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Introduction to the Issue

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While the spring 2012 issue of RCETJ is one of the smaller ones we have published in recent years, its articles come from near and far. The four articles that make up the issue focus on issues related to the use of digital technologies in higher education.

Tham and Tham kick off the issue with a pilot study investigating the use of game-based learning in higher education in Singapore. Next, Oboko and Wagacha describe their efforts in creating a web-based learning system that can accurately predict learner need for, and use of, additional learning materials, which are provided using a support strategy called adaptive link hiding. They are followed by Mufeti, Foster, and Terzoli, who chronicle their experiences building a virtual partnership between the University of Namibia and Rhodes University in South Africa.

The final article by Nyangau and Bado addresses a very different topic that only indirectly focuses on teaching and learning with digital technologies. Nevertheless, it provides some interesting insights as it takes a look at how institutes of higher education are wielding social media tools for recruitment and admission of students.

As the articles in this issue show, technology is being used for a wide variety of tasks in colleges and universities across the globe, and this diversification will only increase as we continue to move forward…

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Is Game-Based Learning an Effective Instructional Strategy to Engage Students in Higher Education in Singapore? A Pilot Study

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Stirling University, UK

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University of Newcastle, Australia

Abstract

Today's Internet Generation is accustomed to multi-tasking, graphics, fun, and fantasy. Educators in Asia are finding it increasingly challenging to engage and motivate students with traditional modes of teaching. One tool that may help them in this endeavor is game-based learning, which is beginning to catch on in K-12 schools and higher education. This paper examined whether game-based learning is an effective instructional strategy for engaging and motivating students in higher education in Singapore. Findings indicate that game-based learning can be a useful strategy to motivate students, because the challenge of a game fosters competition between groups and collaboration within groups.

Keywords

Blended Learning; Game-Based Learning; Pedagogy

Introduction

"Good teaching is open to change: it involves constantly trying to find out what the effects of instruction are on learning, and modifying the instruction in the light of the evidence collected" (Ramsden, 2003, p. 102).

Educators in the 21st century are in the midst of a paradigm shift. They are recognizing the growing need to redesign pedagogical practices to engage 21st century students who are accustomed to multi-tasking, graphics, fun, fantasy, and the Internet, and are incredibly bored by traditional modes of teaching (Jukes, McCain, & Crockett, 2010). Today's students prefer to construct their own learning and gather information, tools, and feedback from multiple sources. They prefer technological and collaborative experiences that exhibit clear goals, enhance motivation, and involve authentic activities (Brown, 2000; Frand, 2000; Oblinger, 2003). In view of this, educators are increasingly seeking to tap the potential of game-based learning to engage and motivate learners.

This paper seeks to examine whether game-based learning is an effective instructional strategy for engaging students in higher education in Singapore. It examines whether instructional games can stimulate student interest and boost their learning motivation. It also investigates what aspects of game-based learning are engaging to students in Singapore.

Literature Review

Recent research suggests that students who are growing up in a digital environment are neurologically different from the generation of baby boomers who have not (Small & Vorgon, 2008). This is caused by the fact that the digital world offers a direct connection between the effort expended and the immediate reward received. In contrast, rewards in class are often deferred until formal assessments or examinations are conducted. Students find such distant rewards as being too far in the future to motivate them to learn. Instead, digital learners prefer learning that is relevant, active, instantly useful, and fun.

Renowned psychiatrist William Glasser asserted that there is a strong connection between fun and learning. Glasser's Choice Theory identifies fun as a basic need that drives human behavior. Students learn best when they enjoy what they are being taught, as they have a strong need to connect and have fun (Glasser, 1998). Strauss (2010), in an article in the *Washington Post*, noted that brain researchers have suggested that fun is required for authentic learning and long-term memory. Neurologist and educator Judy Willis has also highlighted the learning benefits of fun. She noted that when joy, comfort, and spontaneity are replaced by homogeneity and conformity, students' brains are disengaged from effective information processing and long-term memory storage. The joy of learning and discovery is the well-spring for the highest-level of executive thinking, making of connections, and "aha" moments (Willis, 2006).

In the educational context, computer games have been known to offer several related benefits, such as engaging learners in learning environments, increasing motivation, intensifying retention of information, and improving problem-solving skills. In addition, computer games allow groups of learners to share knowledge, skills, resources, and to cooperate for solving problems (Chiong, 2010). Keller and Kopp (1987) posited that motivation plays an important role in learning as it stimulates learner interest. In this regard, games have an important role in promoting engagement and intrinsic motivation in instructional settings, as observed by Malone (1981), Bowmann (1982), Provenzo (1991) and Rieber (1996). Instructional games offer the opportunity for the learner to learn by doing and to become engaged in authentic learning experiences (Garris, Ahlers, & Driskell, 2002).

Advocates of computer game-based learning argue that computer games have the potential to transform the way in which students learn, and can motivate and engage a new generation of learners in ways that traditional education does not. Richard and Oblinger (2003) noted that games are motivating as players need to seek out data and information to successfully complete its challenges, in contrast to the traditional classroom approach of being given facts and figures and then figuring out how they may be relevant. Lin, Liu and Shih (2010) showed that many students found digital games to have a positive effect on their learning motivation, attitude and flow experience.

According to Foreman (2003, p.15), "Games expose players to deeply engaging, visually dynamic, rapidly paced, and highly gratifying pictorial experiences that make almost any sort of conventional schoolwork (especially when mediated by a lecture or text) seem boring by comparison". A recent study by Patrick Felicia (2010) concluded that games are effective in motivating and engaging students. Felicia's research highlighted three key elements which contribute to the motivational outcomes of games: the design of the game, the medium used to deploy the game, and environmental scaffoldings such as support from teachers. The study further observed that games which produce motivational outcomes have clear goals, rules, multi-sensory cues, narratives and a good balance between the educational and entertaining features. Active support from teachers in the introduction and running of the game also increased student motivation.

A large body of literature supports the notion that games can facilitate learning and motivate learners when they are well-designed. Such digital games are appealing and incorporate challenges, clear goals, variety, choice, error toleration, fun, social interaction, feedback and recognition (Richards & Min, 2011; Spitzer, 1996). According to Marc Prensky (2001), there are six key characteristics of games which lead to strong engagement of students: rules; goals and objectives; outcomes and feedback; conflict/ competition/challenge/opposition; interaction; and representation or story. Rules provide structure. They

are needed so that players know what's expected and allowed within the boundaries of the game. Goals and objectives foster motivation, as they give players something to strive for. Outcomes and feedback provide players with information regarding progress towards these goals and objectives, and can be both inside and outside of the game. They are most effective when they are immediate. Conflict, competition, challenge, and opposition are the in-game problems that need to be solved to be successful. Interaction relates to the social aspect of games, i.e. players often interact with each other while playing. This is especially the case for online games like World of Warcraft. Finally, representation means that a well-designed game needs to have a story; it needs to be about something.

Kirriemuir and McFarlane (2004) highlighted two key themes common to the development of games for education, namely "the desire to harness the motivational power of games in order to 'making learning fun' and a belief that 'learning through doing' in games such as simulations, offers a powerful learning tool" (p. 10). In such games, players (sometimes in cooperation with others) are actively solving challenging, situated problems. In addition, well-designed games are consistent with constructivist, situated learning and collaborative learning theories (Tham & Tham, 2011), which stress that learning is an active social process in which meaning emerges from experiences while solving situated, realistic problems.

Some universities around the globe are beginning to utilize game-based learning to motivate students. This is evidenced in the recent work of Ebner and Holzinger (2007) and Virvou, Katsionis, and Manos (2004), who used competitive games and virtual reality games to support the learning and practice of civil engineering and geography, respectively. Game-based learning is also catching on in schools and institutes of higher education in Asia. A study conducted by Zhi and Zhang (2008) showed that students at a large university in Nankai, China learned more from quasi-game-based learning than from purely face-to-face classroom instruction. The study involved 150 third-year undergraduate computer majors (aged between 19 and 22) enrolled in the software engineering course.

In Singapore, however, the use of game-based learning as an instructional strategy to engage students is largely confined to K-12 schools. Two recent studies (Chee &Lee, 2009; Gwee, Chee & Tan, 2010) showed the effectiveness of game-based learning to engage students aged 14 and 15 in deeper learning. Chee and Lee (2009) noted that the use of well-designed game-based learning promoted learning and the acquisition of problem-solving skills and collaborative knowledge building skills among students.

Universities in Singapore are just beginning to explore new ways to engage students in learning. Three large, local universities - National University of Singapore, Nanyang Technological University, and Singapore Management University - have introduced the use of student response systems, using handheld, palm-sized devices, in their weekly graded lecture quizzes (Lei, 2011). Multiple choice quizzes are flashed on a screen and students select an answer using their individual 'clickers'. Lecturers noted that the clickers made lessons more fun and encouraged students to become more involved during lessons, as students felt they were playing a game during the ensuing quizzes. The reason for this is that the use of clickers in lecture quizzes incorporates two essential elements of games in education which motivate student learning, namely, "making learning fun" and "learning through doing" (Kirriemuir & McFarlane, 2004, p. 10).

In short, while the literature provides evidence of the potential of game-based learning as a useful strategy to increase student motivation to learn, institutions of higher education in Singapore have barely begun to implement this pedagogical tool. Therefore, this article examines, in a small way, whether instructional games can stimulate student interest and boost their learning motivation, and which aspects of game-based learning are engaging to students. The reader should note here that there are many definitions of game-based learning. For purposes of this study, the author adopted the definition of game-based learning used by Carson Learning Services (2006): "Game-based learning is the process of taking an idea and creating an activity to deliver that idea in a manner that is motivating, challenging and fun, and has a measurable learning objective as a foundation" (p. 1). Game-based learning tools can include digital games, simulations, educational videos (where students watch a video and discuss answers to questions), and in-class group competitive games such as quizzes and crossword puzzles.

Methods

The author was invited to teach a course at an institute of higher learning in Singapore on the historical and economic developments of two major Asian countries. The author was informed that previous cohorts that had studied this course found the lectures boring and consequently class attendance was poor. Against this backdrop, the author decided to introduce game-based learning to trigger student interest in the subject, to boost class attendance, and ultimately to achieve improved student achievement.

To engage the students, the instructor introduced game-based learning using a blend of multimedia tools such as educational videos (where students watch a video and discuss answers to questions that follow to facilitate understanding of concepts taught), as well as team competition in solving quizzes, puzzles and games that required students to search for information using Internet sources. They were designed according to the best practices described in the literature. The games usually lasted about half an hour and were intended to engage students in the subject taught, enhance retention of information, and improve problem-solving and team skills. Scores were awarded to each team and the winning team was awarded a mystery prize. Before the game-based learning session, students were briefed on the goals and rules of the game. The content for the lesson was then introduced following the game-based learning activity.

A focus group interview was conducted at the end of the course, with a group of 20 young adult Singaporean full-time students, aged between 17 and 18 years and enrolled at an institute of higher learning in Singapore. The students were in Year 2 of their studies and the group was composed of 11 females and 9 males. They attended the same class and thus knew each other well.

The following questions were posed to the focus group:-

1) Did you enjoy the game-based learning introduced in this course? Please provide reasons for your reply.
2) Which aspect of game-based learning do you find most effective in engaging your interest: challenge, fun, or reward?
3) Has the game-based learning triggered your interest in the subject taught?
4) Does game-based learning motivate you to engage in self-regulated learning?
5) Apart from game-based learning, what other factors would motivate you to study and do well in this course?

Findings

The first author acted as the interviewer and the interviews were recorded, transcribed, coded, and entered into the computer for processing and analysis by the second author. Student responses can be summarized as follows:

a) Sixteen of the 20 students said they enjoyed game-based learning. They liked being involved in finding their own answers and learning from peers during group discussions. They felt that the instructional games provided an enjoyable learning experience compared to merely listening and taking notes during a lecture. Four students, however, felt that the games did not affect their motivation to study for the course. They said that achieving good grades was the key motivator. They would be attentive in class even in the absence of games;
b) As for which aspects of game-based learning were most engaging, all students agreed that it was the team work, inter-team competition, instructor feedback, and recognition. They deemed game-based learning enjoyable in that it connected them socially with other students and provided a new, stress-free environment for learning. Students enjoyed the collaborative team work in solving puzzles and quizzes as it gave them a higher sense of social belonging;
c) The game-based learning approach acted as a good trigger for getting students interested in the lessons. Students felt that the use of games stimulated their interest in the subject. Active

participation in games and related activities reinforced their learning and helped sustain their interest in a "boring" subject. A related outcome was good class attendance throughout the 13-week course. Students said they looked forward to the class;

d) Students felt that the 30-minute game session was sufficient as an interest trigger. It would, however, not affect their motivation to engage in self-regulated learning, which is determined more by the need to achieve good academic results to enhance future career prospects;
e) Apart from games, students said that their personal aspirations and ambitions played a vital role in motivating them to study hard. Some students mentioned that gaining their parents' approval and recognition were the most important factors motivating them to study and perform well academically.

To provide more detail, some of the students' comments/views on game-based learning as introduced in the course are shown below:

My perception of the course has changed. My initial view was that this course will be dry and boring. It is about learning facts and figures – so boring! I was pleasantly surprised that the course can be so interesting and enjoyable. Through the instructional videos cum case study, puzzles and quizzes as well as competitive games, I found myself enjoying the lessons. The instructional games motivated me to read up more about the 2 countries and formulate knowledge through self-discovery. The group discussions were also interesting and I learnt from my peers.

I must say that the course is really fun. I looked forward to attending class and did not miss any lessons. I found myself more actively involved as we were required to solve problems together in class and online. It has certainly helped me to be more engaged in studying the course.

My friends and I enjoyed the games. We enjoyed the instructional games. We were actively participating in the games as there is a prize for the winning team. It caused us to be interested in the subject taught.

I enjoyed the team work in solving a case and in finding the answers to the cross-word puzzles. The experiences in collaboration give me a higher sense of social belonging.

Discussion

This paper examined whether instructional games can stimulate student interest and boost their learning motivation and identified aspects of game-based learning which are engaging to students. One major finding of this research is that competition or challenge plays a major role in making instructional games enjoyable (Csikszentmihalyi, 1990) and motivating (Malone, 1981; Malone & Lepper, 1987). Our instructional games required students to interact and compete as a team. The competitive element created a lively atmosphere in class; there was enthusiasm, attentiveness, and excitement among students. This friendly and lively atmosphere and the rapport built set the right mood for the instructor to introduce the content at the end of each game session. Students said that the recognition gained in winning the game enhanced cooperation within their teams. The findings of this research are in line with the observations of Malone and Lepper (1987) that games appear to strongly motivate players to engage in problem solving and critical thinking, due to three interpersonal motivating factors: cooperation, competition, and recognition. Learners would be much more highly motivated if the success of independent tasks (highly desired) would be dependent on the efforts of group members. Endogenous competition and recognition are also strong motivators in fostering learning.

In our study, students found the instructional games beneficial, as they were able to garner new information or knowledge on their own. At the same time, game-based learning activities were scaffolded by instructor guidance, support, and feedback as necessary. Students also expressed that the pre-game briefing, clear learning goals, and appropriate difficulty level of games were important. In addition, debriefing and instructor feedback at the end of each game session were valuable, because students

could learn from their mistakes and gain new knowledge through the activity as a whole, and not just play games for the sake of fun alone. The importance of instructional support and debriefing is also discussed by Crookall (1992), de Jong and van Joolingen (1998), and Garris, Ahlers, and Driskell (2002). Debriefing and feedback give learners the opportunity to reflect on their experience with a game and understand how this experience supports the instructional objectives of the course or program of instruction.

The literature also notes that student profiles and learning styles have a bearing on their participation in games. In this study, some students showed less interest in games or did not get immersed in them. In this regard, several researchers have emphasized that some important considerations in assessing cognitive tools are learner profiles, including academic ability and personality type (Bredemeier & Greenblat, 1981; Dempsey, Lucassen, Giley, & Rasmussen, 1993; Gardner, 1983; Jacobs & Dempsey, 1993; Seginer, 1980). Characteristics of learners, such as the preference to work in a group or alone, can affect their experience with a game, especially when the game is designed with a very open structure (Hogle, 1996).

Conclusion

In sum, this study showed that game-based learning can be an effective instructional strategy in engaging students in learning. The competitive element of instructional games such as the ones used in this research is able to trigger the interest of students in an otherwise “boring” subject. Student interest in the course increased as evidenced by good class attendance and active participation. As noted by Oblinger (2006), games carry an enormous potential to create immersive, experiential learning environments, draw students into a project, and enhance their capabilities in information processing, decision making, knowledge application, problem solving, and group collaboration.

Ignoring the educational power of games dismisses a potential valuable learning tool, as games can be used as a useful learning resource to initiate or sustain the learning process. Game-based learning is a transformative pedagogy that motivates students to engage in learning at a deep, personal level (Chee & Lee, 2009). It is however, important to ensure that instructional games embody sound educational principles and offer learners an experiential, immersive, and engaging, problem-based learning experience.

