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Effectiveness of online presence in a blended higher learning environment in the Pacific

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ABSTRACT

The widespread use of technology has facilitated many changes in the education sector including higher education. Academic institutes are concentrating their efforts on measuring the level of student engagement and participation in online learning environments for student success. This paper analyses student log data to quantify the effectiveness of online presence on student performance in a blended course using frequency and duration as indicators. The analysis shows both frequency and duration having a statistically significant impact on the students' final marks. The study proposes a multiple linear regression model using these measurements to predict the final mark of students in a blended learning environment. The predictive regression model, explained through the use of two new models; Online Measurable Presence Model (OMPM) and Slingshot model, can be used to determine the effectiveness of student online presence for success in a blended higher learning environment in the Pacific.

KEYWORDS

Online presence; higher education; online measureable presence model; slingshot model; blended; Pacific

Introduction

The acronym ICT refers to Information and Communication Technologies which can be described as the human interaction through the use of computing or technological devices (Margaret 2005), and their enormous growth has deeply impacted the education landscape in the last three decades (Latchem 2017). The integration of ICT into education has brought forward a variety of learning environments ranging from a stand-alone computer in classrooms to a pre-packaged computer technology (Margaret 2005; Youssef and Dahmani 2008), establishing a need to redesign courses and re-engineer their delivery modes.

The spread of digital media has introduced broad changes and new skills into teaching and learning processes while re-designing courses for different modes of delivery. Siemens (2013) and Buckingham (2007) state that digital media has allowed ubiquitous access to resources and virtually infinite amounts of information to people, as well as affording new forms of sociality, play, creativity, social activism, networking, and collaboration. With technology seen as the prime driver of pedagogical changes, many education providers have acknowledged the new digital media and introduced new methods of learning in their curriculum (Latchem 2017; Youssef and Dahmani 2008). The new digital environment has enabled changes in learning modes from teacher-centered traditional learning to self-paced and self-directed learning, and has invariably facilitated a significant change to the distance education (Huang, Yang, and Hu 2012; Youssef and Dahmani 2008; Conijn et al. 2017; Baragash and Al-Samarraie 2018). Traditional distance learning has been transformed to a real-time web-facilitated learning where ICT tools are flawlessly integrated to deliver educational content to

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students. Transformation has been necessary because of issues, but not limited to, lack of support from facilitators, feelings of isolation, lack of student motivation and insecurities about learning which led to high dropouts (Sharma et al. 2015; Youssef and Dahmani 2008; Zacharis 2015).

Higher Education Institutes (HEI) have adopted the web-facilitated distance learning models to meet the growing demand for distance education, and reduce the barriers to distance and flexible learning. This method of learning, denoted as eLearning, also actively promotes student-centered learning and offers new and more flexible methods of teaching and learning (Sharma et al. 2015; Youssef and Dahmani 2008; Zacharis 2015; Baragash and Al-Samarraie 2018). A number of studies conducted recently on eLearning indicate that online presence has a significant influence on students' learning and achievement (Dixson 2010; Moore 2014; Vaughan 2014; Zacharis 2015; Yang et al. 2016; Conijn et al. 2017; Mwalumbwe and Mtebe 2017; Baragash and Al-Samarraie 2018). This opens up a window of opportunities to determine the best indicators or measurements of online presence for student success, and consequentially redesign courses for different modes of delivery. The aspirations of HEI in the Pacific remain the same, if not deeper and more pronounced from the viewpoint of the smallness and remoteness of the Pacific Island countries (PICs) (Sharma et al. 2015).

The Pacific region comprises 22 island countries with a total population of 11 million people spread across 33 million square kilometers of the Pacific Ocean (Pacific Community 2017; Reddy et al. 2016). The PICs are classified as developing countries by the World Bank because they lack proper (or complete) infrastructure and have lower living standards, human development indexes and economies (World Bank 2016). While each regional country has its own priorities, a shared commitment of the Pacific region is to create twenty-first century learners for the globalized world, and help mobilize societal transforms and cultural changes (Sharma et al. 2015). This is also in line with the Sustainable Development Goals (SDGs). Therefore, each country invests heavily in ensuring quality education for all its people. The HEI in the Pacific are also looking into ways how the ICT tools and technologies can be utilized to deliver quality education equitably throughout the region, focusing more recently on blended and online modes of delivery with associated institutional research to find out what works best in these delivery modes (Bhartu and Yusuf 2016; Nabobo-Baba, Lingam, and Dakuidreketi 2014; Raturi 2014; Jokhan, Sharma, and Singh 2018).

