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VOICES OF THE DEVELOPING WORLD

An empirical study of the impact of multiple modes of delivery on student learning in a blended course

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ABSTRACT

Finding ways to promote students' online learning performance has always been regarded as a necessity for higher education institutions. In this study, we investigated how certain modes of learning delivery can potentially influence students' learning. Precisely, the effects of Face-to-Face (F2F), Learning Management System (LMS), and Web-based Learning (WBL) on students' online learning were examined. A survey questionnaire, distributed to 196 undergraduate students, was used in this study. The use of these modes showed varied effects on the learning outcomes of students. F2F learning mode was found to influence students' performance in completing online assignments. The result also showed that the use of LMS-based learning mode affects students' performance in the final exam. These results are believed to provide useful directions for the higher education community to better understand how certain modes of learning delivery can be related to the development of students' performance in a blended learning environment.

KEYWORDS

performance development; best practices; LMS; multiple learning modes

Introduction

Blended learning can be defined as an approach that combines different models of Face-to-Face (F2F) and online learning to create a learning atmosphere that sustains motivation and promotes self-learning (Heirdsfield, Walker, Tambyah, & Beutel, 2011). With the growing focus on online learning outcomes in higher education, blended learning has the potential to provide the best environment for enhancing student engagement and performance (Alducin-Ochoa & Vázquez-Martínez, 2016).

Blended learning provides students with the opportunity to choose the most compatible way for them to learn and share resources at their own pace (Kirstein & Flores, 2012). However, as the learning preferences of students tend to be different in the blended learning environment, it is necessary to determine how certain modes of learning delivery can potentially promote the overall learning of the students (Singh, 2003). This is because the varied nature of blended learning can potentially influence the way students learn, which

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may provoke the need for examining ways on how knowledge can be delivered and learned effectively (Chernish, DeFranco, Lindner, & Dooley, 2005). Based on these, it can be said that the different characteristics of each mode may potentially influence students' learning. A number of studies have been conducted to enhance student performance when engaging in learning activities that are supportive of certain modes such as Learning Management System (LMS), Web-based Learning (WBL), and F2F (Gallego & Gamiz, 2015; Hoic-Bozic, Dlab, & Mornar, 2016; Musbah, 2014; Zainuddin, 2016). Most of these studies have been found to examine how these modes can drive students' learning outcomes in various contexts. For example, Taradi, Taradi, Radić, and Pokrajac (2005) investigated how students' learning outcomes can be changed when they learn using WBL, problem-based learning (PBL), and collaborative learning. Reasons, Valadares, and Slavkin (2005) found significant differences in students' learning outcomes when the students use WBL. Still, most of these studies did not consider the direct effect of certain learning delivery modes on students' performance in a blended learning setting.

Therefore, the present study attempts to address this concern by exploring the effects of F2F, LMS, and WBL on students' learning, based on logs data related to completing online assignments, online quizzes, and final exam. Outcomes from this study may offer useful directions for the higher education community to better understand how certain modes of learning delivery can be related to the development of students' learning in a blended course.

Learning modes

Face-to-Face (F2F)

In this mode, the pedagogical model seems to be based on a traditional model in which the instructor provides the content and students use Information and Communication Technology (ICT) tools for leisure and communication (Gros, Garcia, & Escofet, 2012). It allows students to have direct interaction with the instructor to achieve the desired reaction learning. Boon (2010) argued that the F2F sessions may not necessarily lead the students to gain adequate understanding of the course. The F2F mode is related mainly to the instructor's method of delivering the course and to the activities used within the classroom; thus, the online mode of a blended context enhances and complements the F2F delivery of content and leads to reduce the time students need to accomplish a task (Boon, 2010; Zainuddin, 2016). Few studies have addressed how the F2F mode in the blended environment can influence students' learning (Akkoyunlu & Yilmaz-Soylu, 2008; Brown, 2009; Orenstein, 2014). Akkoyunlu and Yilmaz-Soylu (2008) examined students' perception in a blended learning environment with respect to

their learning styles where they found that learning with F2F was positively perceived by the majority of students. Brown (2009) found positive impact of the F2F mode on students' learning and academic achievement. In this study, the F2F learning measured by the students' response to the online survey based on their engagement in three forms: individual (F2F-IL), collaborative (F2F-CL), and instructor-led learning (F2F-ILL).