Future work is needed to examine which instructional design aspects of game-based learning motivate students to engage in this deep, personal learning. One limitation of this study is that learning gains were not measured. While students were able to provide the right answers during the game-based learning activities, the degree of learning was not established. In addition, the findings of this study are based on one group of students in a tertiary institute in Singapore. Future studies involving larger cohorts of undergraduates from different universities in Singapore (and across Southeast Asia) will provide more conclusive evidence on whether game-based learning is an effective instructional strategy to engage and motivate students in learning, and how this, in turn, impacts student achievement.

References

Bowmann, R., (1982). A Pac-Man theory of motivation. Tactical implications for classroom instruction. *Educational Technology, 22*(9), 14-17.

Bredemeier, M. E., & Greenblat, C. S. (1981). The educational effectiveness of simulation games: A synthesis of findings. *Simulation & Games, 12*(3), 307-332.

Brown, J. S. (2000). Growing up digital: How the web changes work, education, and the way people learn. *Change, 32*(2), 10-20.

Carson Learning Services, (2006). *Instructional design: Game-based Learning*. San Francisco, CA: Author.

Chee Y. S., & Lee, L. H. (2009). Game-based learning as a vehicle for developing science inquiry skills using the Centauri 7 Learning Program (pp. 659-666). In S. C. Kong, H. Ogata, H. C. Arnseth, C. K. K. Chan, T. Hirashima, F. Klett, …, et al. (Eds.), *Proceedings of the 17th International Conference on Computers in Education*, Hong Kong: Asia-Pacific Society for Computers in Education. Retrieved from http://www.icce2009.ied.edu.hk/pdf/c5/proceedings659-666.pdf

Chiong, R. 2010. Programming with games. Special Issue on Game-based Learning. *Learning Technology Publication of IEEE Computer Society. 12*(1) Retrieved from http://lttf.ieee.org/issues/january2010/index.htm#_Toc253225010

Crookall, D. (1992). Editorial: Debriefing. *Simulation & Gaming, 23*(2), 141-142.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row, Publishers.

de Jong, T., & van Joolingen, W. R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research, 68(2),* 179-201.

Dempsey, J., Lucassen, B., Gilley, W., & Rasmussen, K. (1993). Since Malone's theory of intrinsically motivating instruction: What's the score in the gaming literature? *Journal of Educational Technology Systems*, *22*(2), 173-183.

Ebner, M., & Holzinger, A. (2007). Successful implementation of user-centered game-based learning in higher education: an example from civil engineering. *Computers and Education, 49*(3), 873-890.

Felicia, P. (2010). What evidence is there that digital games can contribute to increasing students' motivation to learn? Brussels, Belgium: EUN Partnership AISBL. Retrieved from http://linked.eun.org/c/document_library/get_file?p_l_id=23126&folderId=24047&name=DLFE-756.pdf

Foreman, J., (2003). Next-Generation educational technology versus the lecture. *Educause Review, 38*(4), 13-22. Retrieved from http://www.educause.edu/ir/library/pdf/erm0340.pdf

Frand, J. (2000). The Information Age Mindset: Changes in Students and Implications for Higher Education. EDUCAUSE Review, 35(5), 15-24.

Gardner, H. (1983). *Frames of mind* (2nd ed.). New York: Basic Books.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-467. doi 10.1177/1046878102238607

Glasser, W. (1998). Choice Theory: A new psychology of personal freedom. New York: Harper Collins Publishers.

Gwee, S., Chee, Y. S. & Tan, E. M. (2010). Assessment of student outcomes of mobile game-based learning. In S. L. Wong et al. (Eds.), *Proceedings of the 18th International Conference on Computers in Education* (pp. 412-416). Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education. Retrieved from http://www.apsce.net/ICCE2010/papers/c4/short%20paper/C4SP101.pdf

Hogle, J. G. (1996). Considering games as cognitive tools: In search of effective "edutainment". Retrieved from http://twinpinefarm.com/pdfs/games.pdf

Jacobs, J. W., & Dempsey, J. V. (1993). Simulation and gaming: Fidelity, feedback, and motivation. In J. V. Dempsey & G. C. Sales (Eds.), *Interactive instruction and feedback* (pp. 197-227). Englewood Hills, NJ: Educational Technology Publications.

Jukes, I., McCain T., & Crockett, L. (2010). Understanding the digital generation: Teaching and learning in the new digital landscape. Kelowna, Canada: 21st Century Fluency Project Inc.

Keller, J. & Kopp, T. (1987). Application of the ARCS model of motivational design. In C. M. Reigeluth (Ed.), *Instructional theories in action: Lessons illustrating selected theories and models*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kirriemuir, J., & McFarlane, A. (2004). *Literature Review in Games and Learning* (NESTA Futurelab Series. Report 8). Retrieved from the FutureLab website: http://archive.futurelab.org.uk/resources/documents/lit_reviews/Games_Review.pdf

Lei, J. H., (2011, April 4). Lessons "click" for students at universities [Web log post]. Retrieved from http://onestop-portal.blogspot.com/2011/04/lessons-click-for-students-at.html

Lin, C. H., Liu, Z. F., & Shih, J. L. (2010). Analysis of seven important studies in research of joyful learning society. In G. Biswas, D. Carr, Y. S. Chee, & W-Y. Hwang (Eds.), *Proceedings of the IEEE International Conference on Digital Games and Intelligent Toy Enhanced Learning* (pp. 231-233). Kaoshiung, Taiwan. doi: 10.1109/DIGITEL.2010.30

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 5*, 333-369.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning and instruction III: Conative and affective process analyses* (pp. 223-253). Hillsdale, NJ: Erlbaum.

Oblinger, D. (2003). Boomers & Gen-Xers, Millennials: Understanding the "new students". *Educause Review, 38*(4), 37-47. Retrieved from http://net.educause.edu/ir/library/pdf/erm0342.pdf

Oblinger, D. G. (2006). Games and Learning. *Educause Quarterly 3*, 5-7.Retrieved from http://net.educause.edu/ir/library/pdf/eqm0630.pdf

Prensky, M. (2001). Digital game-based learning. New York: McGraw-Hill.

Provenzo, E. F. (1991). *Video kids: Making sense of Nintendo*. Cambridge: Harvard University Press.

Ramsden, P. (2003). *Learning to teach in higher education* (2nd ed.). New York: Routledge Falmer.

Richards, K., & Min, W. (2011). Examining digital game-based learning through the lens of 21st century gamers. In M. Koehler & P. Mishra (Eds.), *Proceedings of the Society for Information Technology & Teacher Education International Conference 2011* (pp. 45-52). Chesapeake, VA: AACE.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research & Development, 44*(2), 43-58.

Seginer, R. (1980). Game ability and academic ability: Dependence on S.E.S. and psychological mediators. *Simulation and Games, 11*(4), 403-421.

Small, G., & Vorgon, G. (2008). iBrain: Surviving the technological alteration of the modern mind. New York: Harper Collins.

Spitzer, D. R. (1996). Motivation: The neglected factor in instructional design. Educational Technology, 36(3), May-June, 45-49.

Strauss, V., (2010, January 21). TV, games, iPods vs. school. *Washington Post*.

Tham, R., & Tham, L. (2011). Blended learning: An Asian perspective. In M. Koehler & P. Mishra (Eds.), *Proceedings of the Society for Information Technology & Teacher Education International Conference 2011* (pp. 684-691). Chesapeake, VA: AACE.

Virvou, M., Katsionis, G., & Manos, K., (2004). On the motivation and attractiveness scope of the virtual reality user interface of an educational game. In M. Bubak et al. (Eds.), *Proceedings of the 4th International Conference on Computer Science* (pp. 962-969). Berlin: Springer-Verlag. Retrieved from http://www.springerlink.com/content/wnvajgjfa2hgkngf/fulltext.pdf

Willis, J. (2006). *Research-based strategies to ignite student learning: Insights from a neurologist and classroom teacher*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Zhi, H., & Zhang, Z. H. (2008). Integration of game elements with role play in collaborative learning: A case study of quasi-GBL in Chinese higher education. *Technologies for E-Learning and Digital Entertainment. Lecture Notes in Computer Science, 5093/2008*, 427-435.

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Using Adaptive Link Hiding to Provide Learners with Additional Learning Materials in a Web-Based System

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Abstract

This article reports results from a web-based online learning experiment that provided learning support to students in an object-oriented programming course. This support was intended to assist learners in acquiring domain knowledge (in this case object-oriented programming knowledge) which they were to use later for problem solving. The course was delivered using adaptive support techniques in which the system interface adjusts in ways that suit different learners. The impact of using one of the implemented support techniques, adaptive link hiding, is reported here. Using this technique, the system provided links to additional learning materials according to its prediction whether or not a learner was likely to access them. The system's decision was guided by a machine learning algorithm, the Naïve Bayes Classifier (NBC). The system's prediction was compared to actual access of these additional learning materials, yielding a predictive accuracy of 72%.

Key Words

Machine Learning Algorithms; Learner Modelling; Naïve Bayes Classifier; Adaptive Navigation Support; Adaptive Link Hiding; Learning Material Links; Web-Based Learning; Learner Knowledge Level

Introduction

Over the last few years, research has geared increasingly towards improving learner experiences in online learning. The study reported on in this article is a part of this effort and originates from a larger research study that was conducted between 2008 and 2011. The research investigated adaptive user interface and metacognitive control scaffolds used to provide learning support in a web-based, non-collaborative learning system. Adaptive user interface techniques were used to support learners during the acquisition of domain knowledge, in this case object-oriented programming. The techniques used consisted of adaptive navigation support with link annotation to propose topics which the student was ready to study, based on his knowledge level. Adaptive presentation support was used to present course content at an appropriate level of performance, based on the learner's current knowledge level. Adaptive navigation support with link hiding was used to adaptively present or hide additional material links at the end of the lesson page, depending on the system's prediction of the learner's preference to use or not to use these materials. Metacognitive control scaffolds were used to raise awareness and application of the elements of metacognitive knowledge (Schraw & Dennison, 1994) and complex problem solving processes (Voss & Post, 1988). The two metacognitive control scaffolds used were online task scheduling and question prompts. The overriding goal was to reduce the various types of undesirable cognitive load experienced by the learner (van Merriënboer & Sweller, 2005) across the continuum of knowledge acquisition (Jonassen, McAleese, & Duffy, 1993; Moallem, 2001).

The results reported in this article are from the first part of the study which investigated the effect of adaptive user interface supports on student cognition and learning experiences. This part of the research focused on the impact of adaptive support on student mastery of object-oriented programming concepts, and whether the sequence of provision of adaptive learning support leads to differences in the perceived value of an online learning environment.

However, in order for the adaptive support to have an impact, it needed to be tested for its predictive accuracy for learner support. To realize adaptive features, machine learning algorithms were incorporated into an adaptive user interface that was developed. The purpose of the algorithms was to infer learner model attribute values, especially attributes whose values are non-static. The attributes considered were initial concept knowledge level, inferred using the Heterogeneous Value Difference Metric (HVDM), and preference to use or not to use additional materials, inferred using the Naïve Bayes Classifier (NBC). The predicted values were used to update the learner model. Then, the updated learner model was used together with the domain model of the course and adaptation rules to guide how the interface adapted itself to the learner.

To test the accuracy of the adaptive user interface, an additional research question was developed, which is the focus of this article:

> What is the predictive accuracy of the adaptive user interface for object-oriented programming (using the Naïve Bayes Classifier (NBC) for determining the need for adaptive learner support?

This paper reports the results of evaluating the accuracy of the NBC in predicting the learners' need to access additional materials.

Review of Related Literature

In an online non-collaborative learning environment, the learner is mostly on his own. He has the responsibility to select the appropriate presentation of content to use, the level of detail to study, favorable navigation paths, the order of concepts to follow, and an appropriate pace of studying (Dabbagh & Kitsantas, 2004). This process increases the student's cognitive load, since interacting with technology is a cognitive process (Langley, 1997). This load is reduced when the learner becomes familiar with the online environment. Therefore, there is a need to provide supports to help the learner select the appropriate navigation path through a system or the appropriate representation of content under study (Kalyuga, 2009). If this does not take place, then the learner is forced to process too much information at the same time in an effort to first understand the relationships among information elements (van Merriënboer & Sweller, 2005). This can cause an increase in the cognitive load, which in turn can affect student mastery of content.

When learners are faced with redundant information due to the use of a one-page-fits-all approach, those learners who do not need some of the information they are presented with suffer from a higher cognitive load. This is because they cannot ignore the redundant information presented to them, and therefore have to reconcile it with what they already know. This is the redundancy effect (van Merriënboer & Sweller, 2005). The process of reconciliation takes up extra cognitive resources, with the result that the students do not achieve at their optimal levels. Therefore, such students can suffer from expertise reversal (Kalyuga, 2009). Expertise reversal is the reduction in the performance of learners who have mastered certain domain knowledge, due to being provided with inappropriate or redundant information, which they have to reconcile. This unnecessary processing takes up part of their limited cognitive resources, such as working memory space, which could have been used instead to solve the task at hand.

Expertise reversal can be reduced or avoided by including adaptive scaffolds in a learning system that provide learners with appropriate and necessary information only (Kalyuga, 2009; van Merriënboer & Sweller, 2005). If a course is designed to have independent, reusable knowledge modules, then these

modules can be combined dynamically into a lesson page that suits the learner's current attributes (Papanikolaou, Grigoriadou, Kornilakis, & Magoulas, 2003). Different lesson representations can be designed to suit different possible types of learners (Oboko, Wagacha, Libboton, Omwenga, & Odotte, 2007). Some of the learner attributes are dynamic, hence the learner model needs to be continually updated to reflect the learner's current status accurately (Virvou & Tsiriga, 2004).

The expertise reversal effect can also be reduced if learners have control in terms of what to learn, which guidance hints to follow or ignore, and which representations of information to study (Langley, 1997; Valcke, 2002). For instance, learners can be given control by leaving all learning material links clickable, irrespective of the kind of adaptive navigation hints provided. In a system where some sections are adaptively hidden or disabled, learners can also be provided with an alternative, longer access route to access the hidden parts (Papanikolaou et al., 2003). Learner control reduces expertise reversal and the associated extraneous cognitive load effects, by allowing them to select what they consider appropriate or relevant according to their current cognitive learning or problem solving skills (Kalyuga, 2009). In short, learner control aids in the personalization of the curriculum.

Personalization has received a lot of attention for some time as an area of research (Brusilovsky, 1999, 2003; Sia, Zhu, Chi, Hino, & Tseng, 2009). Its aim is to make it easier for a learner to use a system, because the interface adjusts itself to suit individual learner characteristics such as interest or prior knowledge. This practice enhances a user's experience and satisfaction (Sia, et al., 2009). To make the necessary and appropriate adjustments, user characteristics need to be captured accurately in order to guide the personalization process. User characteristics should be captured in a non-obtrusive way so as not to distract the user (Benyon & Murray, 1993; Jameson, 2005). One non-obtrusive approach used to learn user interests in the context of web searching and data mining is the analysis of click history (Sia et al., 2009).

Click history is important because if the links on a web page have sufficient descriptive information to indicate what the linked page is about, it can be assumed that when a user clicks on a link he is interested in the content of the linked page (Sia et al., 2009). Therefore, in a web-based learning system, information collected about the topics that a learner has clicked on can be used to build a learner model, which can then be used to guide the adaptation of the system's user interface.

To achieve personalization, a learning system should be able to determine the current value of a learner's dynamic attributes in the learner model. Usually, this results in processing huge amounts of learner-generated data in the same system to create patterns which may be used to guide adaptation. This process is aided by machine learning algorithms that are embedded in the system to infer learner model attribute values or to mine system usage patterns.

Machine learning refers to the use of various algorithms to enable a machine, particularly a computer system, to learn from examples provided to it during training (Mitchell, 1997). The goal is for the system to be able to carry out certain tasks from the same domain as the training examples, and to get better at performing such tasks as more training takes place, indicating that the system learns. Examples of machine learning algorithms include artificial neural network and decision tree algorithms, instance-based learning, evolutionary learning, reinforcement learners, and the NBC used in this study.

Machine learning algorithms can be used to predict learner preferences based on previously recorded actions and preferences of that learner and all other learners in the same system. For example, NBC has been used to predict learning styles using the Felder & Silverman Index of Learning Styles (Kelly, Durnin, & Tangey, 2005), fuzzy logic to predict a learner's knowledge level (Papanikolaou et al., 2003) and NBC to predict learning styles in a web-based system using the Visual, Aural, Read/Write, and Kinesthetic (VARK) Model (Oboko et al., 2007).

