BLENDED LEARNING OPPORTUNITIES AND CHALLENGES IN MATHEMATICS EDUCATION: PERSPECTIVE IN HIGHER EDUCATION

Article Review by Ekemini T. Akpan, Nigeria
(BSc (Ed) Mathematics, Department of Science Education, University of Uyo)
Email: - ekeminitakpan@uniuyo.edu.ng

ABSTRACT

Blended learning (face-to-face plus online learning) is now part of the learning landscape in Higher Education, not just for campus-based courses but also for courses designed for students studying at a distance (Distance Education). This paper focuses on exploring blended learning as an approach to the teaching and learning of mathematics in Higher Education. Its provide insight and understanding of current and future trends regarding how conventional face-to-face instruction in mathematics is influenced by web-based/computer-supported learning. Practical pedagogical issues related to mathematics and blended learning in Higher Education are also discussed. The researcher recommends that higher institutions could utilize blended learning environment such as WebCT in the teaching and learning of mathematics in Higher Education.

KEYWORDS

Blended learning environment, Higher education, Mathematics, WebCT.

INTRODUCTION

The rapid development of information and communication technology (ICT) and the move toward a robust knowledge-intensive and globalized society have created new challenges and opportunities in instructional design model and pedagogical approaches in the tertiary institutions (UNESCO, 2003; Tella, 2014). The use of ICT in the academic landscape has removed time and place constraints in the teaching and learning of mathematics. These explorations of ICT in the teaching and learning of mathematics is facilitated through the use of web-based and computer-supported technologies in both synchronous and asynchronous dimensions, commonly known as virtual learning environment (VLE). VLE can be defined as a self-paced computer-based (web) environment enabling interaction between lecturers and students where various tools are provided for the students to facilitate their learning experience (Chin, 2003). Some VLEs require specific software to be installed on the users' computer, but most VLEs operate across the World Wide Web, so learners often need Internet connectivity to

access a VLE. Access to online courses is granted with a password available only to students enrolled in the official institutional courses by the lecturers (Torrieco & Scancarello, 2009).Downes (2010) noted that the web is shifting from being a medium in which information is transmitted and consumed to a platform, in which content is created, shared, repurposed, and passed along as connective knowledge in networks. Course materials are produced and altered by students, sometimes in collaboration, with lecturers, who takes the role of mediators in the process of teaching of the subject matter using web-based approaches (Komlenov, Budimac, Putnik & Ivanovic, 2013). Thus, knowledge only resides not only in the mind of an instructor or individuals, but also in a distributed manner across a network, and learning is the act of recognizing patterns shaped by these complex networks (Siemens, 2003).The main feature of distributed knowledge is that the learning environment is designed to accommodate the fact that students have different learning styles, needs and preferences.

Meta-analyses have shown that the growing number of students in Higher Education have problems understanding the course content in mathematics, because of their poor knowledge of the subject matter attributed to instructional approaches and learners' perceptions of the learning environment (Lizzio, Wilson &Simons, 2002). It is well-known that mathematics examinations are a major obstacle for students taking mathematical science-related course in higher institution. They have the highest failure rate, many dropouts and lead to considerable delays in completing university degrees. Some may lack interest, motivation, and positive attitude, and some are not interested in specializing in mathematics (Abramovitz, Berezina, Bereman, Shvartsman, 2012). Thus, they pay little or no attention to understanding basic mathematical concepts. Therefore, supplementing conventional face-to-face learning in the classroom with technological-based tools could stimulate learners' interest and gives learners control of their learning task and may also increase the number of students taking mathematics courses. This blended learning approach could influence students' perceptions of the learning environment, their learning approaches, and learning outcomes in the subject matter. This article provides insight into current and future trends regarding how conventional face-to-face instruction is facilitated and influence by web-based/computer-supported learning and other emerging technologies. Practical pedagogical issues related to mathematics blended learning in higher institutions are also discussed.