Learning management system

LMS includes features for delivering courses over the Internet, which involves content creation, assessment, and communication (Piña, 2012). It offers students a set of tools to effectively manage their learning processes. Tracking the activities and behavior of students in the system is one of the benefits of LMS that can help educational decision makers to further improve their learning experiences and outcomes (Jo, Kim, & Yoon, 2014). Many studies have been carried out in the past to investigate the relationship between LMS usage and student performance. For instance, Wolff, Zdrahal, Nikolov, and Pantucek (2013) demonstrated that tracking the changes of the learning activities in the LMS can be used to predict students' failure. Thus, it is anticipated that the level of students' participation and involvement in the LMS activities can be assessed in three forms: individual (LMS-IL), collaborative (LMS-CL), and instructor-led learning (LMS-ILL).

Web-based learning

The informal use of the WBL mode in learning has proven its effectiveness in helping higher education offset the absence of student control and personalization in LMS (Dabbagh & Kitsantas, 2012). Many studies have shown that WBL can provide the necessary means for instructors to build learning materials and conduct activities in open network learning environments (Sclater, 2008; Van Harmelen, 2006). In addition, students can easily access open educational resource and social network tools (Al-Rahmi & Othman, 2013), which makes it easier for learners to integrate new information and collaborate on a task. Olczak (2014) evaluated the impact of using Web resources on student learning. The author showed that making use of Web resources could positively influence student learning as reflected in their performance on online quizzes. Furthermore, Arnold and Paulus (2010) revealed that the use of social network sites in a blended learning environment may positively influence the way students engage in a course. Hommes et al. (2012) found that social network usage is positively associated with student learning and academic performance. Based on this, WBL can be measured in three forms: individual (WBL-IL), collaborative learning (WBL-CL), and instructor-led learning (WEB-ILL).

Method

Participants

The participants consisted of 196 undergraduate students from a key university in a developing country to respond to the questionnaires. All students actively participated in F2F and online learning activities. There were 104 male students (53.1%) and 92 female students (46.9%). Among the participants, 100 (51.0%) were enrolled in Math principles course and 180 (48.0%) were enrolled in a computer course.

Instrument

In this study, the data collection employed two instruments: (i) a Web-based questionnaire about modes of delivery and engagement in a blended learning environment including nine constructs. The LMS mode with 23 questions examined LMS-IL, LMS-CL, and LMS-ILL. The Web mode with 19 questions examined Web-IL, Web-CL, and Web-ILL; whereas, the F2F mode with 17 questions examined F2F-IL, F2F-CL, and F2F-ILL. These items were principally adapted from prior studies (Barnard, Lan, To, Paton, & Lai, 2009; Hamlett, 2006; Liaw, 2008), with modifications in wording to meet the research objectives and to reflect the blended context under investigation (see Appendix A). (ii) The LMS analytics data, which was comprise logs related to students' online performance scores.

Data collection

At the end of the semester, we asked 17 lecturers to post the online survey link on their LMS main page. After receiving the students' responses, we requested the lecturers provide the LMS data (logs) of their students. Student IDs were used in both the questionnaire and LMS data to ensure data consistency and integrity across classes.

Results

Table 1 provides an overview of the descriptive statistics for students' self-reported frequency of the three delivery modes. The Web-CL mode was found to be the most frequently used tool (Mean = 34.68), followed by the LMS-IL (Mean = 33.34). Students' responses also showed that the most common indicators used were LMS-ILL (Mean = 25.93), LMS-CL (Mean = 24.28), and Web-IL (Mean = 22.62). In addition, the mean results for the final exam, quizzes, and weekly assignment were 27.25, 4.25, and 16.02, respectively.