In this research paper, to better understand the role of various elements of online presence in students' performance in a blended course in higher education in the Pacific, we formulated the following questions:

(1) Is there a relationship between the total number of times a student has accessed the topic and his/her final marks?
(2) Is there a relationship between the total time spent by a student in a topic lesson and his/her final marks?

Literature review

Learning management system

A learning management system (LMS) is a software-based system used for the administration, documentation, tracking, reporting and delivery of educational courses and student interaction through online means (Dougiamas and Taylor 2003; Sclater 2008; Zacharis 2015; Conijn et al. 2017; Mwalumbwe and Mtebe 2017; Baragash and Al-Samarraie 2018). One very popular LMS in HEI is the modular object-oriented dynamic learning environment (Moodle), which can be used in many types of environments such as education, training and development and in business settings (Dougiamas and Taylor 2003; Zacharis 2015; Conijn et al. 2017; Mwalumbwe and Mtebe 2017). It is also a platform for teaching and learning that can be used to supplement face-to-face (F2F) courses or online courses or even facilitate a combination of both of these modes in form of a blended learning environment (Zacharis 2015; Conijn et al. 2017).

Blended learning and its requirements

Traditional blended learning, also known as hybrid learning, is the combination of online activities and face-to-face instructions (Graham 2013). However, in recent years blended learning has evolved to a rich blend of effective and social opportunities of face-to-face classes with a technology-enhanced online environment (Graham 2013; Graham, Woodfield, and Buck Harrison 2013; Watson 2008; Zacharis 2015; Conijn et al. 2017; Baragash and Al-Samarraie 2018). Therefore, presenting an opportunity for the blended learning requirements to focus on the technology enhanced elements such as the instructional strategies to a greater extent. Relevant models governing different forms of blended learning are discussed next.

Figure 1 illustrates the different blended learning forms such as *Rotation*, *Flex*, *Self-blend* and *Enriched Virtual* that have been designed recently for primary and secondary school sectors (Staker and Horn 2012, 2014; Staker 2011), from which two (Rotation and Enriched Virtual models) are relevant to HEI while the other two are educationally feasible (Pandit 2012; Friesen 2012). In the *Rotation model*, students rotate between different stations on a fixed schedule, either working online or spending F2F time with the teacher in a course (Staker and Horn 2012; Horn and Staker 2011). Some activities carried out through this model are small-group or full-class instruction, individual tutoring, group projects and assignments.

The courses which support a large number of non-traditional or at-risk students often choose the *Flex model* (Staker and Horn 2012). Within this approach, content and instructions are primarily delivered online. The teachers are present to provide F2F support as needed, while learning is primarily self-guided as the students independently learn and practice new concepts in a digitally enriched environment.

The *Self-blend* model gives students the opportunity to take courses to another level (Staker and Horn 2012). While the students will attend a traditional F2F environment, they also opt to supplement their learning through online courses offered remotely. In order for this pedagogical model to be successful the students must be highly self-motivated. The self-blend model is ideal for students with interests in a subject area that is not covered in the course curriculum.

