teachers use Bb for communication since they can access information disseminated and are automatically enrolled for courses they intend to teach. All Bb courses have basic student information and often contain announcements, posts, etc. The university encourages teachers to use modern methods such as digital testing especially for big classes.

5.2 Usage data from Bb

We present some data to give an indication of the usage of Bb at RU.

5.2.1 Participation

An overview of participation in Bb shows increase in usage by both students and teachers (Table 1).
The number of students and instructors actively using the grading center increased from 2008/9 and 2009/10; therefore successful DLE implementation. There was a general increment in the number of courses from 2008/9 to 2009/2010, and therefore increased DLE usage.

Table 1: Students and instructors actively using Grade Center.

Faculty	students 2009/10	instructors 2009/10	courses 2008/09	courses 2009/10
FU-aggo	448	64	156	148
FU-awfi	580	38	74	83
LETT	4.100	482	786	865
FdR	3.294	230	198	207
FSW	5.338	579	499	465
FdM	3.356	261	330	328
FNWI	2.293	568	459	522
UMCN	1.877	931	172	156

5.2.2 Activity

In table 2 over the period 2008 – 2010, there was an increase in announcements per course, indicating activity increase, hence communication increase in the DLE.

5.2.3 Conclusion from Data

Unfortunately data on collaboration, interactivity and performance was not available. However, the performance on the educational process may be measured by increase in fraction of students passing. The results aid in measurement of DLE efficiency. By looking at the statistics on the number of active courses, we state that number of courses, students, instructors and announcements posted are increasing annually and indicate increase in communication, interactivity, collaboration, which improves HOCS.

6 RECOMMENDATIONS & FUTURE RESEARCH

Based on the study and universities' experience, we recommend the following for successful DLE implementation. The four building blocks of vision, educational software and content, ICT infrastructure and Knowledge skills and attitudes (professionalization) need to be well balanced for the DLE to work efficiently and effectively (Kennisnet, 2010). Teachers' cooperation is very important for DLE efficiency to share experiences and ideas with other universities to inspire and learn from one another (Tondeur *et al*., 2010). Cooperation, leadership and pedagogical use of ICT for learning are needed for efficient use DLE.

The technical team should incorporate tools with features and services that users want to use to make courses more effective and work easier e.g. digital testing and automatic grading.

Students' requirements should be put into consideration by giving them an opportunity to request for services that make their study effective and successful. Polling functionalities can be used by students to exchange ideas, rate DLEs importance and give feedback to plan for its future use. Students can run the portal and give their opinion on their needs, to create an online community as an opportunity to change the institution through the system's online polling capabilities for motivation. Students can use the system to ensure efficiency and effectiveness in running the institution processes.

Experience has shown that use of collaborative tools for communicating, interacting and team work; groups and forums can enhance HOCS to improve their critical thinking skills through creating, reviewing and providing feedback. Forums are a creative way of engaging students to critically evaluate information and get them enthusiastic in discussions to increase learning interest motivation.

Students and tutors should be sensitized and encouraged to use collaborative, interactive and communication tools like the content area, formulate groups, and participate in group discussions, chat, and group email. They need to realize DLE importance to benefit from learning process incorporated. Instruments can be created to discuss difficult concepts in DLEs, which students can continue using at job placements. This teaches them how to apply knowledge in novel situations in real life. The existing DLE solutions should be transformed into virtual LEs featuring course tool shops that provide users with customized information. The institutions should take advantage

Table 2: Average number of Announcements per faculty.

Faculty	available courses 2009/10	number of Announce-ments 2009/10	Avg An-nouncements per course 2009/10	*Ranking*
FU-	148	244	1,6	8
FU-awfi	83	271	3,3	7
LETT	865	3.410	3,9	5
FdR	207	1.462	7,1	3
FSW	465	2.940	6,3	4
FdM	328	3.207	9,8	1
FNWI	522	2.031	3,9	5
UMCN	156	1.309	8,4	2

of ubiquity to deliver information to students' mobile phones in case of emergency. The ability to run the DLE on integrated PDAs, cell phones, tablets should be explored to motivate students.

The institution should integrate assessment solutions and capabilities which enable assessment more broadly beyond the confines of a single course. Teaching, learning and assessment should be integrated in the DLEs, as a redefining tool that enables creation of a very complex and rich environment for interaction, communication and collaboration. We recommend introduction of podcasting building blocks so that students can click and drag an icon to iTunes and subscribe automatically to the course.

One of the challenges with introducing DLEs is teachers are reluctancy to embrace it. Therefore they should be encouraged that DLEs promote students' learning and ease their work.

6.1 Future Research

The Implications on teaching is that stakeholders determine the impact of technology on learning and therefore introduce it willingly. If teachers and students realise benefits of technology, they will embrace it, impacting on instructional content designers, who can design content suitable for students learning and HOCS improvement. The appropriate content and environment for teaching at all levels will be determined to benefit both students and teachers.

The DLE may enhance HOCS since the content addresses students' learning styles, preferences, collaboration, interaction; and encourages anytime, anywhere, and any pace learning.

This being a position paper we provided the data that we have so far, in the next version we include data on collaboration, communication and interactivity, from which we will determine if the DLE improves HOCS. We believe the DLE has improved the learning process due to the increase student numbers, courses and announcements; therefore indicates improvement in communication and collaboration, which improves HOCS. In future we discuss how implementation may be applied in low-infrastructure countries.

REFERENCES

Anderson, L., and Krathwohl, D. (2001). A Taxonomy for learning teaching and assessing: A review of Blooms taxonomy of educational objectives. New York: Addison Wesley Longman, Inc.

Bagarukayo, E., Weide T. P. V and Lubega, J.T. (2011). An Evaluation Strategy for the Moodle Learning Environment Based on Blooms Taxonomy. 3rd International Conference on Computer Supported Education (CSEDU2011) pp 422-426, the Netherlands, ISBN: 978-989-8425-49-2

Bartram, D., and Roe, R. (2008). Individual and Organisational Factors in Competence Acquisition. In N. W.J., and N. L.F., The learning potential of the workplace (pp. 71-96). Rotterdam: Sense Publishers.

Bloom, B. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co. Inc.

Hobgood, B. E., Thibault, M., and Walbert, D. (2011). Kinetic connections: Bloom's taxonomy in action. An introduction to strategies for using the web to push your students to higher levels of thinking. http://www.learnnc.org/lp/pages/778 (retrieved at May 24, 2011).

Jones, V., and Jo, J. (2004). Ubiquitous learning environment: An adaptive teaching system using ubiquitous technology. In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds), Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference. Perth, 5-8 Dec, (pp. 468-474).

Kennisnet. (2010). Four in Balance: ICT at Dutch Schools. Zoetermeer: Kennisnet Foundation.

Khalifa, M., and Lam, R. (2002). Web based Learning: Effects on Learning Process & Outcome. IEEE Transactions on Education, Vol 45, No. 4 .

Liu, K., and Sun, L. (2002). Applying Semiotics in Constructivist Learning. Keynote Paper, International Conference on Teaching and English Translation Marco Politechnique Institute, Marco.