Table 1. The descriptive statistics results.

Indicators	Mean	Standard Error (SE)	Standard deviation (SD)	Kurtosis	Skewness
Performance					
Final exam	27.25	0.75	9.45	−0.13	0.50
Online quizzes	4.250	0.09	1.23	1.26	−1.57
Weekly assignments	16.02	0.48	6.10	0.16	−0.15
LMS					
LMS-IL	33.34	0.41	5.21	−0.01	0.15
LMS-ILL	25.93	0.40	5.01	0.07	−0.32
LMS-CL	24.28	0.47	5.98	0.40	−0.34
Web					
Web-IL	22.62	0.32	4.10	−0.41	−0.03
Web-ILL	14.15	0.24	3.11	−0.18	−0.05
Web-CL	34.68	0.52	6.58	−0.23	−0.09
F2F					
F2F-IL	20.85	0.37	4.74	−0.19	−0.23
F2F-ILL	23.31	0.44	5.52	0.32	−0.71
F2F-CL	18.44	0.33	4.15	−0.59	0.00

Regression results

A multiple regression analysis was conducted to evaluate how multiple learning delivery modes can influence students' online learning performance. The regression analysis was implemented to determine the effect of LMS-IL, LMS-ILL, LMS-CL, Web-IL, Web-ILL, Web-CL, F2F-CL, F2F-ILL, and F2F-IL on the results of final exam, quizzes, and assignments (see Figure 1).

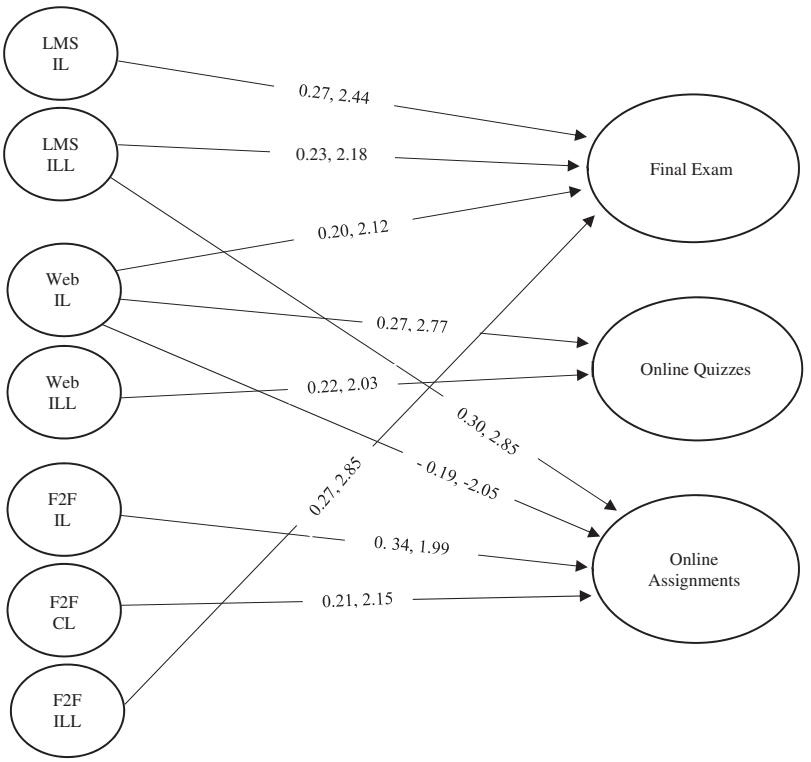

Figure 1. The finalized model.

Final exam

The effects of the three modes of learning delivery on students' final exams were found to account for 12.8% of the variance. The results of the analysis (see Table 2) revealed that four out of the nine variables were statistically significant and served as good predictors of final exam: the LMS-IL (β = 0.27, t = 2.44, $p < 0.05$) was found to affect students' performance in the final exam. In addition, LMS-ILL (β = 0.23, t = 2.186, $p < 0.05$), Web-IL (β = 0.204, t = 2.12, $p < 0.05$), and F2F-ILL (β = 0.279, t = 2.857, $p < 0.01$) were found to significantly predict students' final exam scores. This can be explained by the fact that the students were frequently using the LMS tools individually such as course learning material, assignments, and quizzes that helped them to maintain learning motivation in the course. Furthermore, it is a normal practice among university students to go to the Web for any query or information search (Dias & Diniz, 2014). Following inputs from the F2F sessions, students would quickly explore the concepts on the Web that supported their learning, thus positively influencing their final scores.