The *Enriched Virtual model* is used in a course where students have to attend F2F learning sessions with their teachers and then are free to complete their remaining coursework remotely via the online

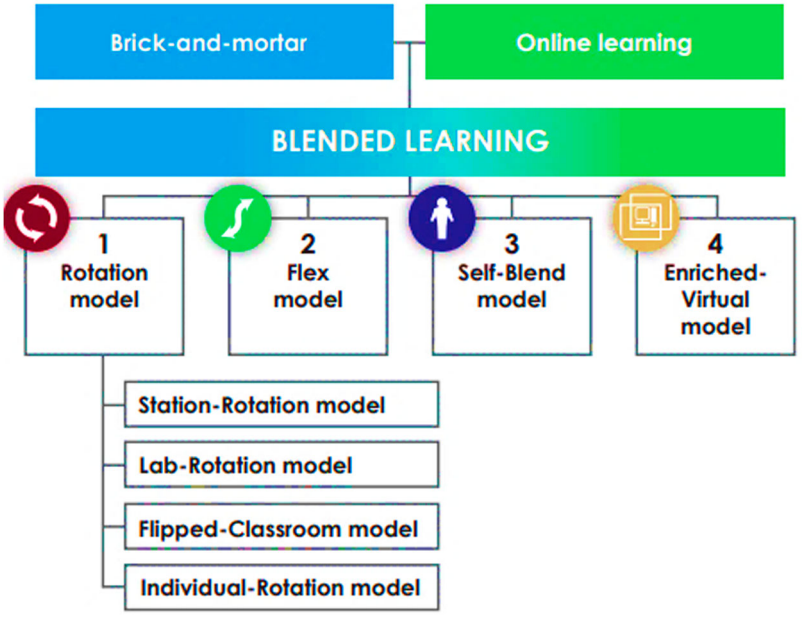

Figure 1. Different blended learning models. (Adopted from Source: (Staker and Horn 2012)).

mode (Horn and Staker 2011; Staker and Horn 2014). In this model, the online mode is the backbone of student learning when the students are located remotely. The model differs from the flipped classroom because the students seldom meet F2F with their teachers. It also differs from fully online courses and programs because the F2F learning sessions are mandatory (Horn and Staker 2011; Staker and Horn 2014).

There are many advantages of blended learning; however, in the interest of brevity, we will only discuss the 4 main ones which are categorized as ease of use, independence, advanced learning and flexibility (Welker and Berardino 2005; Zacharis 2015). Students are likely to interact more with the instructor and peers since there are numerous opportunities to do so in F2F class and the online environment. Students can participate more in class discussions since they can choose the environment (online or face-to-face) in which they feel more comfortable. Students often develop or enhance skills in time management, critical thinking, and problem-solving and have timely access to content (Welker and Berardino 2005;). Then, students can acquire useful skills from using the Internet and computer technology as advanced learning. Finally, the students have more time flexibility, freedom and convenience working at preferred times online from their home that also decreases commuting and parking troubles.

On the other hand, there are disadvantages of a blended learning environment which are explained below through different categories (Cucciare, Weingardt, and Villafranca 2008; Welker and Berardino 2005):

- *Confusion:* Ineffective use of the technological tools in learning can be wasteful. If facilitators and employees are unaware of how to use the learning technology on hand they probably will not get the results they are looking for, and students can get confused due to unclear or confusing instructions.
- *Social Interaction:* Students achieve reduced interaction with their peers and teachers if the learning environment is not well structured and its important features missing.
- *Access*: There can be delay in responses from teachers in the asynchronous environment for question related matters where due to time-bound modules accessibility of the resources such as reference materials are hindered.
- *More Work*: There is a lot more reading by students to attempt their activities such as supplementary reading to accomplish a dedicated task or activity.
- *ICT Competencies*: The facilitators and learners must have sufficient ICT knowledge and a willingness to learn in blended environments. Some may not be familiar with technology and hence have an additional learning curve ahead of them.
- *High Technology Setup & Maintenance Costs*: Purchasing the learning technology such as devices and infrastructure setup for blended learning programs can be very costly.

To eliminate the aforementioned drawbacks a suitable model needs to be chosen and appropriate training conducted to make blended learning work with students. One also needs to have support on hand to teach new online learners and motivate those who may be reluctant to communicate and engage online (Welker and Berardino 2005; Zacharis 2015; Baragash and Al-Samarraie 2018). Figure 2 shows a roadmap for blended learning at The University of the South Pacific that incorporates the university's requirements of blended learning into different clusters for effective equitable learning in the Pacific. The new roadmap builds on the framework constructed by Singh in 2003 which had shown different ingredients for successful blended learning programs, and contextualizes it for the Pacific.