One of the most intuitive algorithms, suitable for use in real time adaptation, is the NBC (Stern, Beck, & Woolf, 1999). NBC is considered suitable for online learning, which requires real-time adaptation to take

place as the learner engages in learning (Stern et al., 1999). Adaptive learning support should be provided as soon as learning commences (Virvou & Tsiriga, 2004). NBC is suitable for such situations, because it needs very little data to classify data (Stern et al., 1999). Moreover, NBC also has very few parameters that need to be set a priori, unlike other approaches such as artificial neural network algorithms (Mitchell, 1997). As such, NBC has been successfully applied in such areas as text and document classification, medical diagnosis, and electronic performance support systems.
The NBC is a powerful tool for predicting the correct category out of a series of possible categories when solving classification problems (Mitchell, 1997). Classification problems involve associating one category value out of the existing category values of the target function, with a new, previously unseen case. Such a case is called a query instance. A training example for classification problems is of the form <Instance><Classification>. Instance is a vector of attributes selected to represent the learner or the domain, and their values at a given point in time. The attribute-value pairs represent training example instances in the problem domain. For example, the concept of whether a football player is active may be represented as *<gender = male, age = 18, weight = 200, practiceSessionsPerWeek = 10, gamesPlayedPerMonth = 10> <activePlayer = Yes>*

NBC is composed of a single category variable, whose values are the possible outcomes or categories for the specific query example under study, and a set of feature variables, which form the instances in the problem domain. The feature variables provide information that is used to distinguish among various categories or classes. These variables are assumed to be mutually independent. This means that the occurrence of one variable does not influence the occurrence of the others, given the class variable.

The classifier can be represented as shown in this formula:

$$P(X/C) = \prod_{i=1}^{n} P(X_i/C)$$

Where $X = (X_1, \ldots X_n)$ is a set of feature variables and C is a class, which is one of the values of the category variable.

Learning for the NBC involves establishing prior probabilities of the different classes and estimating the conditional probabilities of the various feature values, given each of the classes. These classifiers assign the most likely class to a given training example, as described by its feature values. In the problem of classifying learners based on knowledge level, a learner might be labeled as being at a beginning, intermediate or advanced level (Papanikolaou et al., 2003; Virvou & Tsiriga, 2004); as possessing the aural, visual, read/write or kinesthetic learning styles according to the VARK Model (Oboko et al., 2007; Wolf, 2004); or as preferring the activist, pragmatist, theorist or reflector learning styles as described in the Honey and Mumford Model (Papanikolaou et al., 2002). The inferred values are then used to update the learner model, whose up-to-date attribute values are used to achieve the adaptivity of the system's user interface.

Adaptivity refers to the process by which a system adapts its output to a user, using data or knowledge about the user. For a learner, such data could include knowledge level, learning styles or preferences. The data about the learner is contained in the learner model. An appropriate abstraction of the characteristics of the domain or subject knowledge is contained in the domain model. For adaptation to be achieved, some rules have to be specified to indicate how aspects of the interface are to be adapted according to individual learner characteristics in the learner model and the specified model of the domain being studied. The rules of interaction are contained in the interaction model (Benyon & Murray, 1993). The way adaptation takes place also depends on the adaptive hypermedia technology that is used (Brusilovsky, 1999).

Some of the adaptive hypermedia technologies adapt the way information intended for the user is presented. They are called adaptive presentation technologies. Such technologies change aspects of the presented information such as the structure, the level of details provided, the amount of information provided or the knowledge modules combined to form a lesson page. They include adaptive text presentation and adaptive multimedia presentation (Brusilovsky, 1999). Adaptive text presentation

involves presenting different combinations of text-based learning objects, based on some conditions from the learner, domain, and interaction models. Adaptive multimedia presentation is similar, but uses a variety of media to improve the efficiency of communication with the learner (Rowe & Davies, 2011).

Other adaptive technologies used to influence the way a user can navigate through information in a web-based learning environment include adaptive curriculum sequencing technologies and adaptive navigation technologies. They make it easier for the user to determine a suitable navigation path to follow through the course. Adaptive curriculum sequencing technologies provide learners with a pre-determined sequence of curriculum units in a learning system, based on learner attributes such as level of knowledge (Brusilovsky, 1999). The goal of adaptive navigation technologies is to support the learner in hyperspace orientation and navigation by changing the appearance of visible links. Adaptive navigation may be achieved through techniques such as adaptive link sorting, annotation, removal and hiding or disabling (Brusilovsky, 2003). With link hiding, links are selectively made invisible when the content they represent is considered unsuitable for the user at that point in time, according to user characteristics. The hidden links do not appear on the page at all. Otherwise, the links are displayed and remain active. For adaptive disabling of links, the links remain visible but are inactive. Therefore, the user cannot proceed to the page behind the link if he/she is considered not ready to use the contents of that page (Brusilovsky, 2003).

As stated earlier, displaying information that a learner does not need can be distracting (Nam & Smith-Jackson, 2007). Disabled links, which can still be read, also have this effect. If a learner has to deal with redundant or inappropriate information that is not required for the task at hand, then the cognitive load increases. Because a learner's working memory is limited in size, attempting to load unnecessary information into it takes up space that could otherwise be used for learning new material or problem solving (van Merriënboer & Sweller, 2005). Reconciling information provided that is not needed with what the learner already knows also uses up part of the crucial but limited cognitive resources, hence slowing down performance (Kalyuga, 2009).

Adaptive link hiding resolves the issue of cognitive load increase by reducing the learner's information space, thereby reducing the cognitive effort the learner is required to expend in order to learn or perform a task. Thus, adaptive link hiding supports the management of a learner's cognitive load better than most of the other adaptive technologies. It protects the student from the full complexity of the course content by only presenting links that are suitable to the learner's current status (Esichaikul, Lamnoi, & Bechter, 2011). However the links remain available through some alternative means, in case the system is not accurate in its inference of learner attribute values or the learner has another reason for accessing hidden information.

A Comparison with a Similar Study in the Field of Adaptive E-Learning

A similar study to the one reported on here was conducted by Esichaikul, Lamnoi, and Bechter (2011). They used an adaptive e-learning system that was designed for teaching introductory Java programming. The system could analyze a learner's knowledge level using the Dempster-Shafer theory. Thus, a learner's knowledge level was determined when registering in the system, and was then used for adaptation. The system also had a mechanism for updating this knowledge level as the learner progressed through the course, based on test scores. Both the domain and learner models were used to adaptively deliver appropriate course content. The adaptive technologies used included direct guidance (which is part of curriculum sequencing), link sorting, link hiding, and link annotation. Link hiding was used to protect students from the full complexity of the course and reducing cognitive load. Link annotation was used with five different colors corresponding with five different levels of knowledge.

At the end, students were surveyed and were found to have a positive view of the system's adaptive features. In addition, Esichaikul, Lamnoi, and Bechter found that adaptive navigation and adaptive presentation technologies should be combined to suit different learner characteristics and improve system usability. This was achieved in our study by combining adaptive link annotation, link hiding, and text presentation. Esichaikul and colleagues also proposed that tests be made adaptive according to

knowledge level. In our study, this was achieved by having pairs of pre-test questions of varying difficulty presented according to initialized learner knowledge level.

There are some similarities and differences between Esichaikul et al.'s study and ours. Just like in our study, theirs also featured both domain dependent and independent attributes to guide adaptation. In our study, such details included gender, number of programming languages learned, average length of programs written at the university, and level of anxiety experienced while engaging in programming, among others. However, their updating of knowledge level was based on the Dempster-Shafer theory as opposed to machine learning. In their study, adaptive link hiding was based on knowledge level and not preference for additional learning materials. Our study also supported the acquisition of domain knowledge to be used as prior knowledge or domain expertise for a second study that involved support for self-regulation. Self-regulation was supported so as to increase the level of application of metacognitive knowledge and problem-solving processes when completing a programming task. In this way, our study supported learning along the continuum of knowledge acquisition. This was especially important because research has found that prior knowledge is perhaps the most important cognitive resource for problem solving (Kalyuga, 2009).

Methodology

As described earlier, the overall goal of the research was to investigate the effect of adaptive and metacognitive regulation supports on the learning of domain knowledge and application of metacognitive knowledge and complex problem solving processes in a web-based learning environment. The research was organized into two experimental studies, followed by a qualitative comparative case study immediately after Study 2. The overall aim of introducing these supports was to reduce the undesirable cognitive load suffered by the learner. The objective of Study 1 was to investigate the effect of adaptive user interface scaffolds on student learning of domain knowledge and the perceived value of the adaptive user interface features in the context of web-based learning. The research reported here with regards to the system's predictive accuracy for providing adaptive learner support was conducted as part of Study 1, and took place between August and December, 2008 over a period of eight weeks.

The students who participated in the study came from two campuses of the selected university, using judgmental non-random sampling. The intention was to involve at least 90 students because at some point during the research, three treatment groups were to be used. In order to assume normality, it is good practice to have groups with at least 30 members. The resulting sample consisted of 89 first-year Bachelor of Science students in Computer Technology. They were between 18 and 20 years of age; 77.5% of the students were male and 22.5% female. The students used a web-based learning system prototype to learn object-oriented programming using C++.

Study 1 was designed as a quasi-experimental, balanced, post-test only study with randomization and a control group,

Table 1: Experimental Design for Study 1

Group	Treatment 1 (Topic: Class Design)	Post-Test 1	Treatment 2 (Topic: Inheritance)	Post-Test 2
1	Learning system with adaptive support	O_3	Learning system without adaptive support	O_5
2	Learning system without adaptive support	O_4	Learning system with adaptive support	O_6

As shown in the Table 1, the students in Group 1 studied 'class design' (first 8 concepts) with adaptive interface features of the system enabled, and then studied 'inheritance' (last 6 concepts) without the

adaptive features. Members of Group 2 studied 'class design' with the adaptive features disabled but studied 'inheritance' with adaptive features enabled. Following the 'class design' section, all students took a written test, followed by a survey for Group 1 only to establish the perceived value of the adaptive features. At the end of the 'inheritance' part, all students took another written test, with Group 2 members also responding to a survey to establish their perceived value of the adaptive features.

For the control group, the system provided the student with all the course content without any adaptive support, presented in the default order, from simple to complex. The treatment consisted of the use of three adaptive features in the system:

- *Adaptive navigation support through link annotation* was used for suggesting the concepts or topics students were considered to be ready to learn, depending on their current knowledge levels.
- *Adaptive navigation through link hiding* was provided through dynamic display or hiding additional learning materials for a concept or topic.
- *Adaptive text presentation* support was provided by the system annotating the level of content difficulty, also called level of performance for a concept's content, considered suitable for students based on their level of knowledge.

Adaptive Link Hiding for Additional Learning Material Links Using the NBC

The NBC was selected because the target function in this study had a finite set of values {YES, NO}, i.e. it was used to predict whether or not a learner would need to access the additional learning materials for the next concept to be learned. The prediction was made for each learner, one concept at a time, as the learner loaded a new concept's content.

In case the classifier predicted that access to the additional learning materials would be needed, the links to these materials were displayed as part of the course content at the bottom of the lesson page (Figure 1). This made the materials directly accessible because the learner would continue reading the lesson's contents until reaching the bottom of the page. Figure 1 also shows that this particular student's entry knowledge level was predicted to be high, and therefore the system proposed the advanced performance tab, which is shown in grey color.

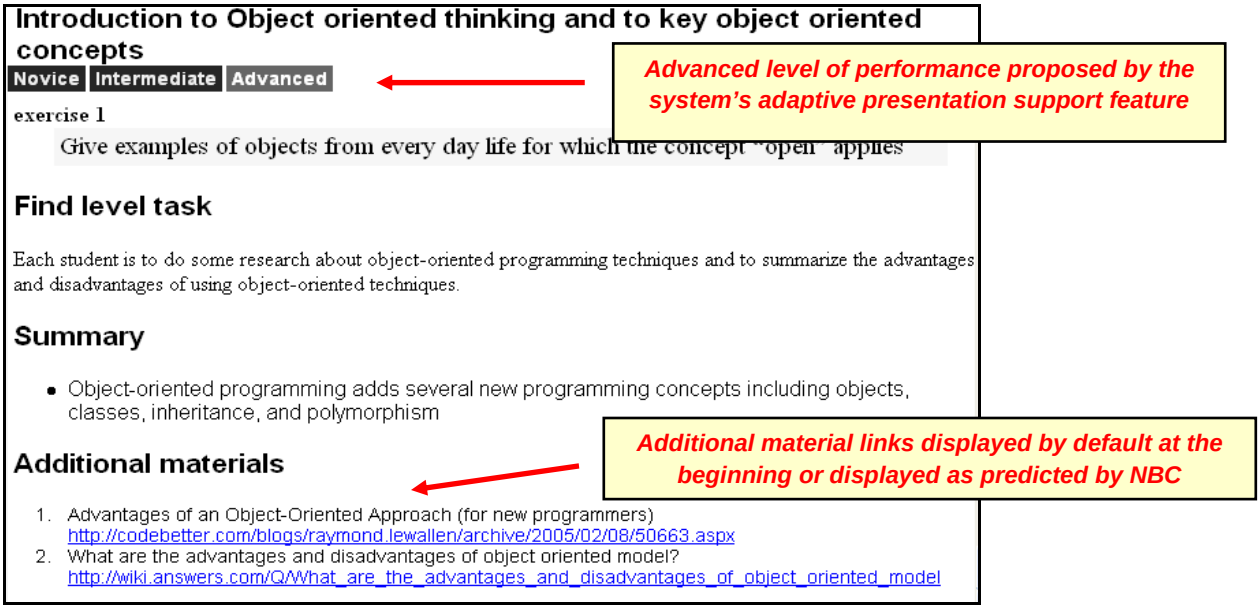

Figure 1: Sample Page Showing a Concept's Contents, with Links to Additional Learning Materials

In designing the learning process, including additional learning materials, it was assumed that by default, the learner would need to access the material. Therefore, the materials were provided at the beginning of learning, as part of the content of the lesson, but then subsequently, they were adaptively displayed or hidden.

The learner had control because if the additional material was hidden yet the learner still felt the need to study it, it could be accessed by following a longer route through the navigation area on the left hand side of the lesson (Figure 2).

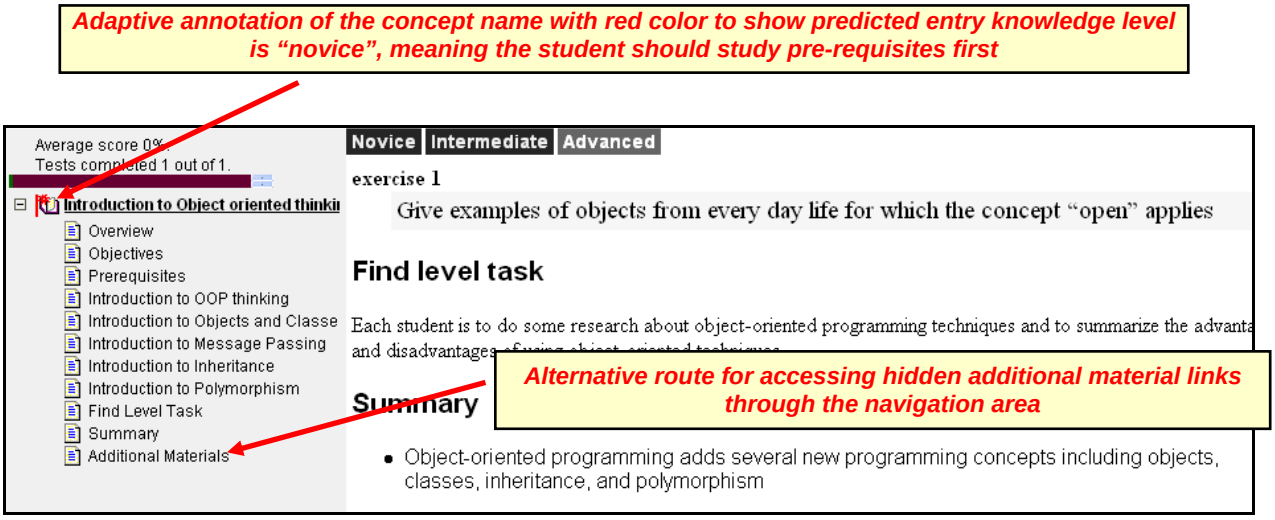

Figure 2: Sample Page Showing an Alternative Way of Accessing Additional Learning Materials

How the NBC Was Used

The information that was passed to the NBC was based on the clicks the learner made while accessing additional learning materials. If the learner made no clicks, i.e. did not access the material by the time of answering the concept evaluation questions, then information to indicate no access was sent to the classifier (NO entry). If the learner made clicks, the corresponding information to indicate access of the additional materials (YES entry) was sent to the classifier. This information on clicks was stored in the database (either Y or N) against corresponding concepts and the current learner.

The design of how this information was stored is shown in Tables 2 and 3. The columns show the usage of additional materials for various concepts studied (e.g. "Add mat. Usage Conc1" stands for "Additional material usage for Concept 1"), as well as the prediction column. The rows represent records of how individual learners used the additional materials for all the concepts studied.

A Y value in the tables indicates that the learner clicked on the additional material links, and therefore it was assumed he/she used them. An N value indicates that the learner did not click on the additional material links, and therefore did not use them.

Table 2 represents the records of all learners, other than the current learner for whom the prediction is being made. Table 3 represents the incomplete record of the current learner. It does not have a value for the last column, called the prediction or classification column. This is the value predicted by the NBC, using the records in both Tables 2 and 3. For example, as shown in Table 2, if the concept for which the learner was to be classified was number 9, then the system could select learners who had studied the course up to concept 9. Their YES or NO values for concept 9 could provide the classification value for

each training example formed from the YES or NO values for concept 1 to concept 8 for all the other learners. For the current learner (User6), whose additional material usage for concept 9 is being predicted, information is only available for concept 1 to concept 8. This learner's information for these concepts forms the query to be answered (Table3).