The influence of other variables such as LMS-CL, Web-CL, F2F-CL, and Web-IL were not significant on final exam scores. The interaction with peers in the three modes, sharing ideas, and asking questions without the presence of the instructor could be a valued resource for online assignments, but not for the final exam. It could be possible that students were always trying to be more independent in their online learning activities that led to the reported result. Students responded that they had less confidence when working in groups in which they were concerned about not getting high grades if they grouped with less capable peers.

Online quizzes

With regards to online quizzes, the effects of LMS, WBL, and F2F related factors were found to explain 6.7% of the variance. The results of the analysis (see Table 3) showed that Web-IL (β = 0.27, t = 2.77, $p < 0.01$) and Web-ILL

Table 2. Results of the effects of different modes of delivery on students' performance in the final exam.

Indicators	β	t	Sig.
LMS-IL	0.27	*2.44	0.01
LMS-ILL	0.23	*2.19	0.03
LMS-CL	−0.03	−0.31	0.75
Web-IL	0.20	*2.12	0.03
Web-ILL	−0.09	−0.91	0.36
Web-CL	−0.13	−1.25	0.21
F2F-CL	−0.00	−0.04	0.96
F2F-ILL	0.28	**2.86	0.00
F2F-IL	0.04	0.04	0.96

Note: *$p < 0.05$., **$p < 0.01$

Table 3. Results of the effects of different modes of delivery on students' performance in online quizzes.

Indicators	β	*t*	Sig.
LMS-IL	−0.11	−1.03	0.30
LMS-ILL	−0.02	−0.01	0.98
LMS-CI	0.04	0.39	0.69
Web-IL	0.27	**2.77	0.00
Web-ILL	0.22	*2.03	0.04
Web-CL	0.02	0.26	0.79
F2F-CL	0.09	0.79	0.42
F2F-ILL	0.03	0.36	0.71
F2F-IL	0.00	0.00	1.00

(β = 0.22, t = 2.03, $p < 0.05$) had a significant effect on students' online quizzes scores. This sheds light on that the student score in online quizzes would be affected positively if they used Web materials and tools to learn individually, thus facilitating the completion of online quizzes.

Online assignments

The LMS, WBL, and F2F related factors were found to explain a total of 12.5% of the variance related to students' performance in online assignments. We found that the LMS-ILL (β = 0.30, t = 2.85, $p < 0.01$) had a significant effect on students' online assignments scores. In addition, the result revealed that both F2F-CL (β = 0.23, t = 1.99, $p < 0.05$) and F2F-IL (β = 0.08, t = 0.03, $p < 0.05$) had positively predicted students' online assignments scores. In contrast, Web-IL (β = −0.19, t = −2.05, $p < 0.05$) was found to negatively affect students' performance in online assignments (see Table 4).

Discussion

In this study, the students reported that the usage of LMS in terms of LMS-IL and LMS-ILL had a positive effect on their final exam scores. This may be reasoned to the students' use of different LMS methods and tools (such as the

Table 4. Results of the effects of different modes of delivery on students' performance in online assignments.