For blended learning to be successful in the Pacific, Figure 2 presents 6 essential ingredients: Technology, Management, Pedagogy, Resource Support, Interface Design and Institution. These 6 categories have specific elements that interplay to deliver a helpful guide for successful course delivery in a blended learning environment, especially in the Pacific region. We do note that many of the elements featuring in the roadmap are gathered from student feedback surveys conducted at The University of the South Pacific over the years, while the success and failure of pilot blended courses in The University of the South Pacific and the staff feedback have also helped in the final

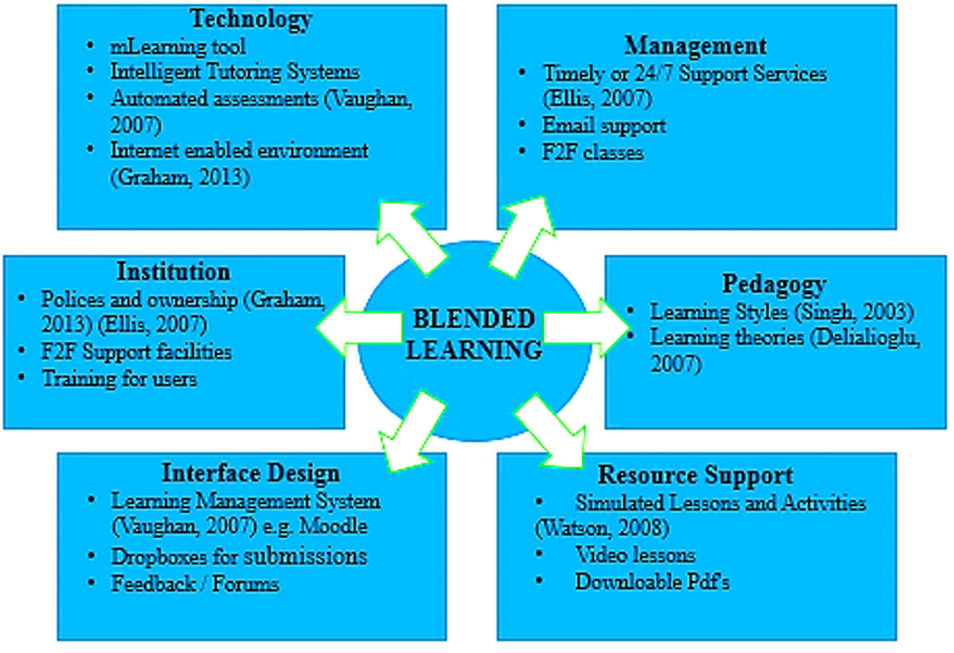

Figure 2. Roadmap for successful blended learning in the Pacific.

design. All-in-all, every element is of specific importance to each category and a missing element can easily result in a failure of the blended course. Therefore, proper planning and resourcing are needed for a successful implementation of blended learning in the Pacific.

Background

The University of the South Pacific is a regional multi-campus, multi-modal higher education institution operating since 1968, with a student cohort of more than 29,000 populating its 14 campuses and 11 centers (Chandra 2017; The University of the South Pacific 2015). The 'University' is collectively owned by its 12 member countries – Cook Islands, Fiji Islands, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu spread over the Pacific Ocean (see Figure 3). The population of these countries range from a high 867,000 (Fiji Islands) to a low 1160 (Tokelau). The land area also varies significantly, the smallest being Tokelau with a land area of about 12 square kilometers (Pacific Community 2017).

Each 'University' member country houses at least one campus, which usually varies from others in size and student population, support services and facilities, infrastructure, and, modality of courses and programs. The smaller centers are a part of the larger campuses normally spread across remote locations or based in the outer islands of some regional countries. The main campus, Laucala Campus, is located in Suva (Fiji Islands) and has the highest headcount as the hub of the University's administrative, academic and commercial operations (Sharma et al. 2015; The University of the South Pacific 2015). The main campus also coordinates and facilitates most of the courses and programs in online and blended modes offered in the region through Moodle.