Table 2: Sample of Additional Material Usage for Other Learners (Excluding Current User), Including the Prediction Column

User	Add mat. usage Conc1	Add mat. usage Conc2	Add mat. usage Conc3	Add mat. usage Conc4	Add mat. usage Conc5	Add mat. usage Conc6	Add mat. usage Conc7	Add mat. usage Conc8	Classification (Add mat. usage Conc9)
1	Y	Y	Y	Y	Y	Y	Y	N	Y
2	N	Y	Y	N	Y	N	Y	Y	Y
3	Y	N	N	N	N	Y	Y	N	N
4	N	Y	Y	N	Y	N	N	Y	N
5	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 3: Additional Material Usage for the Current User up to Concept 9 (Also Called the Query Instance)

User	Add mat. usage Conc1	Add mat. usage Conc2	Add mat. usage Conc3	Add mat. usage Conc4	Add mat. usage Conc5	Add mat. usage Conc6	Add mat. usage Conc7	Add mat. usage Conc8	Prediction of mat. usage Conc9
Current User (User6)	Y	Y	Y	Y	N	N	Y	Y	?

Training the classifier in this case could involve calculating various probabilities using the training examples and the query instance. Then, the classifier would use these probabilities to predict whether the current learner would need to access the additional materials for concept 9 or not.

In sum, the administration of the treatment, using the adaptive features in the learning system, followed these steps:

1. The student selected the concept to be studied.
2. The system selected all concepts studied by the current student up to the current one and their values, indicating how additional materials had been used.
3. The system also selected records of all other students who had studied the course up to the current concept.
4. The system used these records to predict whether the current student would want to access additional materials for the current concept.
5. The system kept a record of the prediction in such a way that it could not be edited.
6. The system used the prediction to present to or hide from the student additional material for the current concept.
7. If the material was not displayed and the student still wanted to access it, he/she used another way of accessing the material through the concept map on the left hand side of the lesson page.

8. The system recorded actual material usage for each concept for the current student.
9. At the end, the system's predictions were compared to actual usage of the additional materials for each concept to determine the percentage of prediction accuracy.

Results

The accuracy of the technique for providing learners with additional learning materials using the NBC was calculated in two ways:

1) The records of all the other learners were used when making the prediction for the current learner for the new concept, irrespective of their knowledge level category. A sample of these records is shown in Table 4.
2) Only those learners in the same knowledge level category as the current learner were considered, as shown in Table 5.

Approach 1

Participating students generated 639 additional material usage records for the different concepts studied. A sample of these records is shown in Table 4. The value type field indicated that all learners (NBC_all) were considered by the NBC algorithm. The record also has the usage value predicted by the classifier (Y or N) and a column containing values (Y or N) to show whether the additional materials were actually used. The last column has values of 0 or 1 to indicate whether or not the prediction was accurate. An entry of 1 indicates that the predicted value was the same as the actual usage value.. An entry of 0 indicated that the prediction was not correct i.e. YES was predicted but actual usage was NO or NO was predicted whereas the actual usage value was YES.

Table 4: Sample of Processed Prediction Data when Considering All Other Learners Who Had Studied up to the Current Concept

user_id	Concept_id	Value_type	Calculated	Actual Usage	Accuracy
1	G2_2	NBC_all	N	Y	0
1	G2_3	NBC_all	Y	Y	1
1	G2_4	NBC_all	N	Y	0
14	G1_1	NBC_all	N	N	1
14	G2_1	NBC_all	Y	N	0
14	G2_2	NBC_all	Y	N	0
18	G1_1	NBC_all	N	Y	0
18	G2_1	NBC_all	Y	Y	1
18	G2_2	NBC_all	Y	N	0

Out of 639 predictions, 461 were correct. Concepts which were not studied were excluded. Thus, the accuracy percentage of the prediction, when considering all the other learners who had studied the course content up to the current concept, was calculated as:

$$\text{Percentage Accuracy}_{all} = (461/639) * 100 = 72.14\%.$$

Approach 2

When only considering learners in the same knowledge level category as the current learner during prediction, 640 records were collected. Table 5 has the column user_id which contains values that identify the users and the column concept_id which has values that identify concepts being studied by the learner. The table also has the value_type column which contains the value NBC_cat, indicating that only learners from the same knowledge level category as the current learner were considered by the NBC algorithm. The values of the rest of the columns – calculated, actual usage and accuracy- had the same meaning as in Table 4.

Table 5: Processed Prediction Data when Only Considering Other Learners with the Same Knowledge Level as the Current Learner

user_id	Concept_id	Value_type	Calculated	Actual Usage	Accuracy
1	G2_1	NBC_cat	Y	Y	1
1	G2_2	NBC_cat	N	Y	0
1	G2_3	NBC_cat	Y	Y	1
1	G2_4	NBC_cat	N	Y	0
1	G3_1	NBC_cat	Y	Y	1
1	G5_1	NBC_cat	N	Y	0
14	G1_1	NBC_cat	Y	N	0
14	G2_1	NBC_cat	Y	N	0
14	G2_2	NBC_cat	Y	N	0
14	G2_3	NBC_cat	N	N	1
14	G3_1	NBC_cat	Y	N	0
14	G3_2	NBC_cat	N	N	1
14	G3_3	NBC_cat	N	N	1
14	G5_1	NBC_cat	Y	N	0

Of the 640 entries, 295 were accurate predictions. The accuracy percentage of predictions was calculated as:

$$\text{Percentage Accuracy}_{cat} = (295/640) * 100 = 46.09\%.$$

Discussion and Conclusion

The prediction accuracy of the system when all previous learners who had studied up to the current concept were considered was higher (72%) than when only other learners at the same knowledge level were considered (46%). The difference is a big one, and it could have been caused by differences in the number of training examples used in the two different approaches. In the approach of selecting learners according to knowledge level, the number of learners considered at a time during prediction was much smaller than when all learners were considered. With machine learning classifiers, accuracy increases as the number of records increases, until a threshold level is reached where over-fitting takes place.

When all the learners were considered, the number of training examples was higher, and therefore the prediction accuracy was higher. If the number of training examples per knowledge level considered had

been higher, there are chances that the results could have been different. Knowledge levels with more examples are more likely to have higher prediction accuracy than those with fewer examples.

From the data collected, learners who logged into the system earlier had fewer accurate predictions than those who logged in later. This was realized when the prediction records were ordered in ascending order by user identifier. The user identifier was a numeric value generated according to when the learner registered in the system. The number of accurate predictions at the top of the table was generally smaller than those at the lower end of the table. This happened because those who registered later joined a higher number of other learners already participating and therefore the number of examples considered during later predictions was higher. This goes a long way to further underscore the influence of the number of training examples considered during prediction on the system's prediction accuracy.

It can be concluded that the system can predict possible usage of the additional learning materials fairly accurately (72%), especially when considering all the other learners who have studied up to the current concept. Accuracy is even better if the number of learners involved or the number of training examples is larger. Accuracy of prediction was further confirmed from open-ended items in a questionnaire administered at the end, in which a number of learners indicated that they liked the way the additional learning material links were displayed adaptively.

These results are significant in the context of reducing the information space the learner has to deal with at any point in time during the learning process. Parts which do not need to be included in a lesson, due to being too advanced for the learner or irrelevant according to the learner's characteristics (e.g. current level of knowledge) or task being carried out, can be adaptively excluded. This reduces intrinsic and extraneous cognitive load effects for the learner in an online learning system where there is very little support from the instructor or peers. This is especially important, because in online learning the learner has to determine independently the appropriate navigation path or level of difficulty or detail at which to study the course content, and therefore, he/she can do with some learning support. This support should be non-disruptive by not changing the structure, look and feel, or layout of the system's interface too much during adaptation. In this study, this was achieved by placing additional material links at the bottom of the lesson page. Whether or not these materials were displayed, the rest of the lesson page remained intact. Disruption for purposes of data collection was also avoided because the data used as input to the NBC was collected indirectly through logging each learner's clicks. This disturbs the students less, allowing them to concentrate on the task at hand.

Link hiding also contributes to the provision of appropriate information to the learner and therefore, reduces expertise reversal effect (Kalyuga, 2009). This is vital in lengthy online training programs where a learner's knowledge of the domain gradually becomes advanced, and therefore there is no need to force a learner to study introductory material every time by providing the same page to both novice and advanced learners (van Merriënboer & Sweller, 2005). With many organizations now embracing corporate e-learning, where employees study work-related online modules from their offices or elsewhere at their own pace, this adaptive feature can filter out what individual learners do not need to see.

This study also informs learning system design as it assists the designer in the choice among various adaptive navigation support technologies such as link annotation, link hiding, link sorting, or link removal. To reduce the cognitive load associated with the adaptive user interface, and therefore allow the learner to focus more on learning or problem solving, link hiding seems to be most suitable. Even though link annotation is the most popular, the annotated links remain on the interface, with additional information being introduced as a result of the way the links are annotated, hence even increasing cognitive loads on learners. Link sorting introduces a new structure for the course, which the learner has to learn and acquaint himself with before carrying on with learning or problem solving. Link removal makes parts of the course inaccessible by excluding them. This is inappropriate, because as can be concluded from the prediction accuracy of 72%, there is room for misclassification and therefore links should not be made completely inaccessible to the learner. Instead, the links should be hidden with the learner being given control to access these materials if necessary through an alternative path.

Future Work

Students indicated in an open-ended question on a questionnaire administered soon after studying the course that they liked the way additional materials were displayed adaptively. They also indicated in closed-ended items on the same questionnaire that they found the adaptive features of the web-based system useful to their learning. The questionnaire had 13 items on a 7-point Likert scale. All 13 items were found to have a positive relationship with student test scores. However, only 2 of the items had a significant positive relationship with test scores (Oboko, 2012). Further investigation on the relationship could bring forth interesting findings.

The prediction technique based on the Naïve Bayes Classifier should be tested further so as to find out if its accuracy increases monotonically or whether it will increase up to a certain number of examples, and if so, at what number. This would be a pointer to the optimal number of students who could participate in a study in which this algorithm is used to make similar predictions. It would also help in estimating the point at which overfitting of the machine learning algorithm occurs (Mitchell, 1997). Increasing the number of participating students beyond this level would then impair prediction accuracy.

Tests also need to be conducted to investigate how prediction accuracy varies as the number of students in the various knowledge level categories increases. An increase in the number of students per knowledge level also increases the number of training examples available for each category. It is possible that after a certain number of training examples is reached, the knowledge-level-based prediction gets better than prediction based on all learners. Such an outcome is likely, because only similar learners are considered in this case.

The system also needs to be tested in a learning environment that is based on social science or physical science courses so that the performance of the system can be compared in subject areas other than computer science courses such as object-oriented programming, the course studied by students during this study. The domain dependent attributes of the learners will most likely not the same (Virvou & Tsiriga, 2004), and it would be useful to determine what effect this will have on their browsing patterns, perception of the value of the adaptive features to their learning, and their cognitive performance scores.

References

Benyon, D. R., & Murray, D. M. (1993). Applying user modelling to human-computer interaction design. *AI Review, 6*, 43-69.

Brusilovsky, P. (1999). Adaptive and intelligent technologies for web-based education. In C. Rollinger & C. Peylo (Eds.), Special Issue on *Intelligent Systems and Teleteaching, Künstliche Intelligenz Journal, 4*, 19-25.

Brusilovsky, P. (2003). Developing adaptive educational hypermedia systems: From design models to authoring tools. In T. Murray, S. Blessing, & S. Ainsworth (Eds.), *Authoring tools for advanced technology learning environment* (pp. 377-409). Dordrecht, the Netherlands: Kluwer Academic Publishers.

Dabbagh, N., & Kitsantas, A. (2004). Supporting self-regulation in student-centered web-based learning environments. *International Journal on E-learning, 3*(1), 40-47.

De Villiers, M. (2002). *The dynamics in the theory and practice of instructional design* (Unpublished doctoral dissertation). University of Pretoria, Pretoria, South Africa. Retrieved from http://upetd.up.ac.za/thesis/available/etd-02212003-180121/

Esichaikul, V., Lamnoi, S., & Bechter, C. (2011). Student modelling in adaptive e-learning systems. *Knowledge Management & E-Learning: An International Journal (KM&EL), 3*(3), 342–355.

Jameson, A. (2005). User modeling meets usability goals. In L. Ardissono, P. Brna, & A. Mitrovic (Eds.), *UM2005, User Modeling: Proceedings of the Tenth International Conference* (pp. 1–3). Berlin: Springer..

Jonassen, D. H., McAleese, T. M. R., & Duffy, T. M. (1993). A Manifesto for a constructivist approach to technology in higher education. In T. M. Duffy, J. Lowyck, & D. H. Jonassen (Eds.), *The design of constructivistic learning environments: Implications for instructional design and the use of technology*, Heidelburg, Germany: Springer-Verlag.

Kalyuga, S. (2009). Managing cognitive load in adaptive ICT-based learning. *Journal of Systemics, Cybernetics and Informatics, 7*(5), 16-21.

Kelly, D., Durnin, S., & Tangney, B. (2005). 'First aid for you': Getting to know your learning style using machine learning. In *Proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies (ICALT)* (pp. 1-3). Kaohsiung, Taiwan, IEEE.

Langley, P. (1997). *Machine learning for adaptive user interfaces*. Proceedings of the 21st German Annual Conference on Artificial Intelligence (pp. 53-62). Freiburg, Germany: Springer.

Mitchell, T. (1997). *Machine learning*. McGraw-Hill, New York.

Moallem, M. (2001). Applying constructivist and objectivist learning theories in the design of a web-based course: Implications for practice. *Educational Technology & Society 4*(3), 113-125.

Nam, C. S., & Smith-Jackson, T. L. (2007). Web-based learning environment: A theory-based design process for development and evaluation. *Journal of Information Technology Education, 6*, 24-43.

Oboko, R. (2012). *Adaptive learning and metacognitive regulation support for ill-structured problem solving processes in web-based learning* (Unpublished doctoral dissertation). University of Nairobi, Nairobi, Kenya.

Oboko, R., Wagacha, P., Libboton, A., Omwenga, E., & Odotte, Z. (2007). Non-obtrusive determination of learning styles in adaptive web-based learning. *Proceedings of the Moi University 3rd Annual International Conference*. Eldoret, Kenya.

Papanikolaou, K. A., Grigoriadou, M, Kornilakis, H., & Magoulas, G. D. (2003). Personalizing the interaction in a web-based educational hypermedia system: The case of INSPIRE. *User Modeling and User-Adapted Interaction, 13*(3), 213-267.

Rowe, N., & Davies, P. (2011). *The anatomy of an adaptive multimedia presentation system*. Paper presented at the 3rd International Conference on Advances in Multimedia: MMEDIA 2011, Budapest, Hungary. Retrieved from http://eprints.bournemouth.ac.uk/17418/1/nick_and_philip_anatomy_of_adaptive_eleaning_Submitted.pdf

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, *19*, 460-475.

Sia, K. C., Zhu, S., Chi, Y., Hino, K., & Tseng, B. L. (2009). Capturing user interests by both exploitation and exploration. In *User Modeling 2007, Vol. 4511/2009* (pp. 334-339). Berlin: Springer.

Stern, M. K., Beck, J. E., & Woolf, B. K. (1999). *Naive Bayes Classifiers for user modeling.* Paper presented at the 7th International Conference on User Modeling, Banff, Canada.

Valcke, M. (2002). Cognitive load: updating the theory? *Learning and Instruction, 12*(1), 147-154.

van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17*(2), 147-178.

Virvou, M., & Tsiriga, V. (2004). A framework for the initialization of student models in web-based intelligent tutoring systems. *User Modeling and User-Adapted Interaction 14*, 289-316.

Voss, J. F., & Post, T. A. (1988). On the solving of ill-structured problems. In M. T. H. Chi, R. Glaser, & M. J. Fair (Eds.), *The nature of expertise* (pp. 261-285). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wolf, C. (2003). *iWeaver: Towards 'learning style'-based e-learning in computer science education.* (Unpublished doctoral dissertation). Faculty of Education, Language and Community Studies, RMIT University, Australia.

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Challenges Experienced in the First Year of Implementation of a Teaching and Learning Virtual Partnership at the University of Namibia

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Abstract

Advances in information and communication technologies are enabling higher education institutions to build virtual partnerships with other institutions. Virtual partnerships are defined here as collaborations between geographically dispersed institutions, where interaction between these institutions is enabled mainly by electronic modes of communication. This article reports on the participants' experiences of the implementation of one such partnership from the perspective of a partner in a developing context. It uses the SANTED Virtual Classroom Project (VCP), a virtual partnership initiative between the Departments of Computer Science at the University of Namibia (UNAM) and Rhodes University (RU), as a case study. In the VCP, the department at RU was tasked with building teaching and human resource capacity in the department at UNAM. The article focuses on the challenges experienced at UNAM during the first year of implementation of the VCP and lessons learned.