Indicators	β	*t*	Sig.
LMS-IL	−0.04	−0.40	0.68
LMS-ILL	0.30	**2.85	0.00
LMS-CI	−0.15	−1.32	0.18
Web-IL	−0.19	*-2.05	0.04
Web-ILL	0.18	1.73	0.08
Web-CL	0.07	0.74	0.45
F2F-CL	0.23	*1.99	0.04
F2F-ILL	−0.06	−0.69	0.49
F2F-IL	0.218	*2.159	0.032

syllabus, calendar, and grades, learning material, assignments, and quizzes), which helped them to complete their learning tasks effectively, thus influencing their final scores. This finding is supported by Gašević, Dawson, and Rogers (2016) who reported a significant positive effect of LMS tools on student performance. Furthermore, the results revealed that students were concerned about downloading online materials, take notes at their pace, and prepare assessment tasks. As the use of online recorded lectures as a supplement to F2F lectures is common (Williams, Birch, & Hancock, 2012), it is possible that students who used the additional recorded lectures are likely to perform better in their final exams than students who were only attending lecture sessions (Day & Foley, 2006). LMS-ILL produced a significant positive effect on the students' final exams. The results of this study supports the findings of some previous works that have shown that students' participation in online homework and quizzes can improve their performance (Baxter & Thibodeau, 2011; Orenstein, 2014; Trost & Salehi-Isfahani, 2012). Earlier studies on LMS have reported a positive association between assignments and final scores (Johnson & McKenzie, 2013; Titard, DeFranceschi, & Knight, 2014; Trost & Salehi-Isfahani, 2012). These studies assumed that providing constant feedback could motivate students to progress in online tasks (Gutarts & Bains, 2010).

Students' learning from the Web individually (Web-IL) had a positive effect on their performance in terms of final exams and quizzes. Theoretically, Web resources are believed to provide students with an unlimited informal content interaction that can enhance their engagement and improve their examination scores. It also could play a fundamental role in acquiring appropriate contents that help practice for learning and facilitate the completion of online quizzes (Mosharraf & Taghiyareh, 2016). This finding is supported by Ngoumandjoka (2013) who emphasized the role of different Web tools in promoting students' learning and knowledge acquisition. The negative effect of Web-IL on students' online assginemts can be due to the unsupervised browsing of the Web resources and social networks that provided the students with different contents or different answers to similar questions, thus increasing cognitive load among students.

We also found that F2F-ILL had a significant positive effect on students' final exam, while F2F-IL and F2F-CL had a significant positive effect on students' online assignments. It is well established in the literature that successful students are those who attend more F2F lectures (Fitzgibbon & Prior, 2006). In a blended learning setting, Akkoyunlu and Yilmaz-Soylu (2008) examined the perception of 34 students with respect to their learning styles. They indicated that F2F mode had the highest grade of students' perceptions and learning was best linked to this mode. Orenstein (2014) found that the F2F interaction within the blended learning was more significant in relation to the final course grade. They placed a high value on F2F interactions with the instructors asking

questions to stimulate problem-solving skills, which could lead to better learning experience through connecting the students and making them actively engaged in the learning process. In addition, the positive effect of F2F-IL and F2F-CL on students' completion of online assignments can be explained by the availability of other colleagues, peers, friends out of class, and family members, who regularly engage with the students to provide interpersonal support, which reflects positively on their learning and online assignment scores (Anderson, 2008). Previous studies supported the view that F2F-IL can help to build student engagement and interaction in blended learning environments (Brown, 2009; McDonald, 2012). These studies indicated that the relationship between students' interaction and their sense of belonging to the community in blended courses is the result of their collaboration in a problem-solving task.

Although this study proposed the effect of different learning modes on students' online learning performance, further research on the role of certain behavioral and organizational factors in certain modes of learning delivery needs to be conducted. In addition, future works may also consider the possibility of triangulating present work results with other performance measurement techniques.