Methodology

This exploratory research design utilizes mixed methods; a blend of different qualitative and quantitative research methods which explore the effectiveness of online presence of students in a blended course through an array of data collection methods and statistical analysis. The advantage of adding a

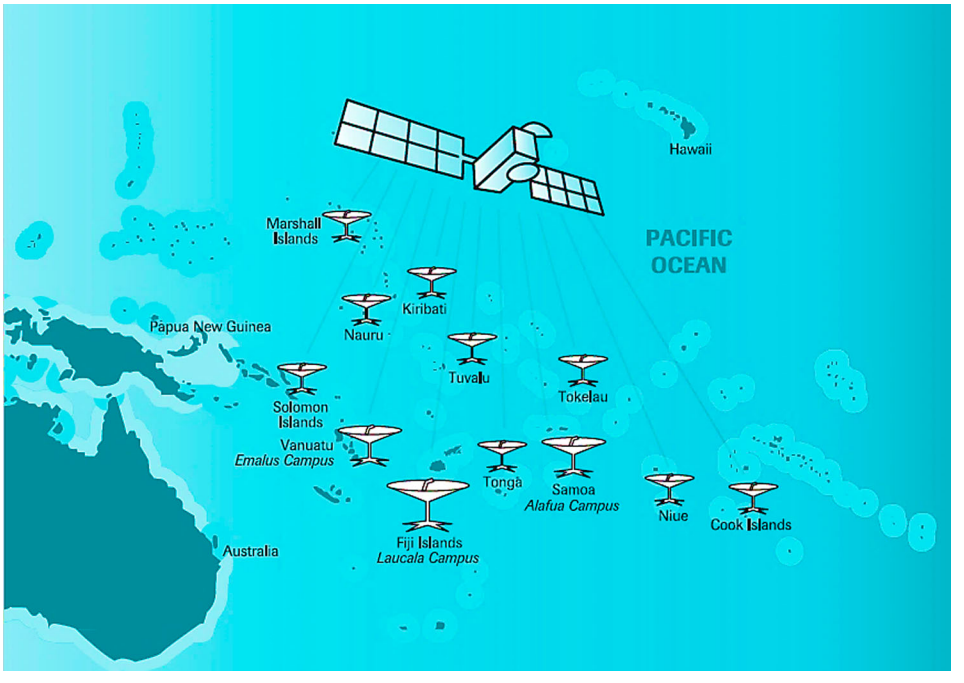

Figure 3. The University of the South Pacific's campuses and centers in the member countries connected using satellite telecommunication. (The University of the South Pacific 2015).

qualitative component to the research is that it offers a complete description and analysis of a research subject, without limiting the scope of the research and the nature of participant's responses (Collis and Hussey 2003).

Settings

The blended course chosen from The University of the South Pacific for this Study is UU100 – Communication and Information Literacy. It is a 14-week first year course offered in blended and online modes at all the campuses and centers of the university. The aim of this course is to ensure that all incoming students develop knowledge and competence in the use of computers and information resources. The course is designed to address the broader imperative for students to develop their capacity to locate, access, evaluate and use information efficiently and effectively (Reddy and Sharma 2015). UU100 comprises of a number of assessments including topic assessments, online quizzes, assignments and e-portfolio activities, the majority of which have to be submitted online through the Dropbox in Moodle. The topic assessments include topic lesson which comprises of topic notes, videos and reinforcement questions; and topic activity which can be either a quiz, Dropbox or a question/answer forum (Reddy and Sharma 2015).

Different measures of online presence

Researchers have chosen different sets of variables to measure the online presence in blended environments for their research based on factors such as LMS, online tools, course website design and learning analytics.

For example, Mwalumbwe and Mtebe (2017) generated a prediction model for student performance based on LMS, which made us aware of different variables utilized in the Learning Analytic Tool. The model showed that exercises and forum posts were the only 2 variables to impact student

Table 1. Different variables of LMS at The University of the South Pacific (Modified from Source: (Mwalumbwe and Mtebe 2017)).