PERSPECTIVE OF BLENDED LEARNING IN HIGHER EDUCATION

There is no agreed definition of blended learning, but there has been a common theme presented in many discussions in the literature; the recognition of some combination of virtual learning and the physical environment. Blended learning is a mixture of conventional face-to-face learning and online learning (virtual learning), adopted to foster active learning, interactivity, and collaborative learning experience as learners' strive to understand, develop knowledge, and creativity in the learning process. According to Singh (2003) blended comprises various event-based activities including face-to-face learning in the classroom, live e-learning (online) and self-pace learning. This pedagogical model encourages students to learn in an interactive and

collaborative environment at their own pace and in their own time. Oliver and Trigwell (2005) summarize the concept of blended learning as follows:

- Combining or mixing web-based technology to accomplish an educational goal.
- Combining learning theories (e.g., constructivism, behavourism, cognitivism, and connectivism) to produce an optimal learning outcome with or without instructional technology.
- Combining any form of instructional technology with face-to-face instruction-led training and
- Incorporating instructional technology with the design model of an instructional program of study.

BLENDED LEARNING TOOLS IN MATHEMATICS EDUCATION

The mathematics/computer laboratory is considered to be suitable environment for the adoption and implementation of a blended learning approach. The mathematics/computer laboratory could also facilitate the growth of blended learning, if the required software, hardware and Internet facilities are created to optimize its functionality. Basically, blended learning tools that facilitate mathematics instruction are computer-assisted instructions such as MATLAB/SIMULINK software, Modular Arithmetic Software (MAR), Home Work System (HWS), Microsoft MathType Software (MMS), and SPSS. Technology-enhanced tools such as; e-forum/e-mail platforms, Video on Demand, Animated Video Delivery System, and power point presentation facilitate blended learning in mathematics instruction when moderated by lecturers on various courses in higher institutions.

Nevertheless, sophisticated web-based or VLEs have emerged such as; The Modular Object Oriented Dynamic Learning Environment (MOODLE) platform, Blackboard Learning Management System, e-converge pedagogical model, WebCT, MUMIE online resources, WebALT, web2.0, and other open courseware (Albano, 2012; Albano & Maresca, 2010).VLEs can supplement traditional face-to-face teaching methods, but there are a number of challenges in Higher Education where; for example, increased students' number, automated assessment, increased participation, and improved access to limited resources.

These tools are designed with features that blend with the conventional face-to-face classroom and the goals of the courses, as well as, facilitating intensive learning opportunities for the learners. Chin (2003) suggested that the fundamental tools offered by any VLEs to complement conventional face-to-face classroom should including the following:

- **Communication tools:** The basic feature of any VLE that can supplement conventional face-to-face classroom learning is any form of synchronous or asynchronous

communication tools. It should allow forwarding of mails to regular Internet e-mail addresses. Students are encouraged to use the e-mail feature and communicate with lecturers and with fellow students/colleagues. It provides a more convenient method of filing correspondence relative to the course. Another fundamental communication tool is the discussion board; an electronic board works in much the same way as a physical notice board, by allowing students to post messages for others to read and post replies. This tool helps to compile comprehensive class activities and quiz schedules for the online study sessions, and other relevant information pertaining to the course. A live chat or discussion forum is another synchronous communication tools integrated into VLEs. One benefit of this tool is that it can enable student-student, and student-lecturer communication at different locations. Interactive whiteboard are used in VLEs to help students and lecturers to compose material interactively in a synchronous way so that everyone can sees the work of another and contribute.

- **Content delivery tools:** A core function of a VLE is the ability to deliver content in a variety of formats. This tool allows the instructor/course designer to submit/upload files (e-book, e-journal), deliver lecture support notes, and image, audio, or video presentation files, as well as interactive animations.

- **Assessment tools:** This tool enables students to view their quiz grades and examination results. Its enables instant marking, quick data analysis and quick feedback for students. The results can be used with other features within the system by the lecturers.

- **Content exchange and group work tools:** These tools allow staff and students to provide and share files with one another. This means that students can share work in an online environment rather having to meet face-to-face. Students can use this tool to make group presentations.