Keywords

Virtual Partnerships; Virtual Collaboration; Virtual Communities; Developing Contexts; Implementation Challenges

Introduction

The convergence in information and communication technologies (ICTs) is enabling higher education institutions to build virtual partnerships with other institutions. Virtual partnerships are defined here as collaborations between geographically dispersed institutions, where interaction between these institutions is enabled mainly by electronic modes of communication. A virtual partnership is thus characterized by the inter-institutional nature of participation in the collaboration, the sharing of work and resources to achieve a common goal, and the use of electronic technologies as the main type of communication. Educational institutions have reported an increase in collaborative partnerships over the past two decades (Eddy, 2010; see also Graber & Bolt, 2011; Ilemobade & Ballim, 2005; Keats, Beebe, & Kullenberg, 2003; Plane & Venter, 2008). More recently, donor agencies have also increased funding of higher education partnerships to enable collaborative program delivery, joint research, academic exchange programs and other initiatives aimed at strengthening faculty collaboration (Hertaas, 2010; Ishengoma, 2011; Maassen, Pinheiro, & Cloete, 2007). In accordance with Target 18 of Goal 8 of the Millennium Development Goals, which aims to harness the benefits of ICTs in the developing world (United Nations [UN], 2006), funding agencies are also enabling educational institutions to take advantage of ICTs to build the much needed capacity in developing contexts (Parker, 2010; United

Nations Development Programme [UNDP], 2009) and to participate in the continued growth of internationalization and globalization of education (Bashir, 2007; Marco, 2009).

Successful virtual partnership initiatives have the potential to enhance the quality of teaching and research in partnering institutions (Mbanguta, 2004), increase reach to a dispersed population of students (Koppelman & Vranken, 2008; Moran, 1990), and create synergy among partners (Keats, Beebe, & Kullenberg, 2003). For institutions with insufficient human resource capacity to meet their curricula and research demands, utilization of expert knowledge from other institutions is also believed to result in quality enhancements of educational systems (Bashir, 2007; Eddy, 2010; Tettey, 2010). In addition, collaborative partnerships can serve as a benchmark for academics and institutions on the relevance of their program offerings, while at the same time enabling organizations to learn from one another (Organization for Economic Cooperation and Development [OECD] & World Bank, 2007).

Keats and Beebe (2003) suggested that virtual partnerships can have a significant impact in Africa, where there is a low level of participation in higher education. However, they also cautioned about the potential failure of partnerships when the full implications of their implementation are not fully understood by all participants or are underestimated. Kezar (2005) and Eddy (2010) also reported that over 50% of academic partnerships fail due to the unavailability of successful models that illustrate how collaboration should be fostered. According to Ratcheva and Vyakarnam (2001), the lack of such models makes it difficult to transfer successful experiences from one partnership to another. Buik-Aghai (2003) also observed that the lack of models makes it difficult to determine how environments for partnerships should be designed, what they should be composed of, and how they should be structured. While institutions in developing contexts can greatly benefit from successful partnerships, it is also widely acknowledged that there are many challenges to creating and sustaining them (Eddy, 2010; Plane & Venter, 2008).

In developing countries, reported partnerships range from initiatives that involve two or more partners collaborating in response to a specific need to full-fledged virtual universities that may involve a multiplicity of partners (Keats, Beebe & Kullenberg, 2003). The African Virtual University, for example, is a full-size virtual university with several partners located in different parts of the world (Graber & Bolt, 2011). Virtual partnerships in these countries are, however, marred by several challenges, including insufficient national bandwidth capacities, lack of infrastructure, and scarcity of funding (Watson, 2010). A report by the Council for Higher Education and Training (CHET) of South Africa has also revealed that large funds are earmarked for ICT investments in education, but there is no clear understanding of what really works and what does not (Maassen, Pinheiro & Cloete, 2007). The report contrasted the seemingly high expectations from the investments made with a lack of clear and consistent strategies for the use of ICT in education. There is, therefore, a need to identify and establish systematic approaches to implementing virtual, ICT-based partnerships in contexts such as the Southern Africa region, if the return on ICT investments as well the perceived benefits of these partnerships are to be realized there.

This article reports on the experiences of building a virtual partnership in a developing context from the perspective of one of the partners. It uses the South Africa Norway Tertiary Education Development Programme (SANTED) funded Virtual Classroom Project (VCP), a partnership initiative between the Departments of Computer Science at the University of Namibia (UNAM) and Rhodes University (RU), as a case study. From the results gathered using semi-structured interviews and observations made during implementation, the article focuses on the challenges experienced during the first year of implementation. It highlights some possible problem areas and presents lessons learned that should be considered by those contemplating to develop virtual partnerships to ensure successful implementations.

The SANTED Virtual Classroom Project

In 2007, all academic departments at UNAM undertook a comprehensive curriculum review of their undergraduate degrees. Prior to this curriculum review process, all departments in the Faculty of Science (including the Department of Computer Science) had been offering a double-major Bachelor of Science (BSc) degree. With the establishment of the new curriculum, however, each department introduced a new single-major BSc curriculum. The implementation of the new curriculum commenced in January 2008 with

first and second-year students, while third and fourth year students were not affected until 2009 and 2010, respectively. The Department of Computer Science, however, did not have the required human and infrastructural capacity to fully implement the requirements of the new curriculum. It therefore resolved to seek external assistance to ensure a successful implementation of the new curriculum (Thinyane, Mufeti, Terzoli, & Wright, 2010).

In September 2004, the Department of Computer Science at UNAM had signed a letter of intent to collaborate with the Department of Computer Science at RU. The two departments, however, did not have the necessary financial resources to start the collaboration. With the possibility of financial support for capacity-building work between South African universities and other universities in the Southern African Development Community (SADC) region offered by SANTED during that time (Hansen, Africa, & Boeren, 2005), the two departments jointly applied for funding for professional development of UNAM lecturers to prepare them for the implementation of the new curriculum. SANTED agreed to fund the project from January 2008 to December 2009.

The proposal that was funded by SANTED detailed the goals and objectives of the project, the project plan, as well as the specific items that would need funding. It also identified the courses that would be taught, the lecturers from RU who would be responsible for each of the courses, and the possible delivery mechanism for the courses. At the onset, it was agreed that a local facilitator from UNAM would be appointed for each course and participate in the development and delivery of course content for capacity building purposes. The proposal also identified the project's main objectives:

- Fast-tracking of the selected students through the new curriculum, to afford the Computer Science department at UNAM an opportunity to pilot the newer part of the curriculum even before its adoption by the entire university.
- Enabling participating students to graduate with a single-major BSc in Computer Science in 2008 and 2009, rather than having to wait for the approved single-major BSc graduation in 2010. The single-major BSc is equivalent to an Honors Degree in Computer Science offered by South African universities at the time. Students graduating through the project would therefore be able to register directly for a Master's of Science (MSc) degree in South Africa, without first having to complete an Honors Degree.
- Strengthening of the staff complement at UNAM, by:
    - Involving current UNAM lecturers in content delivery. For the first year of implementation (2008), all lectures would be given by lecturers from RU; all lecture sessions and content would be recorded and made available for reuse at UNAM. In the second year of implementation (2009), UNAM lecturers involved in the project would be expected to deliver some of the lectures, with the RU lecturer also present to provide feedback and suggest approaches for presenting specific topics.
    - Funding participating students for an MSc at RU. Once they completed their MSc degree, they would be expected to come back as lecturers at UNAM to strengthen the teaching of the new curriculum.
    - Giving UNAM lecturers participating in the project a chance to register for PhD studies and conduct joint research with experienced professors at RU.

In the planning stage, the project coordinators at both institutions also presented the proposal to their respective institutional management for their support and approval. UNAM senior management in particular appreciated the possibilities of the project, especially because the Department of Computer Science had struggled to attract qualified personnel over the years (UNAM Computer Science, 2006, 2007). The department at RU had, through its Centre of Excellence, already started building capacity in other Computer Science Departments in South Africa, and the proposed project was viewed as a continuation of that work (Rhodes University, 2008). The project was thus well-accepted by the management of both institutions.

In the resulting project, the departments at UNAM and RU agreed to pilot the implementation of the third and fourth year to selected students in their final year of study in 2008 and 2009, meaning that the

department at UNAM would roll out the more strenuous part of the curriculum earlier than expected. The primary aim of the pilot project was to develop the content for the newer courses prior to full implementation, while at the same time building the required teaching capacity of the department to enable it to meet the needs of the new curriculum. To minimize costs, it was also agreed that student and lecturer mobility would be minimal, with lecturers being mostly based at RU and students at UNAM. When the project commenced, there was a paucity of literature on similar collaborative initiatives in the region where lecturers at one institution use technology to deliver courses to students at another. It was therefore difficult to identify and anticipate possible problems and challenges that may arise during the project.

Project implementation was initially scheduled to start at the end of February 2008, to coincide with the commencement of teaching for the 2008 academic year at UNAM. The commencement was, however, delayed due mainly to logistical reasons experienced in the project. It took more time than expected to establish the structures and processes for communication and procure and disburse the needed funds, which further impacted the timely acquisition and delivery of the required computer equipment.

Methodology

Selecting Project Participants

Although many players were indirectly involved in the project, four stakeholders actively participated in the day-to-day implementation: the project coordinators, the lecturers, the facilitators, and the students. One coordinator was nominated from each department at each university to oversee project implementation. The coordinators were responsible for managing project activities, engaging the critical people required to make the project a success, and monitoring the day-to-day logistics. The coordinators also drafted the funding proposal for the consideration of SANTED.

The RU lecturers chosen to participate in the project were those who had taught similar modules in the previous years. Each module had one lecturer, with the exception of the real-time multimedia module that is usually taught by two lecturers at RU. No requirements for teaching in an online environment prior to participating in the project were specified. However, only one lecturer did not have experience in teaching using virtual classroom solutions, more specifically videoconferencing. In addition to teaching the courses, the lecturers' responsibilities included developing the required competencies in the facilitators at UNAM. Third, lecturers also acted as links to forging a stronger collaborative relationship between the RU and UNAM departments.

Each course was expected to have at least one facilitator, who were lecturers from the Department of Computer Science at UNAM. All facilitators had previously taught BSc courses at UNAM, using a face-to-face delivery mode. Upon completion of the SANTED project, it was expected that the modules delivered virtually through the project would be handed over to these facilitators. They were therefore chosen based on the interest they had shown in the course, as well as their willingness to take over the courses once the project came to an end. This would ensure a smooth transition of the courses from the RU lecturers to the UNAM facilitators, while at the same time ensuring sustainability in teaching the courses.

Initially, the project targeted five top-performing UNAM computer science students in their final year of BSc studies at UNAM, for each year of the implementation. Because the fast-tracking process was aimed at implementing courses of the new BSc curriculum, it was important to select students who were able to cope with the requirements of these courses without necessarily having completed their prerequisites. As such these students were expected to work much harder than their peers when the full implementation of the new curriculum commenced. The number was limited to five students for each year because 1) the funders could only provide five bursaries per year as incentives for participating students participating; 2) the venue and resources allocated to the project were limited and could only accommodate a maximum of five students; and 3) the project was a pilot of the new single-major BSc degree and could not be rolled out to all fourth year students at once.

Moreover, at the early stages of the project, several challenges were encountered. UNAM had difficulty in accepting changes in their degree structure, without having gone through the appropriate approving structures such as the Faculty, the Senate, the Council and the Namibia National Qualifications Authority. The only other way that students could be allowed to register for the new modules without any approval was if they took the modules for non-degree purposes, i.e. in addition to the standard courses of the fourth year. This also meant that UNAM students would not receive any credits for completing the modules, which in turn imposed a constraint on the choice of students. The top students were not necessarily interested in registering for additional modules that would not be counted towards their degree qualifications. As a result, the choice was limited to students who were ahead in the course completion of one of their majors (e.g. students who had completed a statistics major but not a computer science major), in order for them to not be overwhelmed by the amount of work. The offer was also extended to students who had already completed the fourth year program, including the tutors in the department who had already obtained their first degree.

Choosing a Virtual Classroom Solution

One of the first steps in the implementation was choosing an appropriate and suitable virtual environment for the project. For economic reasons, it was initially agreed in the planning stages of the project that the lecturers would be physically based at RU while the students were based at UNAM, and that mobility between the two campuses would be minimized. There was, therefore, a necessity to identify suitable communication mechanisms that would enable synchronous, virtual delivery of classes between the two universities. Video conferencing was considered as one option, because it allows for real-time, interactive sessions. The department at UNAM, however, did not have a dedicated video conferencing facility and had to reserve the university's video conferencing room for every session, which was subject to availability. An Internet-based virtual classroom solution was perceived to be more accessible, as it would allow participants to enter and exit as needed, provided they had access to computers and the Internet. The project leaders identified several virtual classroom solutions and tested them for their suitability to the delivery of real-time, interactive lectures.

The process of selecting an appropriate virtual classroom solution in the context of the SANTED virtual classroom project conformed to Wenger, White, Smith, and Rowe's (2005) cycle of inventiveness. The cycle posits that in the process of determining what technology to use in a community of practice, certain participants (which they referred to as technology stewards) would use the following three moments of inventiveness to determine the appropriate technology for the community: inventiveness of technology market, inventiveness of serving the community, and inventiveness of use.

The two project coordinators, one based at RU and the other at UNAM, performed the role of technology stewards and were responsible for identifying the appropriate technology. They consulted with the lecturers at both institutions and identified the following as the minimum requirements for the virtual classroom solution (Thinyane, Mufeti, Terzoli, & Wright, 2010):

- Audio interactions between the participants and, at best, video interactions at the remote sites
- Document sharing feature and, at best, screen sharing
- Whiteboard features
- Recording and playback features
- Graceful degradation when connectivity drops
- Alternative ways of synchronous communication
- Direct relay between the remote sites

Several virtual classroom solutions were available at the commencement of the project. The investigation leading to the selected solution was, however, strongly constrained by the urgency to begin teaching the courses. As a result, the investigation only focused on three software solutions that topped a Google search for the term "Virtual Classroom." The results were Elluminate (http://www.elluminate.com), Wimba Horizon (http://www.wimba.com) and DimDim (http://www.dimdim.com). The three virtual classroom

solutions were tested to ensure they met the minimum requirements described above. Although all three options met most of the requirements, Wimba Horizon was the only solution offering the recording and playback feature, which was considered a necessity in this capacity building initiative. It was therefore selected as the virtual classroom solution to be used in the SANTED VCP.

Data Collection and Analysis

Understanding the challenges experienced in the implementation of the VCP required access to all people involved in the project, including students, lecturers, and facilitators, as well as to the content of the courses and other activities that were part of the everyday implementation of the project. To collect data from these diverse sources, several data collection methods were used, including document analysis, questionnaires, semi-structured interviews with the participants, and field notes recording the observations of the program activities. Documents collected included the project proposal, semi-annual reports submitted to the funders for periodical reviews, and data from emails exchanged between project participants. Two questionnaire instruments adapted from Lander, Burns, and Spence (1999), were developed for students and lecturers, and administered at the beginning and end of each course taught in the project. The questionnaire instruments presented respondents with questions related to the characteristics of teaching, characteristics of technology, module management and coordination, and several open-ended questions regarding the different aspects of the project implementation. An interview protocol was prepared to guide the conversations during the semi-structured interviews. The protocol questions focused on various aspects of the implementation, including participants' tasks and responsibilities, their expectations, and their reasons for attendance of, or absence from, sessions).

Data collected was triangulated during the data analysis stage. Since the data collection process only involved ten participants in their first year of study, the data collected from different sources were manually compared to abstract underlying themes. The concepts of activity theory were used to analyze the relationship between the participants, their objectives, the technological tools used, and the rules governing the implementation of the VCP. To identify the underlying reasons hindering the achievement of the project objectives, the study reported on in this paper focused on the contradictions concept of activity theory. This concept emphasizes the need for identifying tensions between and within the different elements of an implementation and is widely used to identify challenges involved in technology-mediated interventions (Netteland, 2007). In the next section, our findings are reported with regards to the implementation of the VCP, the challenges encountered during implementation, and lessons learned.

Findings:

Implementation of the VCP

Four modules of the new BSc curriculum at UNAM were selected for delivery in 2008. The observed experiences from each of the four modules (Real-Time Multimedia, Computer Networks, Java Enterprise, and Human Computer Interaction) are described below.

Real-Time Multimedia. This was the first module to be delivered in July 2008, which coincided with the official launch of the VCP. One of the lecturers responsible for this course travelled to UNAM for the launch of the project and took advantage of his physical presence in Namibia to deliver the first three lectures face-to-face. The remaining 21 lectures were delivered using the selected virtual classroom solution. Apart from delivering lectures, the two lecturers also had to introduce the students to the overall goals of the project and ensure that they were comfortable with learning in a virtual environment.

The module was intended to offer a practical introduction to real-time multimedia in Internet Protocol (IP) networks. The practical components required students to set up and configure a soft switch Private Branch Exchange called ASTERISK, and connect it to IP phones that were distributed to students. The lecturers would demonstrate the steps involved in setting up, maintaining, and releasing communication sessions.