	Variables	Description	Source
1	Total login frequency in LMS	Adding up the number of individual student's login time into the LMS	Mödritscher, Andergassen, and Neumann (2013), Yu and Jo (2014), Korkofingas and Macri (2013)
2	Time spent in the LMS	Calculating the total amount of time spent between login and logout	Davies and Graff (2005), Mödritscher, Andergassen, and Neumann (2013), Yu and Jo (2014), Delialioglu and Yildirim (2007)
3	Number of downloads	Adding up the numbers of course materials downloaded	Yu and Jo (2014), Korkofingas and Macri (2013)
4	Interactions with peers	Counting the total number of student's postings responding to peers	Mödritscher, Andergassen, and Neumann (2013), Yu and Jo (2014)
5	Number of online exercises performed	Counting number of exercise a student has done	Mödritscher, Andergassen, and Neumann (2013), Korkofingas and Macri (2013)
6	Number of online forum posts	Counting a number of posts a student has contributed in the discussion forums	Davies and Graff (2005), Yu and Jo (2014)
7	Number of topics visited	Counting number of times topics visited	Delialioglu and Yildirim (2007)
8	Time spent on each topic	Calculating the total amount of time spent on topics	Delialioglu and Yildirim (2007), Korkofingas and Macri (2013)

performance which motivated us to explore other variables such as frequency and duration in detail on their impact on student's final performance.

Motivated by the influential work of Mwalumbwe and Mtebe (2017) and keeping in mind behaviorism and learning styles of Pacific students, this research considered a set of variables that were only captured through Moodle. These are listed under Table 1 with their sources from the literature. The sources in Table 1 validate the reliability of these variables as effective indicators of online presence. Then from correlation analysis some of the variables were disregarded because of a high correlation between these variables may have resulted in multicollinearity. Therefore, we selected frequency and duration as our main variables. In addition, instead of looking at login and logout data for the LMS, we have focused our research on login and logout data of individual topics and activities incorporated in a selected blended learning environment. The reason for exploring the frequency and duration of lessons and activities is to obtain a comprehensive insight into students' performances based on their real interaction.

Data collection and analysis

The qualitative data were collected through an online questionnaire from the Google docs, while the quantitative data were extracted from the Moodle logs. The participants for the online questionnaire were same students who are part of quantitative research. The Moodle log data was collected as a comma separated values file (csv) and a Structured Query Language (SQL) file for analysis. The participants were made aware that their identification, responses to the questionnaire, and Moodle logs would be confidential. The student activities on the course website or course shell were tracked through the Moodle log system. Moodle log stores the click history of each student, that is, it stores the user identification number, login frequency and the start and end time of the topics. Through Moodle, students can access course information, class presentations, and activities. It is also used to administer tests, quizzes and to facilitate class discussions. This project received ethics approval from the university's ethics committee for the use of student data.

Content analysis was used to analyze the data gathered from the questionnaire, and SQL and Excel with SPSS were used to analyze the data collected from Moodle logs. Content analysis allowed us to see the closed questions in the questionnaire in a better way where the remarks explain the responses.

The fit-for-purpose research for this study was an inductive one where we began with a specific observation, which led to a hypothesis. The reasons for adopting the inductive approach was that it takes into account the context where research effort is active, and it is also most appropriate for

Table 2. Different ranges of the two variables of LMS at The University of the South Pacific.

No.	Variables	Low impact	High impact
1	Frequency	• At most 6 out of 13 topics visited • At most 6 out of 13 activities visited	• At least 7 out of 13 topics visited • At least 7 out of 13 activities visited
2	Duration	• At most 6 out of 13 topics completed • At most 6 out of 13 activities attempted	• At least 7 out of 13 topics completed • At least 7 out of 13 activities attempted • At least 7 out of 13 quizzes completed while going over the lesson

small samples that produce qualitative data. Later, the deductive approach was used to test the hypothesis.