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APPENDIX A QUESTIONNAIRE FOR LMS, WBL, AND F2F LEARNING MODES

- **Learning Management System (LMS)**

Construct	Items
Individual Learning in LMS (LMS-IL)	I use the Blackboard system as an autonomous learning tool.
	The interactive E-book instructional videos in Blackboard system are helpful for me.
	I follow my own learning plan viewing the course in blackboard system
	The interactive E-book in the Blackboard system is suitable to the way I learn.
	I view the weekly-recorded sessions for lectures in Blackboard system on my own to assist my learning.
	I download weekly presentations from Blackboard system to assist my learning.
	I learn best from the printed textbook of this course from Blackboard system.
	I summarize my learning in Blackboard to examine my understanding of what I have learned.
	I find the Blackboard materials helpful for my learning.
Individual Learning Evaluation in LMS (LMS-ILL)	It is easy to use the interactive E-book to do the course homework in the Blackboard system.
	I practice exercises using the Interactive E-book in the Blackboard system to enhance my learning
	Using E-book exercises in the Blackboard system keeps me on task in this course.
	I view the videos' examples of exercises in Blackboard system to help me in doing my homework.
	Using examples of E-book exercises in the Blackboard system helps me to prepare myself for exams and quizzes.
	Regularly I do my homework weekly in Blackboard system alone.
	Usually, I check my grades in Blackboard system.
Collaborative Learning in LMS (LMS-CL)	I use the Instant messaging (IM) to contact my classmates in the Blackboard system.
	I participate in chats with my classmate during virtual classroom Blackboard system.
	I use email feature on Blackboard system to contact my classmates if I have questions regarding the course.
	I use email feature on Blackboard system to get help when I do not know how to solve the exercises and quizzes.
	I post in discussion boards in the Blackboard system regularly.
	I use discussion boards for the course in the Blackboard system when I don't understand the materials or assignments
	I find that the solutions and responses to questions posted in the Blackboard system discussion board are more helpful to my learning.

- **Web-Based Learning (WBL)**

Construct	Items
Individual Learning on the Web (WBL-IL)	I learn the course best from videos lectures of the university's YouTube channel by myself.
	I prefer to learn course from other YouTube channels by myself.
	I find the web-based materials are helpful for my learning.
	I continuously search for new instructional websites that help me in my study.
	Browsing instructional websites helps me to understand the course.
	I use the web-based materials as an autonomous learning tool.
Individual Learning assessment on the Web (WBL-ILL)	I practice exercises on instructional websites to help me before doing my homework and quizzes on Blackboard.
	I practice the exercises on instructional website to help me to prepare myself for exams and quizzes.
	I search on websites when I do not know how to solve the exercise and quizzes.
	I relay on other e-books to help me in studying for final exam.
Collaborative learning on the Web (WBL-CL)	I share my course problems with my classmates in the university discussion board.
	I find that the solutions and responses to questions posted in the university discussion boards are more helpful to me in learning.
	I find that the solutions and responses to questions posted in the other discussion boards are more helpful to me in learning.
	Previous students help me on my homework and quizzes in other discussion boards.
	I communicate with my classmate to study the course lectures by using social network.
	I find solutions and responses posted by students on Social Network helpful for my learning.
	I join my university students' Facebook groups to get help if I have questions regarding the course.
	I use twitter to contact my classmates if I have questions regarding the course.
	I usually use WhatsApp groups to contact my classmates if I have questions regarding the course.

- **Face to Face (F2F)**

Construct	Items
Instructor–led learning Face to Face (F2F-ILL)	Face-to-face lectures greatly contribute to my learning in this course. I learn the course best when I interact face-to-face with the instructor. The instructor is helpful in guiding the class towards understanding course topics. The instructor helps to keep the course participants on task in a way that helps me to learn. My instructor provides explanations to help me to understand the content of the course. My instructor provides feedback to the class during the discussions to help us to learn.
Collaborative Learning in Face to Face (F2F-CL)	The face-to-face studying groups can assist my learning performance. I communicate with my classmate's face to face to study the course lectures. I participate actively with my classmates in small groups to study. I meet the previous students to ask them about the course. I study the course in face-to-face groups to get help when I do not know how to solve the exercises and quizzes.
Individual Learning in Face to Face (-F2F-IL)	I receive a lot of help from my family members to learn this course. I ask my family members to help when I study for this course. I ask my family members when I don't understand the course content or assignments. I contact other friends if I have questions regarding the course. I find someone who is knowledgeable in the course content to consult when I need help. I learn from a tutor to help me in studying the course.