Students used Wimba for the first time during this module. They had to learn to cope with a virtual environment, while at the same time learning the content of the module. Lecture sessions were mainly conducted in the early hours of the day, as the Internet connection seemed to be more reliable in the morning than in the afternoon. Both the students and lecturers indicated that they were comfortable with lectures offered through the virtual classroom. A concern raised by the students was on the restricted dynamics of the virtual environment, which they felt was very limited in terms of features that enabled the lecturers to demonstrate all the practical concepts of the course. Student attendance was good, with all students being present at more than 95% of the sessions.

Computer Networks. The second course delivered was Computer Networks, which introduced students to the operation, planning, installation, and management of modern computer networks. Initially, the plan was to conduct four lectures using the face-to-face mode and 20 lectures using the virtual classroom solution. Apart from the lectures, there were other course materials in the form of video clips, books, and lectures that were pre-recorded on a DVD and distributed to students before increasing technical issues with the virtual classroom solution. Other virtual classroom sessions were later delayed or cancelled, and the lecturer only managed to present five lectures using Wimba. Seven lectures were delivered face-to-face over a period of three days, during the lecturer's visit to UNAM. The rest of the lectures were pre-recorded on a DVD and couriered to the facilitator at the university, who then distributed the DVDs to the students. The Wimba application in this course was mostly used to provide a real-time environment for discussion of content, rather than for offering real-time, interactive sessions. Lecture sessions were, however, always complemented with a synchronous online discussion, which enabled the lecturer to explain the concepts in greater detail and attend to the student queries.

Enterprise Java. The third module delivered was Enterprise Java. The first five lectures were delivered using the Wimba virtual classroom. By the time this module was taught, however, connecting to Wimba had become unreliable due to inadequate bandwidth to support the traffic generated by the class. As a result, the lecturer and students agreed not to connect all computers in the laboratory to the Wimba software at the same time. Instead, a single computer with speakers and a microphone was set up to allow students to connect to the virtual classroom and communicate with the lecturer. This was believed to conserve bandwidth, while at the same time allowing for completion of lecture sessions. Some of the lectures were also pre-recorded on a DVD and couriered to students. The last three lectures were delivered face-face at UNAM.

Java is a practical course that required the lecturer to often demonstrate practical concepts on the screen. Although this feature is available in Wimba, it became increasingly difficult to use this feature due to unpredictable bandwidth availability. The students indicated that they thought that their lecturer had wished to demonstrate certain programming aspects, but could not do so due to a limited lecturing environment. The lecturer highlighted the difficulty associated with the use of a virtual classroom, indicating, for example, that it was sometimes difficult to know how many students where in class.

Human computer interaction. The last module delivered was Human Computer Interaction (HCI). Like the other modules, all lectures for HCI should have been delivered online, but when the module was presented, it had become almost impossible for the students and lecturers to communicate using the virtual classroom because of the many disconnections they experienced. As a result, the first three lectures were delivered face-face at UNAM while the remaining 20 lectures were recorded on DVDs and shipped to students at UNAM. Thus, students learned mainly using a computer-based learning mode in the HCI module. In addition, students communicated with their lecturer mainly via email.

Challenges Encountered in the Implementation of the Virtual Classroom Project

Accreditation of courses at UNAM. The project was supported by the Office of the Vice Chancellors at both institutions. In the initial proposal, it was agreed that the modules would contribute to the students' academic records so they could graduate with a BSc in Computer Science (single major). However, during the registration process it became apparent that the courses that were part of the project could not be accredited to the degree, making it impossible for students to graduate with a BSc single major. UNAM

argued that the existing fourth year students were already part of the old BSc curriculum approved by the University Council. Changing their registration to the single major BSc would have to go through the recognized channels for approval. The department was advised to seek approval at Faculty, Senate, and Council levels to enable students to register, but this process would have taken a long time and would have delayed the project by at least six months. UNAM insisted that all students (whether participating in the project or not) must complete all courses in the approved double-major BSc curriculum. It was, however, suggested that students who wished to participate in the project could register for and take these modules in addition to the standard courses required for the BSc qualification. UNAM administrators determined that the additional modules would count towards the students' BSc qualifications. To better accommodate students willing to participate in the new modules, RU agreed to give credits to students who had participated in the project by admitting them directly into an MSc degree upon successful completion of the modules offered through the project.

Recruiting capable students for the Virtual Classroom Project. The original proposal sought to give only the five top performing students of the fourth year class of 2008 an opportunity to participate in the project. This decision was made because not all fourth year students had the required background knowledge to be successful in the fourth year modules of a new curriculum. As a result of the challenges experienced with accreditation of the courses, the choice of students for the virtual classroom project was limited. The imposed constraint resulted in an effort to select students who were either ahead in their coursework due to exemptions or a change of majors, or who had to continue their studies because they had to repeat some courses they had previously failed.

Availability of the virtual classroom solution. As reported in the implementation section, the availability and usage of the chosen virtual classroom solution, Wimba, also became a challenge over time. Wimba is a web-based solution, hosted by a server physically located in Europe. All connections to the virtual classroom had to first go to Europe to allow participants to meet in the classroom. This server-client model did not suit the setting of the project. It was also difficult to customize the features of the classroom to suit the context of implementation. In time, all participants expressed their disappointment with the virtual classroom solution, which ultimately proved to be unusable in our context.

Bandwidth stability and reliability. At the beginning of the project the project venue was equipped with a 2MB asymmetric digital subscriber line (ADSL) exclusively dedicated to the VCP. During the process of selecting an appropriate virtual classroom solution for the VCP, the 2MB bandwidth seemed sufficient for the needs of the selected solution. As discussed in the implementation section, disconnections from the virtual classroom were experienced throughout the project, which were attributed to insufficient bandwidth availability. Due to the inherent characteristics of ADSL, 2MB was not always guaranteed, and the bandwidth sometimes dropped as low as 128Kb/s. As correctly observed by Schneider, Wagner, Winter, and Kolbe, 2010, these fluctuations in bandwidth often render an application unusable due to intolerable delays that result from bandwidth demands of multimedia data.

Student commitment. The level of student commitment and the amount of time they dedicated to the project activities decreased over time. Discussions with students revealed that the course requirements became increasingly challenging for them. Since the courses were listed as non-credit, it did not really matter whether the students passed or failed. Students also indicated that they felt their understanding of, and ability to cope with, the course content decreased over time, and that it became increasingly difficult to cope with the content of all the modules.

Student attendance and motivation. In the first course, students were highly motivated at first and class attendance was good, although one or two students would arrive up to ten minutes late. High attendance in the first course might be attributed to the fact that students were still getting used to learning in a virtual environment. Students were very enthusiastic, and were especially looking forward to completing the course which would enable them to go for further studies the following year. As the project progressed, however, at least three of the students saw their chances of registering for an MSc degree decrease as they knew that only one or two students would eventually be selected for further study. Towards the end of the year, two students had completely dropped out of the course and were no longer attending the

discussion sessions with the lecturers. They partly attributed their withdrawal from the course to heavy workloads and their inability to cope with the stress of preparing for examinations in their credit-bearing subjects.

User level of tolerance. Initially, students and lecturers were patient when the virtual classroom solution did not work. After some time, however, user level of tolerance of technical issues had decreased to such an extent that if the virtual classroom solution did not connect at the first attempt, both the students and the lecturer would suggest postponing the class session to another time.

Lessons Learned from the Implementation

The challenges experienced during the first year of the VCP have implications for future implementation efforts. The following three lessons were learned from the implementation.

Aim of the partnership must be clear to all stakeholders and approved by both institutions. In the VCP, participants from both departments knew what to expect from the partnership, but it appears that this vision was not clearly communicated to and shared with the senior management at UNAM. As a result, the original objective of the partnership could not be implemented as approved. This oversight of not fully advising UNAM management had further implications for the choice of students, accreditation of the courses, and eventually the overall outcome of the project. Therefore, it is important that the aim of any partnership be made explicit to all stakeholders in the beginning stages and that it supports already approved (existing) activities of the institution. This recommendation is consistent with the findings of Kezar (2006), who argued that stakeholders should invest ample time and effort to ensure that their aim for partnering is known and approved by everyone involved. Kezar (2006) further observed that collaborative activities succeed better when they are aligned with the mission of the institution.

Incentives are required for all participants to encourage active engagement in project activities. Initially, it was assumed that facilitators would automatically participate in the project in order to learn and acquire the competencies required to teach the courses once the project ended. It was also assumed that the students would participate because of the financial incentives provided to them in the form of bursaries. As reported, however, the need for learning and the scholarships provided did not oblige or incentivize students and facilitators to participate in the project. Consequently, it is important to identify participants' expectations from the partnership initiative and to design incentive schemes that seek to meet these expectations.

The choice of the virtual classroom solution should take into account the implementation context. In the process of choosing an appropriate virtual classroom solution, participants followed the inventiveness of the technological market (Wenger, et al., 2005) approach. In this approach, the functionality that the participants need is first identified (e.g., document sharing/uploading and recording and playback to enable students to catch up on missed lectures) and available technology is then evaluated against this required functionality. As demonstrated in this project, it is important to ensure that the chosen solution does not only meet the pedagogical requirements of the partnership, but also matches the technical realities of the context of use. Although the functionality provided by Wimba Horizon, the chosen solution in the VCP, was adequate, the provision of bandwidth through the ADSL eventually rendered the "appropriate" solution unusable in the context of implementation.

Conclusions

The challenges experienced by the participants involved in the implementation of a virtual partnership initiative between the Computer Science Departments at Rhodes University and the University of Namibia served as the focus of this article. Although four courses were delivered to UNAM students through the partnership, the difficulties experienced in the accreditation process of courses, unavailability of bandwidth despite having a dedicated broadband line, and the inability to customize the virtual solution to work in low bandwidth contexts were identified as some of the challenges experienced in the

implementation. In addition, issues such as the differing understanding of partnership aims, lack of understanding of participants' motivations and expectations, and the unavailability of a virtual classroom solution were identified as possible factors that may affect the outcome of a partnership. To ensure success in future implementations, it is crucial to ascertain that all stakeholders know the purpose of the partnership and that their motivations and expectations of the partnership are articulated. As such, it is essential that a solid foundation for similar projects is laid during the preparatory stages. It is also important to ensure that the chosen virtual classroom solution is usable within the context of implementation. Comprehensive testing of such a solution is critical before project commencement. Finally, although the project described here is a work in progress and the partnership involves Departments of Computer Science at two institutions only, lessons learned can inform future attempts to build partnerships between academic institutions in similar contexts.

References

Bashir, S. (2007). *Trends in international trade in higher education: Implications and options for developing countries*. Washington, DC: The World Bank.

Buik-Aghai, R. (2003). *Patterns of virtual collaboration* (Doctoral dissertation, University of Technology, Sydney, Australia).

Eddy, P. L. (2010). *Partnerships and collaboration in higher education*. New York: John Wiley & Sons.

Graber, M., & Bolt, S. (2011). The delivery of business courses via the African Virtual University: A case study. *Open Learning: The Journal of Open, Distance and e-Learning*, *26*(1), 79-86.

Hansen, S., Africa, H., & Boeren, A. (2005). *Review of South Africa - Norway Tertiary Education Programme (SANTED).* Johannesburg, South Africa: SANTED.

Hertaas, L. (2010). *Aid and higher education in Ethiopia: Foreign donor's influence in the higher education system with emphasis on quality*. (Master's thesis, Oslo University College, Oslo, Norway).

Ilemobade, A. A., & Ballim, Y. (2005). Undergraduate engineering training through institutional collaboration in the Southern African region. *South African Journal of Higher Education, 19*(4), 735-753.

Ishengoma, J. M. (2011). Strengthening higher education space in Africa through north-south partnerships and links: Myths and realities from Tanzania public universities. Paper presented at the Conference of Rectors, Vice Chancellors and Presidents (COREVIP), Stellenbosch, South Africa.

Keats, D., Beebe, M., & Kullenberg, G. (2003). Using the Internet to enable developing country universities to meet the challenges of globalization through collaborative virtual programmes, *First Monday*, *8*(10). Retrieved from http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/1625/1540

Kezar, A. (2005). Redesigning for collaboration within higher education institutions: An exploration into the developmental process. *Research in Higher Education*, 46(7), 831-860. doi: 10.1007/s11162-004-6227-5

Kezar, A. (2006). Redesigning for collaboration in learning initiatives: An examination of four highly collaborative campuses. *The Journal of Higher Education*, *77*(5), 804-838.

Koppelman, H., & Vranken, H. (2008). Experiences with a synchronous virtual classroom in distance education, In J. Amillo, C. Laxer, E. Menasalvas, & A. Young (Eds.), *Proceedings of the 13th Annual Conference on Innovation and Technology in Computer Science Education* (pp. 194-198) New York: ACM. doi: 10.1145/1384271.1384324

Lander, R., Burns, J., & Spence, M. (1999). De Montfort University case studies in the use and evaluation of videoconferencing in teaching and learning. A case study produced for the JTAP videoconference focus group. Leicester, UK: De Montfort University, Learning in Virtual Environments (LIVE) Research Group.

Maassen, P., Pinheiro, R., & Cloete, N. (2007). *Bilateral country investments and foundations partnership projects to support higher education across Africa* (2006/07 Report). Retrieved from the Center for Higher Education Transformation website: http://www.chet.org.za/files/uploads/reports/Maassen%202007%20Bilateral%20Country%20Investment.pdf

Mbanguta, Z. (2004). North-South collaboration on engineering education through CDIO educational theory reforms: The creation of an African CDIO knowledge society. *World Transactions on Engineering and Technology Education*, *3*(1), 129-134.

Moran, L. (1990). Inter-institutional collaboration: The case of the Australian inter-university women's studies major. *Journal of Distance Education, 5*(2), 32-48.

Netteland, G. (2007). *E-Learning for change in a large organization: Identifying problems and opportunities in the implementation of e-learning* (Doctoral dissertation, University of Bergen, Norway).

OECD, & World Bank. (2007). *Cross-border tertiary education: A way towards capacity development*. Retrieved from the World Bank website: http://siteresources.worldbank.org/EDUCATION/Resources/cross_border_tertiary_education_Eng.pdf

Parker, S. (2010). *Lessons for a ten-year funder collaborative: A case study of the Partnership for Higher Education in Africa*. New York: Clear Thinking Communications.

Plane, J. D., & Venter, I. (2008). *Comparing capacity building frameworks for computer science education in underdeveloped countries: an Asian and African perspective*. Paper presented at the 13th Annual Conference on Innovation and Technology in Computer Science Education, Madrid, Spain.

Ratcheva, V., & Vyakarnam, S. (2001). The challenges of virtual partnerships: Critical success factors in the formation of inter-organizational teams, *AI & Society*, *15*(1), 99-116.

Rhodes University. (2008). *Annual research report.* Grahamstown, South Africa: Rhodes University.

Schneider, J., Wagner, J., Winter, R., & Kolbe, H.-J. (2010). *Out of my way: Evaluating low extra delay background transport in an ADSL access network*. Paper presented at the 22nd International Teletraffic Congress (ITC22), Amsterdam, the Netherlands.

Tettey, W. J. (2010). *Challenges of developing and retaining the next generation of academics: Deficits in academic staff capacity at African Universities*. Canada: Partnership for Higher Education in Africa.

Thinyane, H., Mufeti, T. K., Terzoli, A., & Wright, M. (2010). Google Docs and Skype for a low bandwidth virtual classroom for developing countries. In *Proceedings of the IST-Africa 2010 Conference*, Durban, South Africa: IIMC International Information Management Corporation.

UNAM Computer Science. (2006). *Annual report computer science.* Windhoek, Namibia: University of Namibia.

UNAM Computer Science. (2007). *Annual report computer science.* Windhoek, Namibia: University of Namibia.

United Nations (UN). (2006). *The millennium development goals report 2006*. Retrieved from the United Nations website: http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2006/MDGReport2006.pdf

United Nations Development Programme (UNDP). (2009). *Capacity development: a UNDP primer*. Retrieved from the United Nations Development Programme website: http://content.undp.org/go/cms-service/download/asset/?asset_id=2222277

Watson, P. (2010). Co-operation in higher education and postgrauate programmes in the SADC region. *SARUA Leadership Dialogue Series, 2*(1), 9-31. Retrieved from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/Leadership%20Dialogue%20Series_Vol%202%20No%201.pdf

Wenger, E., White, N., Smith, J. D., & Rowe, K. (2005). Technology for communities. In *CEFRIO Book Chapter 5*(2), 1-15. Retrieved from http://technologyforcommunities.com/CEFRIO_Book_Chapter_v_5.2.pdf

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Social Media and Marketing of Higher Education: A Review of the Literature

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Abstract

The emergence of social media has revolutionized the practice of communication in two fundamental ways. First, social media have made it possible for one person to send an instant message to millions of others worldwide. Second and perhaps more important, social media make it possible to establish a two-way communication channel between the sender and receivers or simply between receivers or "followers" outside the control of the original sender. Social media, therefore, transcend the traditional bureaucracy when it comes to marketing or seeking information from an institution. We conducted a review of the literature to find out how institutions of higher education are leveraging social media for recruitment and admissions purposes, and whether prospective students use social media in their college search process. Our findings indicate that social media use by institutions of higher education is on the rise, yet it is unclear whether content on university social media pages influences prospects' choice-making processes.