Over 3 million records were retrieved from the Moodle log data in SQL format. Due to the chaotic nature of the log data, data cleaning and data reduction processes were performed using SQL and Microsoft Excel. Upon completion of the processes, a sample of 873 students was obtained to represent the population. The variable, Total_Frequency was obtained by adding the number of times the students had accessed a particular topic. In a similar manner, the second variable, Total_Duration was calculated by taking the sum of the time spent on each topic. Table 2 illustrates the range (low-high impact) of the two variables selected from Moodle at The University of the South Pacific. Students who complete up to 6 topics only and attempt 6 or less activities have less chance of attaining a pass grade in the course. Thus, a low-high cutoff value of 6 was selected. The final results analysis was obtained from the course coordinator to identify the final grades of the students.

Demographics

The demographics of the 873-student sample is provided in Figure 4 that contains measurements of gender, campus and delivery mode of the course. Majority of the participants were females 60% (524/873) compared to 40% (349/873) males. A dominant 53% (463/873) of the participants were from Laucala Campus, followed by 14% (122/873) from Vanuatu. It is also noted that some 53% (463/873) of the participants had enrolled in the blended mode whereas the remaining 47% (410/873) were in the online mode of study.

For the qualitative data, the demographics of 1054 participants are shown in Figure 5 that contains measurements of campus, gender, internet medium, internet frequency and communication medium. The majority of the participants 80% (841/1054) were from the main campus in Fiji. In

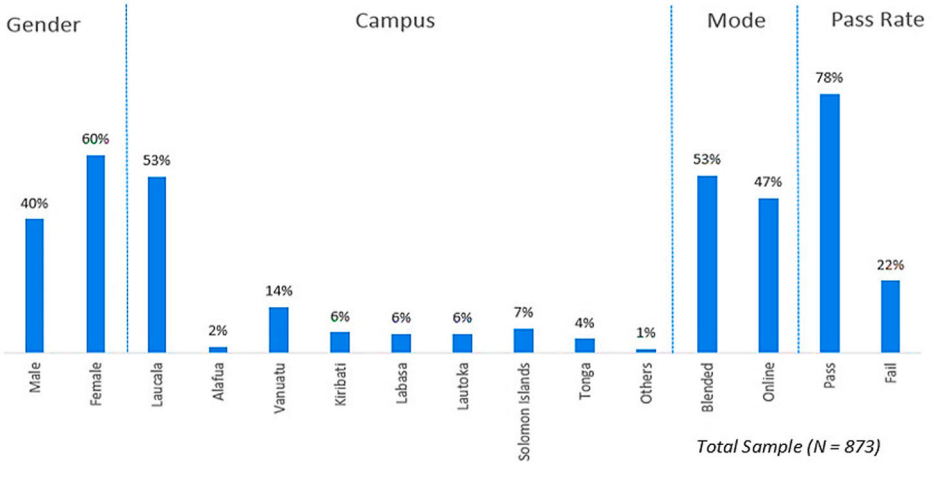

Figure 4. The demographic profile of the survey participants from the quantitative data.