BENEFIT OF BLENDED LEARNING IN HIGHER EDUCATION

- Studies have shown that courses using blended learning delivery method contribute to improved learning outcomes for the students (Boyle, Brandley, Chalk, Jones & Picard, 2003; Groen and Carmody, 2005; Iozzi & Osimio, 2012). Twisg (2003) reported that courses redesigned to include blended learning resulted in students achieving higher grades, greater knowledge, and understanding of course concepts. This could lead to a reduction in the student dropout rate in higher institutions.

- Another benefit of blended learning is the increased flexibility of access to learning which facilitates review and learners' control of the learning environment. The Internet provides flexibility and efficiency in teaching and learning activities. Teaching sessions can be conducted via video or teleconference links so that learners can attend classes online. Study materials are readily available over the Web. Applications provided over

the Internet such as e-libraries, e-books, e-resources provide opportunities for learners and instructors. The blended learning approaches allow learners who lives some distance away from the institution to enroll in a program, and the online component allows them to work whenever and wherever they prefer because they can access the Internet without making the journey to campus (Tam, 2000).

- Garrison and Kanuka (2004) explored how blended learning can offer transformational potentials to higher institutions. Higher institutions could harness innovative technologies in teaching and learning program by redesigning the curriculum to enhance a community of enquiry, supporting active and meaningful learning. Blended learning also foster professional leaning community, improves institutional reputation, and allows the development of social cohesion due to the inclusion of the face-to-face component (Owston, Wideman, Murphy & Lupshenyuk, 2008).

- Blended learning is cost and resource effective. Institutional costs are reduce because the materials can be placed online and re-used at convenience (Vaughan, 2007; Holland, 2012). The size of the student cohort can increase and the number of classrooms decreases. The use of blended learning can help to reduce staff numbers and student classroom contact time, and consequently save staffing costs.

- Blended learning also promotes student interest, perceptions and satisfaction in the learning environment. It enables students to be more motivated and more involved in the learning process, thereby enhancing their commitment and perseverance. Dziuban, Hartman, Juge, Moskal, Sorg (2006) reported that students satisfaction is higher with blended learning courses compared with purely face-to-face courses.

In addition, Azizan (2010) envisaged that blended learning in Higher Educational Institution

- Offer an efficient and effective approach
- Provide more choice of learning to learners
- Increase learning resources
- Encourage independence and conviviality.

CHALLENGES OF BLENDED LEARNING IN HIGHER EDUCATION

Despite the opportunities provided by blended learning, the students, instructors and institutions face some challenges with its implementation. These include the following:

- Studies have shown that students enrolled in blended courses can sometimes have unrealistic expectations. The students in blended learning programmes assumed that fewer classes meant less work, inadequate time management skills were inadequate, and

they experienced problems with accepting responsibility for personal learning (Vaughan, 2007)

- Students in such courses have also reported feeling isolated due to the reduced opportunities for social interaction in a face-to-face classroom environment.

- Having difficulty with more sophisticated technologies is another challenge when implementing blended learning. For example, students may have to rely on slow (e.g., dialup) Internet connections. Poor Internet connectivity has been reported to inhibit students' ability to engage in online discussions, which could lead to considerable frustration and have a negative impact on learning.

- The challenge for implementation of blended learning in higher institutions is time commitment. Johnson (2002) estimates that planning and developing a blended learning course for large numbers usually takes two to three times the amount of time required to develop a similar course in a traditional format.

- Funds are insufficient for the development of a Learning Management System (LMS), which is required to enhance blended learning in higher institutions.

- Technical support for course design may be lacking. This results from insufficient interrelation between the ICT experts and faculty members offering blended learning courses. In order to ensure a successful blended learning experience for students; there should be university support for course redesign, which may involve deciding what course objectives can best be achieved through online learning activities, what parts of the course can best be accomplished in the classroom, and how to integrate these two learning environments.

PROPOSED BLENDED LEARNING MODEL FOR HIGHER EDUCATION

Khan, as cited in Singh (2003), proposed a blended learning model. The framework has eight dimensions: institutional, pedagogical, technological, interface design, evaluation, management, resource support, and ethical (Figure 1). Each dimension in the framework represents a category of issues that need to be addressed. These issues help to organize thinking, and ensure that the resulting learning program creates a meaningful learning experience.