Keywords

Social Media; Marketing; Recruitment; Admissions; Higher Education

Introduction

The development of new information and communication technology has altered human life in many ways. Education is one of the fields that has witnessed a significant revolution in recent years due to the emergence of Web 2.0 tools. Web 2.0 tools such as wikis, blogs, and social media differ from regular websites (Web 1.0) in the sense that they allow for two-way communication between reader and writer. More specifically, the reader has the ability of not only consuming but also producing information, for example by responding to a post on a blog, uploading and sharing a video, or adding content to an existing wiki. These affordances of Web 2.0 tools have several positive implications for higher education. Instructors are finding ways to use Web 2.0 tools to foster a media-rich environment where learners interact and construct knowledge. Various studies have highlighted the important role that Web 2.0 tools play in higher education. The use of blogging, for instance, promotes self-expression, self-reflection, and reflective dialogue among learners. In addition, team blogging has the potential to enhance learners' social skills (Coutinho, 2007; Deng & Yuen, 2011). Similarly, wikis provide a platform that both instructors and students can use for sharing and collaboration on projects (Parker and Chao, 2007).

Instructors are not the only people in higher education who are taking advantage of Web 2.0 tools, however. Higher education administrators, especially admissions officers at various institutions, are

finding ways to reach out to potential students through the use of social media. The recent emergence of social networking sites such as Facebook, Twitter, YouTube, and LinkedIn, and their popularity especially among young people, has contributed to a growing interest of admissions officers in their use for marketing purposes.

There are two concepts in social media lexicon worth distinguishing: social network sites and social networking sites. Social *network* sites, according to Boyd & Ellison (2008), are

> web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. (p. 211)

As such, social network sites establish an online connection between people who already share an offline connection. Social *networking* sites, on the other hand, are social sites that are often used to initiate relationships between strangers.

This paper takes a broad approach to the definition of social networking sites. For our purposes, these types of sites include both social networking and social networks, as we are interested in the use of social networking tools to establish a connection between complete strangers as well as people who already share connections. Our broad approach to the concept of social networking is consistent with the way institutions of higher education use social media, as they not only try to establish a connection with people they already know (current students and alumni), but are also interested in establishing relationships with complete strangers who may be interested in their institutions (e.g. prospective students). For reasons of simplicity, we use the term social networking sites to refer to both social network and social networking sites in this article. The key element of interest here is the idea of networking and building connections.

Social networking sites were originally designed for college students to build and maintain a network of friends. Facebook is an example of a social networking site that was initially designed for college students. Later on, however, the site became popular outside of higher education and was made available to anybody with an email address. Other sites such as Twitter and LinkedIn soon followed. As the use of these sites expanded to include high school students, admissions officers began to look for ways to use them as marketing tools to connect with and recruit potential students.

Within this context, our article reviews literature related to the use of social media in higher education from two perspectives. We begin with an administrative perspective as we review how institutions of higher education, particularly admissions officers, use social media for recruitment and admissions purposes. Relevant literature reveals that the majority of admissions officers prefer creating and maintaining accounts on various social media sites, because these allow them “direct contact” with potential prospective students as opposed to traditional marketing strategies. Next, we glean from the literature the extent to which prospective students use social media to find schools during their college search process. In other words, we investigated whether social media play a role in a prospective student’s college search and eventual decision-making. .

Thus, this review aims to achieve a dual purpose - to provide policy makers in institutions of higher education and admissions officers with insights into how social media are currently being used as a tool for marketing, recruitment, and admission of potential students, and to suggest ways to improve current practice. To that end, our review was guided by two research questions:

1. How do college admissions officers use social media for recruitment purposes?
2. To what extent do students use social media to search for information about universities and colleges, and do social media play a role in their decision which institution to attend?

Methodology

We utilized a systematic review approach to search for literature that would answer our research questions. This approach entails collecting empirical and theoretical studies that provide answers to pertinent research questions (Booth, 2001; Hemsley-Brown & Sharp, 2003; Sheldon & Chalmers, 1994). While the systematic review approach was initially developed in the medical field, its application has also been adopted in the social sciences. Key elements of the systematic review include: an explicit research question to be addressed; transparency of methods used for searching for studies; exhaustive searches which look for unpublished as well as published studies; clear criteria for assessing the quality of studies (both qualitative and quantitative); clear criteria for including or excluding studies based on the scope of the review and quality assessment; joint reviewing to reduce bias; and a clear statement of the findings of the review (Evans & Benefield, 2001). A systematic review should not be confused with a meta-analysis. A meta-analysis, according to Glass (1977), is a statistical technique primarily used for reviewing, summarizing, and combining or integrating the findings of quantitative studies. A meta-analysis, therefore, uses measures such as effect size or number of characteristics to mathematically combine results of several studies. If effect sizes or number of characteristics are similar, then a meta-analysis of several articles may be performed with the intent of improving the reliability of the results; if the measures are different, then a meta-analysis can be used to explain the variations.

For this study, the systematic review included extensive searches of relevant educational databases including Academic Search Complete, Academic Search Premier, Educational Research Complete, and Educational Resource Information Center (ERIC). We extended our searches beyond databases to include Internet queries using search engines such as Google Scholar. We identified prior publications as well as secondary references by authors identified in the original searches to perform further searches. We performed these searches using various terms which we combined with “higher education” or “universities” or “colleges.” Some examples of the search terms we used include “universities use social media to reach potential students”; “institutions of higher education use social networking sites to advertise their programs to potential students”; “college admissions officers use social media to recruit new students”; “social media and higher education marketing”; “social media and higher education”; “social media and student recruitment”; and “universities using social media to reach out to potential students.”

We did not limit our search to a particular time frame because literature on social media, a relatively recent phenomenon, dates back only a few years. Instead, we prioritized our search to scholarly articles reporting empirical research relating to our questions. Our searches returned 24 articles and 3 unpublished theses. We read the articles and unpublished theses independent of each other, and then met to compare notes on the pertinence of each of these to our research questions, excluding any articles or opinion pieces that were not relevant to our research questions. In the end, we selected 11 articles (Barnes & Lescault, 2011; Barnes & Mattson, 2009, 2010; Cappex.com, 2011; Constantinides & Stagno, 2011; Fusch, 2011a, 2011b; Merrill, 2010; PBP Executive Reports, 2010; Spraggon, 2011; Varsity Outreach, 2011) and the 3 unpublished theses (Glassford, 2010; Stageman, 2011; Stagno, 2010). We then reviewed each piece thoroughly to extract key findings relevant to our research questions.

Next, we used a “thematic analysis” to analyze, synthesize, and report our findings. Thematic analysis involves aggregating empirical research as well as theoretical literature around a research topic or area to achieve two goals: (1) to illuminate what has been established about that particular research topic, and (2) to highlight consensus across the various themes identified (Tranfield, Denyer, & Smart, 2003). We present our findings and a summary of our review in the sections that follow.

Social Media and Recruitment of Future Students

The use of social media by institutions of higher education to market themselves to potential students is a relatively new phenomenon, and as a result, not much academic literature exists on this issue. One of the most comprehensive and recent studies in the field was conducted by Barnes and Mattson (2009), who compared social media use by admissions officers at American colleges from 2007 to 2008. Using a list

generated from a directory compiled by the University of Texas, the researchers conducted a telephone survey of admissions officers of all accredited four-year institutions in the United States. A total of 453 phone interviews were conducted with admissions officers in 2007, followed by 536 additional interviews in 2008. Data were analyzed quantitatively and qualitatively, and the findings reveal that admissions officers:

- are increasingly using social media to recruit and research potential students;
- are increasingly familiar with social media (63% in 2008 as compared to 55% in 2007);
- are using different types of media platforms such as blogging, video blogging, and social networking sites to market their institutions. For example, institutions of higher education use videos to give virtual tours of campuses, showcase their dorms, or show prospective students sample lectures;
- feel that social media are important to their future admissions strategy (89%).

The researchers concluded that there is genuine enthusiasm among admissions officers concerning the use of social media for recruiting potential students. However, they also found that admissions officers need to learn the rules of engagement in online environments in order to be effective.

Barnes and Mattson (2010) conducted a follow-up study in order to further investigate social media use by admissions officers at institutions of higher education. A total of 478 admissions officers responded to a telephone survey concerning their use of social media for institutional marketing. Findings confirmed previous results in that:

- social media use by admissions officers continues to increase;
- social media familiarity continues to increase (83% in 2009 as compared to 63% in 2008);
- 95% of admissions officers use at least one form of social media, up from 85% in 2008;
- 91% of participants reported that social media is “somewhat important” to their future recruitment strategy, an increase of 3% from 2008.

In a more recent study, Barnes and Lescault (2011) also investigated the adoption of social media among higher education admissions officers for marketing purposes. Using purposeful sampling of accredited colleges and universities in the United States, they conducted a total of 456 telephone surveys with admissions officers at sample colleges and universities. The data were analyzed quantitatively and the results confirmed the findings of Barnes and Mattson (2009; 2010): Admissions officers at colleges and universities in the U.S. are utilizing social media to research and recruit potential students. The findings also revealed that Facebook is the most widely used, with 98% of respondents indicating that their institutions were taking advantage of it as a recruitment tool. Other social media platforms used include YouTube (86%), Twitter (84%), and blogs (66%). These results represent a substantial increase compared to previous years. The study also reported that institutions that use social media platforms tend to have social media policies in place, indicating who is in charge of maintaining their accounts.

Cappex.com (2010) conducted a study on the use of social media by admissions officers in private and public institutions of higher education. A total of 170 college admissions officers participated in the study; 119 came from private and 51 from public institutions. Consistent with previous findings, the results of this study revealed that social media use by admissions officers is on the rise. In addition, 62% of the participants said that they would dedicate more resources to social media use in the future. Among the major social networking sites, Facebook was the most widely used (66%), followed by Twitter (41%), and YouTube (27%). Facebook seemed to be the social networking site of choice for advertising, because the site affords institutions the opportunity to create a fan page, and a forum that allows them to connect with potential students through updates on admissions and current events on campus. For social media to be effective, however, Capex.com recommends that institutions of higher education make the contents of their Facebook pages engaging, and maintain a social presence in order for this platform to be an effective marketing strategy. Finally, increased use of social media platforms has not diminished use of

traditional methods of recruitment, as 97% of admissions officers still prefer traditional fairs as their main recruitment method.

In similar fashion, Spraggon (2011) investigated the use of social media as marketing tools for undergraduate business schools, collecting data from 20 undergraduate business school websites and conducting interviews with marketing officers at selected institutions. The data were analyzed qualitatively. The findings of this study suggest that a disconnect exists between theory and practice when it comes to marketing on social media platforms. While the main websites of the institutions tended to be linked to university-branded social networking sites, most homepages of undergraduate programs were not. This problem, according to the author, is due to the fact that institutions of higher education do not take the time to develop a social network marketing strategy before adopting the tools. Based on these findings, Spraggon recommended admissions officers draft a strategy that takes into consideration audience, objectives, tactics, tools, and metrics before engaging in social media marketing.

A survey conducted by Merrill (2010) sought to determine if universities are utilizing social media for international recruitment and outreach efforts. Thirty institutions of higher education responded to an online survey, including some from Germany, New Zealand, and Canada. Similar to other studies, Facebook, Twitter, YouTube, and LinkedIn were the social media tools of choice for Internet recruiting and international outreach. The respondents indicated that social media provide greater potential than traditional methods, such as international travel, for recruitment events and direct mailings. In other words, advertising on social media is more cost-effective as compared to traditional methods. Admissions officers also preferred social media as a recruitment strategy because (1) it allows them 'direct contact' with prospects, and (2) it expands the recruitment base, especially with respect to international students.

Varsity Outreach (2011) surveyed 2,000 colleges and universities to determine if they were using Facebook to recruit new students. A total of 150 colleges and universities completed the survey. Despite the low response rate (7.5%), the results were consistent with findings from previous studies pointing towards growth regarding the use of social media in recruitment. College admissions officers and marketing staff are increasingly utilizing social media platforms to reach out to potential students. Of the institutions that responded, 93% had a Facebook presence, while nearly 80% of those used the social networking site as one of its recruitment tools. Also, more than half of the respondents considered Facebook a "very important" admissions tool. Colleges and universities further reported using other social networking platforms including Twitter, YouTube, and blogs. Finally, the findings also provided some reasons as to why institutions of higher education are not using Facebook as a recruiting tool: 69% of respondents did not know enough about Facebook; 50% did not see much potential for student recruitment; 47% reported fear of losing control/brand; 28% reported concerns about invading privacy; and 16% cited a lack of resources. Fear of losing brand perhaps stems from the fact that conversations on social media are very fluid, and as such, an institution may not have control over what users post on their profiles. A student who has had an unpleasant experience with an institution, for example, may take to ranting on social media and under such circumstances, an institution can essentially lose control of the conversation.

Finally, in a more focused study, Glassford (2010) investigated how Bowling Green State University is leveraging social and digital media for recruitment purposes. An online survey was administered to 6,450 members of the 2009 and 2010 freshman classes. The majority of respondents found Facebook and YouTube "somewhat effective" in obtaining admission-related information. However, the response rate for this study was only 3.8%, thus raising questions regarding its representativeness.

The various studies discussed above illustrate a growing trend in adopting social media for recruitment and admissions purposes in higher education. It has therefore become imperative to review the efficacy of specific social networking tools to provide administrators with adequate knowledge to select the tools that meet their specific needs. Accordingly, PBP Executive Reports (2010) conducted a review of major social network sites in order to identify ways in which institutions of higher education can use these tools to market themselves to potential students. The review found that both Facebook and Twitter can be effective tools for marketing higher education to potential students. Facebook, with its fan pages, personal

page, and group features, provides institutions of higher education with an opportunity to maintain a vibrant online social presence. Twitter can be used to provide quick, admissions-related information to students and direct them to the main university website for further details. Some institutions also use Twitter functions such as 're-tweet' to broadcast tweets received from former or prospective students. The report concluded that while both Facebook and Twitter can be effective tools for marketing higher education, Facebook provides more affordances than Twitter.

In two similar articles, Fusch (2011a, 2011b) interviewed three social media and marketing experts to find out how specific digital tools can be used to achieve specific marketing purposes. He found that different tools can be used for different purposes. Online video sharing sites, such as YouTube, provide institutions of higher education with invaluable platforms to reach out to prospective students; Facebook can be used to generate desires for campus visits; and Twitter allows admissions officers to provide personalized services to prospective students who are in advanced stages of the application process. Another tool discussed by Fusch is Quora, a website that allows institutions to promote their academic strengths in the public domain. According to the author, an institution's reputation can rise quickly if faculty from that institution provide quick and high-quality responses to questions posed on Quora.

In short, the relatively small body of currently existing literature indicates that social media are slowly altering marketing, recruitment, and admissions practices in institutions of higher education. However, these platforms are relatively new and still evolving, and as a result, not all institutions have adopted their use. In those institutions that are using them, social media are only one component of comprehensive marketing, recruitment, and admissions strategies. We present a summary of our key findings in Table 1 below.

Table 1: Social Media Use by Admissions Officers: Summary of Key Findings

Author(s)	Topic	Instruments	Participants	Key Findings
Barnes & Lescault (2011)	Social media use by admissions officers	Telephone surveys	Admissions officers at U.S. colleges and universities *n* = 456	Admissions officers are using social media to recruit Facebook, YouTube, Twitter, and Blogs are the most widely used tools Some institutions have social media policies in place
Fusch (2011a; 2011b)	affordances of different social media tools	Interviews	Social media and marketing experts *n* = 3	Different tools can be used to achieve different purposes Facebook can be used for generating interest in campus visits; YouTube for reaching out to students; and Twitter for providing personalized services to individual students

Table 1: Social Media Use by Admissions Officers: Summary of Key Findings (Continued)

Author(s)	Topic	Instruments	Participants	Key Findings
Spraggon (2011)	Social media use for marketing undergraduate business programs	Document analysis (websites) Interviews	Marketing officers from 20 undergraduate business schools	Theory-practice disconnect University social networking sites only link to university homepages, not to individual program pages Universities do not take the time to develop social network marketing plans before adopting the tools Recommends universities develop a plan before adopting social networking tools for marketing
Varsity Outreach (2011)	Facebook use by admissions officers to recruit students	Survey	Admissions officers from 150 universities and colleges	Facebook use to recruit students is increasing 93% have a Facebook page or group Privacy concerns related to Facebook use
Barnes & Mattson (2010)	Social media and college admissions	Telephone surveys	Admissions officers from 4-year accredited institutions in the U.S. n = 478	Higher education institutions outpace Fortune 500 companies in adoption of blogging Admissions officers are using social media to research and recruit students Social media use by admissions officers for marketing their institution is increasing 83% are familiar with social networking sites 95% use at least one form of social media 91% think that social media is "somewhat important" to their future recruitment strategy
Cappex.com (2010)	Social media use by admissions officers in private and public institutions	Online survey	College admissions officers at U.S. colleges and universities *n* = 170; (119 from private, 51 from public institutions)	Social media use is on the rise Facebook, Twitter, and YouTube are the most popular tools Traditional recruitment methods, such as fairs, are still popular Engagement and social presence needed on university pages on social networking sites

Table 1: Social Media Use by Admissions Officers: Summary of Key Findings (Continued)

Author(s)	Topic	Instruments	Participants	Key Findings
Merrill (2010)	Social media and international students recruitment	Online survey	Officers from 30 institutions mostly from Germany, Canada, and New Zealand	Most popular social media used are Facebook, Twitter, LinkedIn Social media preferred method for recruiting international students compared to travel
PBP Executive Reports (2010)	Review of social networking sites as tools for advertising higher education	N/A	N/A	Facebook and Twitter can be effective tools for marketing higher education Facebook provides more affordances than Twitter through its "fan page" and "group" features
Barnes & Mattson (2009)	Social media and college admissions	Telephone surveys	Admissions officers from 4-year accredited institutions in the U.S. n = 453 (2007) n = 536 (2008)	Social media use by admissions officers for recruitment purposes is on the rise 89% of admissions officers say social media is somewhat important to their future admissions strategy Use of blogging, video-blogging, and social networking sites Need to learn rules of engagement in online environments

Social Media Use by Students for College Search

As described so far, most research on the usefulness of social media for marketing and recruitment by institutions of higher education has been conducted from an administrative perspective. However, it is just as important to find out the role social media may play in prospective students' decision-making processes.