Figure 1. Khan's Octagonal Blended Learning Model

- **Pedagogical:** This dimension is concerned with the combination and selection of the learning contents to be delivered online and to be delivered offline (face-to-face). It also analyzes the learners' learning style, objective of the contents, and evaluates students learning outcomes.

- **Technological:** This dimension examines the availability, accessibility and usability of the LMS to enable the synchronicity of blended learning. The technological component also requires the services of technical experts to support the system.

- **Management:** This component deals with issues related to quality control, availability of technical experts, upgrading of infrastructures for multiple deliveries and improvement facilities.

- **Interface design:** This addresses issues related to the user interface of each element in the blended learning environment.

- **Evaluation:** This assesses the capability and effectiveness of the blended learning environment and examines the functionality and improvements of a specific LMS.

- **Resource support:** This deals with making different type of interactive resources (online and offline) available for learners.

- **Ethical**: The ethical dimension identifies the ethical issues that need to be addressed when developing a blended learning program, for example, equal opportunity, cultural, diversity, and nationality.

CONCLUSION

The emergence of computer and technologies has made teaching and learning of mathematics a dynamic process. Blended learning courses are being offered at different higher institutions through the use of LMS. This study has outlined the concept of the blended learning approach from the perspective of mathematics in Higher Education. Moreover, the different blended learning tools that can enhance teaching and learning in mathematics education are discussed. The benefits of blended learning as well as challenges during implementation are also discussed. This study proposes a blended learning model that can foster best practices in blended learning (i.e., Khan's octagonal model). The study can be considered as a proactive prospect for higher institutions aiming to adopt a blended learning approach, in order to harness the diverse learning opportunities that technology can provide. It may also enable faculty members to select a suitable blended learning environment for teaching and learning program in mathematics.

RECOMMENDATION/FURTHER STUDY

Higher institutions could adopt Khan's model to design and implement a blended learning environment using a specific LMS such as WebCT. International consortium could be established with other universities to foster and develop blended learning approaches for different programs. Blended learning project should be properly funded, so as to address issues beyond the proposed Khan's model. Further studies should be carried out using WebCT as a blended learning platform to ascertain its effectiveness and efficiency in mathematics course delivery.

REFERENCE

1. Abramovitz, B., Berezina, M., Bereman, A., & Shvartsman, L. (2012). A blended learning approach in mathematics. In A. Ajuan, M. A. Huertas, S. Trenholm, and C. Streegmann (Eds), *Teaching mathematics online: Emergent technology and methodologies* (pp. 22-42). Retrieved on 04/07/13 from www.igi-global.com/chapter/blended-learning-approach-mathematics/57923 DOI: 10.40/8/978-60960-0

2. Albano, G. (2012). Mathematics education: teaching and learning opportunities in blended learning. Retrieved on 06/07/13 from www.igi-global.com/chapter/mathematics-education-teaching-learning-opportunities/57934

3. Albano, G., & Maresca, G. (2010). A blended learning course in mathematics education: a case study. Proceedings of the 7th PAN-Hellemi Conference with International Participant (ICT Education). *1*(1), (pp. 245-252).

4. Azizan, F. Z. (2010). Blended learning in higher education institution in Malaysia. Proceedings of Regional Conference on Knowledge Integration in ICT.

5. Boyle, T., Bradley, C., Chalk, P., Jones, R., & Picard, P. (2003). Using blended learning to improve student success rates in learning to program. *Journal of Educational Media,* 28(2-3), (pp. 102-178). DOI: 10.1080/135816503200015316

6. Chin, P. (2003). Virtual learning environment: learning and teaching support network. LTSN Physical Sciences Centre, Available on www.physsci.ltsn.ac.uk

7. Downes, S. (2010). Learning networks and connective knowledge. In H. H. Yang & S. C. Yuen, Collective intelligence and e-learning 2.0: implication of web-based communities and networking, (pp.1-26). Retrieved on 03/07/2013 from www.igi-global.com/chapter/learning-networks-connective-knowledge/37067 DOI: 10.4018/978-1-160566-729-4

8. Dziuban, C., Hartman, J., Juge, F., Moskal, P.& Sorg, S.(2006). Blended learning enters the mainstream. In C. J. Bonk & C. R. Graham (Eds), Handbook of blended learning: global perspectives, local designs, (pp. 195-208). San Francisco, CA: Pfeitter.

9. Garrison, D. R., & Vaughan, N. D. (2004). Blended learning in higher education: framework, principles, and guidelines. San Francisco, CA: Jossey-Bass.

10. Groen, L., & Carmody, G (2005). Blended learning in a first year mathematics subject. Proceedings of Uniserve Science Blended Learning Symposium, (pp.50-55). Retrieved on 24/09/14 from www.uniserve.edu.au/pubs/procs/wshop10/2005Groen.pdf

11. Holland, F. (2012). Assessing the cost-effectiveness of online and blended learning. Presented at PACE Seminar, Centre for Technology and School Change, Teacher College, Columbia University.

12. Iozzi, F., & Osimio, G. (2012). The virtual learning classroom in blended learning mathematics undergraduate course. Presented at ICME 10. Available online at http://www.icme-organiser.dk/tsg15/Iozzi&osimio.pdf

13. Johnson, J. (2002). Reflections on teaching a large enrollment course using a hybrid format. Retrieved on 12/7/14 from http://www.uwa.edu/ttt/articles/jjohnson.htm

14. Komlenov, Z., Budimac, Z., Putnik, Z., & Ivanovic, M. (2013). Wiki as a tool of choice for students' team assignments. *International Journal of Information System and Social Change*, *4*(3), (pp.1-16). Retrieved on 20/06/2013 from www.igi-global.com/article/wiki-as-a-tool-of-choice-for-students-team-assignment/84798 DOI: 10.4018/jissc.20/3070101

15. Lizzio, A., Wilson, K., & Simons, R (2002). University students' perceptions of to the learning environment and academic outcomes: Implication for theory and practice. *Studies in Higher Education,* 27(1), (pp. 27-52). DOI: 10.1080/03075070120099359

16. Oliver, M., & Trigwell, K (2005). Can blended learning be redeemed? E-learning. DOI: 10.2304/elea.2005.2.1.17

17. Owston, R., Wideman, H., Murphy, J., & Lupshenyuk, D. (2008). Blended teacher professional development: a synthesis of three program evaluations. DOI: 10.1016/j.ihedu.2008.07.003

18. Siemens, G. (2013). Connectivism: A learning theory for digital age. International Journal of Instructional Technology and Distance Learning. Retrieved on 12/04/2013 from www.connectivism.ca

19. Singh, H. (2003). Building effective blended learning program. *Educational Technology*, *43*(6), (pp.51-54)

20. Tella, A. (2014).Globalization, blended learning, and mathematics education: Implication of pedagogy in tertiary institution. Retrieved from www.igi-glabal.com/chapter/globalization-blended-learning-and-mathematics-education/83453

21. Tam, M. (2000). Constructivism, instructional design and technology: implication for transforming distance learning. Educational Technology & Society, *3*(2), (pp. 50-60) Retrieved from http://www.ifests.info/journal/3_2/tam.html

22. Torrieco, A. & Scancarello, I (2009). A model for asynchronous discussion in a mathematics content course. Retrieved from www.igi-global.com/chapter/model-asynchronous-discussion-mathematics-content/5793

23. Twigg, C. A (2003). Improving learning and reducing cost: Lesson learned from round 1 of the grant program in course redesign. Troy, NY: Centre of Academic Transformation. Retrieved from www.then.cat.org/PCR/R1lesson.html

24. UNESCO (2002). Open and distance learning: trends, policy, and strategy consideration. Paris: UNESCO.

25. Vaughan, N. D. (2007). Perspectives on blended learning in higher education. *International Journal of Blended Learning*, *6*(1), (pp. 81-94).