Institutions of higher education use social media to reach out to potential students, because the assumption is that many prospective students use these tools. Stagno (2010) carried out a study to empirically test this assumption, investigating the use of social media by 403 prospective students in the Netherlands and the role that these media play in their decision-making process for choosing a particular college or university. The results showed that 95% of the participants had at least one social media profile. The most widely used social networking site was Hyves (88.4%), followed by YouTube (60.1%), and Facebook (40.3%). Interestingly, however, the study reported that social networking sites were last on the list of resources potential students rely on to find information about institutions of higher education. Instead, students still use traditional methods including campus visits, university websites, and brochures as primary sources of information. Stagno perceived this apparent discrepancy as a marketing strategy problem. Put differently, having a presence on a social networking site is not a marketing strategy in itself; instead institutions of higher education should develop a clear marketing strategy for social networking sites, define their goals, and make decisions based on them (see also Spraggon, 2011).

Within the same line of research, Constantinides & Stagno (2011) surveyed 400 Dutch students in their last two years of high school to determine the impact that social media have on their decision to attend a particular college. The findings of this study confirmed those reported in Stagno (2010), as the majority of students ranked social media last on a list of information sources that affect their college decisions.

Stageman (2011) conducted a case study to understand how prospective students use social media to communicate with higher education institutions from the beginning of the application process up to the decision-making point. Thirteen incoming freshmen at Marquette University participated in focus group interviews to get a better understanding of their experiences while going through the application process. The findings of the study were eye-opening as the university's social media sites did not appear to have had a substantial influence on the participants' decision to attend. However, Stageman's study also revealed that incoming freshmen find university-sponsored social media useful in helping them to establish two-way communication with university officials, build a network of friends, establish a personal identity, and make a smooth transition from home life to campus life. These findings imply that social media may not be important in the college search process, but become important once prospective students have made the decision to attend a particular institution.

There is lack of consensus in the limited literature available regarding whether prospects use social media for college-search and decision-making processes. Two issues became quite clear during our research, however: (1) that prospects do not seem to use social media for obtaining admissions-related information as they still rely on traditional methods such as campus visits, fairs, and email, and (2) that social media become important after prospects have made the decision to attend. We present a summary of our findings in this area in Table 2 below.

Table 2: Social Media Use by Prospective Students: Summary of Key Findings

Author(s)	Topic	Instruments	Participants	Key Findings
Constanti-nides & Stagno (2011)	Social media and marketing of higher education	Survey	Dutch students in their last two years of high school *n* = 400	The majority of students have a profile on social media sites Social media rank last on the list of information sources that influence students' decisions to attend a particular college
Stageman (2011)	Social media use by incoming freshmen in admissions process	Focus group interview	Incoming freshmen at Marquette U. *n* = 13	University social network sites did not affect participants' decisions to attend a particular college Once admission decision is made, incoming freshmen use university-sponsored social media to build a network of friends, connect with school officials, and make a smooth transition from home life to school life

Table 2: Social Media Use by Prospective Students: Summary of Key Findings (Continued)

Author(s)	Topic	Instruments	Participants	Key Findings
Glassford (2010)	The impact of social media on enrollment	Online survey	Incoming freshmen in 2009 and 2010 *n* = 242	The majority of respondents found Facebook and YouTube "somewhat effective" in getting admissions-related information The participants found Twitter not effective Respondents were either satisfied with the social media of the university or they didn't use them at all
Stagno (2010)	Social media use by prospective students for college search	Survey	Prospective students in the Netherlands *n* = 403	95% of participants had a social media page Hyves, YouTube, and Facebook were the most popular Social networking sites were last on the list of resources potential students use to search for college and obtain information Campus visits, university websites, and brochures were top Need for marketing strategy that uses social networking sites

Discussion and Conclusion

The dual purpose of this literature review was to illuminate how institutions of higher education are leveraging social media to reach out to potential students and whether these same students use social media in their college search process. This section draws together our findings, builds on the literature to make recommendations for institutions of higher education, and points out future areas of research. Consistent with the overall approach we took in our search, this section is divided into two parts; the first focuses on findings that speak to our first research question: How do college admissions officers use social media for recruitment and admissions purposes? In the same way, the second section highlights findings that illuminate the extent to which prospective students use social media to search for information about universities and colleges and whether social media play a role in their decision to attend.

The findings of our literature review reveal that both admissions officers and prospective students are actively using social media, albeit for different purposes. Admissions officers at various institutions of higher education are using social media to connect with potential students and market their institutions (Barnes & Lescault, 2011; Barnes & Mattson, 2010; Cappex.com, 2010; Glassford, 2010; Merrill, 2010; Varsity Outreach, 2011). The majority of the institutions surveyed had created a profile or page on popular social networking sites such as Facebook and Twitter. In addition, institutions of higher education are increasingly using blogs and social media platforms such as YouTube to share digital information with prospective students. Barnes and Mattson (2010), for instance, found that some universities use videos to give virtual tours of campuses or simply to showcase their residence halls or sample lectures.

The literature indicates that Facebook is currently the most widely used social media tool, followed by Twitter (Barnes & Lescault, 2011; Cappex.com, 2010; Glassford, 2010; Varsity Outreach, 2011). Facebook is the most popular platform because of its features. Admissions-specific fan pages, for example, afford universities a forum that can be leveraged to maintain a vibrant online presence through regular updates (Cappex.com, 2010; Fusch, 2011a, 2011b; PBP Executive Reports, 2010; Varsity Outreach, 2011). In addition, Facebook's fan pages allow institutions to target not only prospective students who "like" the institution's profile or page, but also the friends of these prospective students.

Twitter seems to be more effective in providing bite-sized admissions-related information and driving prospective students to the university's main page. As Fusch (2011b) points out, Twitter allows admissions officers to provide more tailored services to prospective students during the admission process. As a further marketing strategy, institutions use Twitter's 're-tweet' function to selectively broadcast positive experiences from prospective and current students (PBP executive Reports, 2010).

Going forward, most institutions plan to invest more resources into social media marketing, perhaps pointing to a growing popularity of social media as an effective marketing tool for higher education institutions (Barnes & Mattson, 2010; Cappex.com, 2010). In this respect, the literature reviewed here shows a growing awareness and perceived importance of social media (Barnes & Mattson, 2009, 2010; Barnes & Lescault, 2011). However, despite the growing use of social media for recruitment purposes, admissions officers still prefer traditional methods of marketing and recruitment such as fairs and direct mailings.

Regardless of their immense potential and widespread use, social media present new challenges for institutions of higher education. Two issues came to the fore during our research. The first involves a lack of clear policies that guide interactions between prospective students and admissions officers on social media (Barnes & Mattson, 2009). This lack of ethical guidelines opens the door to potential abuse and the associated public relations disasters for the institutions involved. For one, a prospective student may, for instance, "friend" an admissions officer (or the other way around) during the course of their interactions on social media sites, potentially leading to inappropriate contact beyond the official relationship. Such contact may lead to ethical violations that will in turn compromise the entire admissions process. Moreover, it is not clear whether admissions officers can deny a prospect admission based on 'private' information obtained from that prospect's personal profile. Yet, admitting a student who clearly exhibits social issues, based on information on his or her profile at the time of admission, is likely to expose an institution to potential law suits related to negligence should that student eventually cause harm to other students, faculty, or staff.

The second challenge relates to the approach taken by institutions of higher education in adopting the use of social media for marketing, recruitment, and admissions. Institutions of higher education appear to be in a race to adopt social media without doing the necessary groundwork. In other words, adoption of social media seems to be ad hoc and unsystematic, without prior development of coherent marketing strategies or clear goals (Spraggon, 2011). Most admissions offices just create a space on popular social media sites, upload admissions-related information and pictures of their institutions, and expect results in the form of increased enrollment rates. However, to leverage the potential of social media effectively, institutions of higher education will need to shift from this ad hoc approach to a more methodical one that systematically integrates social media tools into the overall marketing, recruitment, and admissions strategy. To ensure effective and successful social media marketing and recruitment campaigns, institutions of higher education should begin by developing a coherent marketing strategy with specific target audiences in mind and clear, measurable goals.

Social media expand the recruitment base tremendously by transcending both space and time, and all a prospect needs to "meet" with an institution's admissions officer is an Internet-capable device. To tap this potential, we suggest that institutions increase the number of hours spent online responding to questions from potential prospects in both asynchronous and synchronous digital spaces. For example, admissions departments could develop formal online advising schedules and post these to the institution's admissions pages on social media and encourage prospects to sign up. Those interested can then sign

up to “meet” and chat one-on-one with admissions officers in real-time. This way, admissions officers will be able to provide prospects personalized and focused responses to their questions.

In addition, colleges and universities should maintain consistency in all elements of their online environment so as to successfully transition a prospect from a social media site to the institution’s program page. If an institution is advertising its nursing program on social media, for example, then that institution’s marketing strategy should be such that a single click on the program’s icon on a social media site transports prospective students to that program’s homepage. In so doing, the prospect immediately gets a “feel” for the program he or she is interested in, as opposed to having to find it after having been taken to the institution’s main landing page (PBP Executive Report, 2010). Regardless, it is difficult for institutions of higher education to evaluate the impact of social media for marketing, recruitment, and admissions on enrollment, especially when a clear framework or metrics to measure success have not been developed.

The second section of this literature review sought to determine the extent to which prospective students use social media in their college search process and whether social media play a role in their decision to attend. As we found out during our search, there is a dearth of empirical work in this area, and we uncovered only three studies that specifically addressed this question (Constantinides & Stagno, 2011; Stageman, 2011; Stagno, 2010). The studies found that social media use is prevalent among prospective students, but there is no indication yet that these media are being used to seek information directly related to college admission.

In sum, the literature shows that admissions officers are using social media for recruitment and admissions purposes, but because the practice of using such tools for recruitment campaigns and admissions is relatively new and inconsistent, there are still many grey areas. Based on our review, we recommend that institutions:

- draft clear policies regarding the use of private information accessed via prospects’ personal profiles;
- develop systematic marketing strategies with clear target audiences, realistic goals, and metrics to measure the extent to which these goals are being reached; and
- invest more resources into social media to leverage the full potential of these tools and offer students an online experience that is consistent across platforms and motivates them to use social media tools as avenues of information gathering during the college search process.

Future research should focus on creating a framework or metrics for evaluating the impact marketing on social media has on students’ decisions to attend and enrollment numbers. Such measures should help clarify which social media tools are the most effective and why, thus ensuring better targeting of already limited resources. In addition, the impact of social media marketing and recruitment campaigns on prospective students’ decision-making processes should be more carefully and systematically studied. This will help illuminate not only the efficacy of advertising on social media platforms, but also has the potential to transform the ways in which institutions of higher education advertise their programs.

References

Barnes, N. G., & Lescault, A. M. (2011). *Social media adoption soars as higher-ed experiments and reevaluates its use of new communications tools*. Retrieved from the University of Massachusetts, Dartmouth website: http://www.umassd.edu/media/umassdartmouth/cmr/studiesandresearch/higherEd.pdf

Barnes, N. G., & Mattson, E. (2009). *Social media and college admissions: The first longitudinal study.* Retrieved from the Society for New Communications Research website: http://sncr.org/sites/default/files/mediaandadmissions_0.pdf

Barnes, N., G., & Mattson, E. (2010). *Social media and college admissions: Higher-ed beats business adoption of new tools for third year*. Retrieved from the University of Massachusetts, Dartmouth website: http://www.umassd.edu/media/umassdartmouth/cmr/studiesandresearch/socialmediaadmissions.pdf

Booth, A. (2001, May). *Cochrane or cock-eyed? How should we conduct systematic reviews of qualitative research?* Paper presented at the Qualitative Evidence-based Practice Conference, Taking a Stance. Coventry, UK.

Boyd, D., & Ellison, N. (2008). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, *13*(1), 210-230.

Constantinides, E., & Stagno, Z. M. C. (2011). Potential of the social media as instruments of higher education marketing: A segmentation study. *Journal of Marketing for Higher Education, 21*(1), 7-24.

Coutinho, C. P. (2007). Cooperative learning in higher education using weblogs: A study with undergraduate students of education in Portugal*. Proceedings of the 5th International Conference on Education and Information Systems, Technologies and Applications* (EISTA) (pp. 60-64). Orlando: EUA, Julho.

Cappex.com (2010). *Establishing a benchmark for social media use in college admissions*. Retrieved from the Cappex.com website: http://www.cappex.com/media/EstablishingABenchmarkForSocialMediaUse.pdf

Deng, L., & Yuen, H. K. (2011). Towards a framework for educational affordances of blogs. *Computers & Education, 56*(2), 441-451.

Evans, J., & Benefield, P. (2001). Systematic reviews of educational research: Does the medical model fit? *British Educational Research Journal*, *27*(5), 527-541.

Fusch, D. (2011a, January-February). Making informed investments in social media. *Higher Ed Impact Monthly Diagnostic*, 8-11. Retrieved from: http://www.academicimpressions.com/hei_resources/0211-diagnostic.pdf

Fusch, D. (2011b, January-February). Marketing and recruiting with social media. *Higher Ed Impact Monthly Diagnostic*, 12-13. Retrieved from: http://www.academicimpressions.com/hei_resources/0211-diagnostic.pdf

Glass, G. V. (1977). Integrating findings: The meta-analysis of research. *Review of Research in Education*, *5*, 351-379. doi: 10.2307/1167179

Glassford, S. (2010). *Recruitment at Bowling Green State University: The role of social and digital media* (Unpublished master's thesis). Bowling Green, OH: Bowling Green State University.

Hayes, T., Ruschman, D., & Walker, M. (2009). Social networking as an admission tool: A case study in success. *Journal of Marketing for Higher Education*, *19*(2), 109-124.

Hemsley-Brown, J., & Sharp, C. (2003). The use of research to improve professional practice: A systematic review of the literature. *Oxford Review of Education*, *29*(4), 449-471.

Merrill, N. (2010). *Social media in international student recruiting and outreach survey*. Retrieved from the Global Campus website: http://www.wepapers.com/Papers/126185/Social_Media_in_International_Student_Recruiting_and_Outreach_Survey

Parker, T. R., & Chao, J. T. (2007). Wiki as a teaching tool. *Interdisciplinary Journal of Knowledge and Learning Objects, 3,* 57-72. Retrieved from http://ijklo.org/Volume3/IJKLOv3p057-072Parker284.pdf

PBP Executive Reports (2010). *Facebook & Twitter: Engaging & recruiting prospective students*: *A special report for higher education administrators.* Retrieved from the PBP Executive Reports website: http://www.pbpexecutivereports.com/

Sheldon, T., & Chalmers, I. (1994). The UK Cochrane centre and the NHS centre for reviews and dissemination: Respective roles within the information systems strategy of the NHS R&D programme, coordination and principles underlying collaboration. *Health Economics*, *3*(3), 201-203.

Spraggon, D. I. M. (2011). *Think before you tweet: Social media best practices for undergraduate business schools* (Working Paper No. 2011-1). Retrieved from the University of Massachusetts, Amherst website: http://people.umass.edu/resec/workingpapers/documents/ResEcWorkingPaper2011-1.pdf

Stagno, M. C. Z. (2010). *Potential of the social media as instruments of higher education marketing: Guidelines for a social media marketing strategy for the University of Twente*. (Unpublished thesis). University of Twente, Enschede, the Netherlands.

Stageman, A. (2011). *Consulting social media in the college transition process: Experiential accounts of the class of 2014* (Unpublished master's thesis). Marquette University, Marquette, WI.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207-222.

Varsity Outreach (2011). *Facebook and admissions: A closer look at how college admissions offices use Facebook.* Retrieved from Varsity Outreach website: http://www.varsityoutreach.com/Documents/FacebookAndAdmissions2011.pdf

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