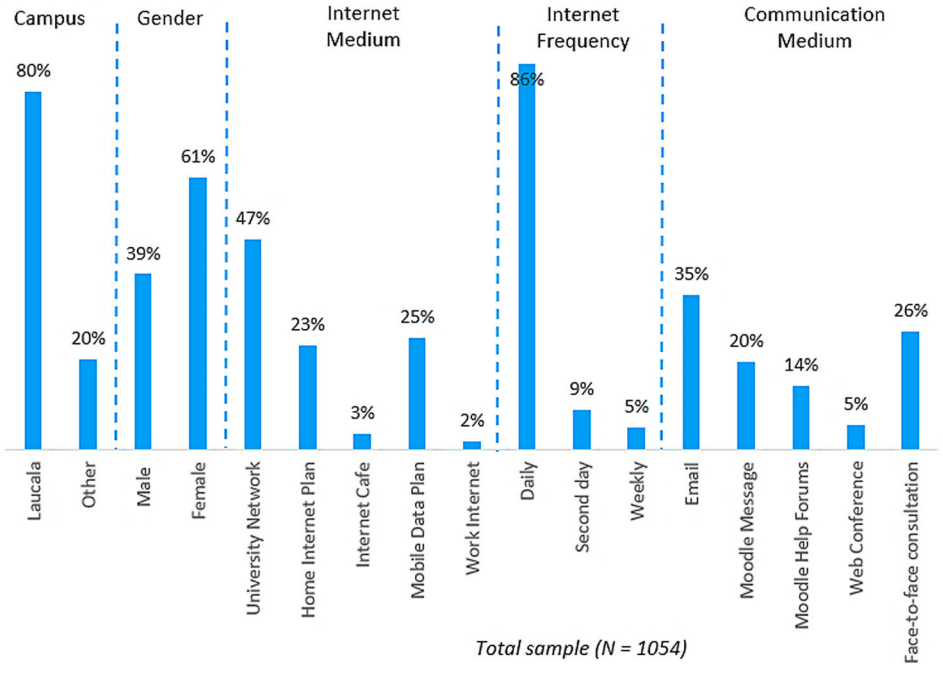

Figure 5. The demographic profile of the survey participants from the qualitative data.

addition, there was more female participation 61% (641/1054) compared to males 39% (413/1054). The students used a variety of media to access the internet: most students (47%) used the university network, followed by mobile data plan (25%), home internet plan (23%), internet café (3%), and finally work internet (2%) being the least used medium. Regarding frequency of access to internet, a majority 86% (910/1054) of the participants used the internet daily, 9% (93/1054) accessed the internet every second day, while some 5% accessed the internet once a week. The participants also used a variety of mediums to communicate with their facilitators, including the email (35%), Moodle message (20%), help forums (14%), web conference (5%) and F2F consultations (26%).

Results and analysis

The four research-related questions which were in the form of Likert scale for the qualitative research were tested for validity using the Pearson Product Moments Correlations test as shown in Table 3.

The r value for $N = 70$ at 5% significance level is 0.235.

For Item 1 (3a), since $p = .00 < .05$ and the $rxy = 0.663 > r$ value, it can be concluded that item 1 is valid. Similarly, all other items 3b, 3c, 4b, 4c, 5a, 5b, 5c, 6a, 6b and 6c are deemed to be valid.

The following steps were used to analyze the data for the quantitative research:

Step 1: Data cleaning
Step 2: Normality testing
Step 3: Data visualization using Scatter Plot
Step 4: Correlation analysis
Step 5: Hypothesis testing
Step 6: Designing a Prediction model

In Step 1 the data were cleaned using Microsoft Excel, Microsoft Access and SQL. The data were then analyzed using IBM SPSS-21. Step 2 involved the normality test conducted using the

Table 3. Validity test using Pearson product moments correlations.

Questions	3a	3b	3c	4a	4b	4c	5a	5b	5c	6a	6b	6c
Pearson Correlation	**.663****	**.651****	**.586****	**.588****	**.563****	**.466****	**.667****	**.670****	**.589****	**.589****	**.462****	**.353****
Sig. (2-tailed)	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.003**
N	70	70	70	70	70	70	70	70	70	70	70	70

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Test of normality.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FinalMarks	0.205	873	0.000	0.835	873	0.000
Total_Frequency	0.042	873	0.001	0.992	873	0.000
Total_Duration	0.044	873	0.000	0.977	873	0.000

Kolmogorov–Smirnov and the Shapiro–Wilk tests. The results in Table 4 show that the data were not normal ($p = .000 < .05$).

In Step 3 the data were represented using scatter plots. A linear relationship between the Total_Frequency and FinalMarks is seen from the scatter plot in Figure 6 which also shows that students with total frequencies between 0 and 20 ($0 \leq$ Total_Frequency ≤ 20) have mostly achieved final mark below 40. Another interesting observation is that a large cluster of students with total frequencies between 40 and 80 are shown to have generally done well, scoring final marks above 60. In Figure 7, the data points seem more scattered; however, a linear relationship is still observed. A large number of students have spent between 400 and 1200 min in this blended course and have generally done very well. The students with very high total duration (Total_Duration > 1200 min) have scored very high Final_Marks. Interestingly a few students scored low Final_Marks despite having very high Total_Duration.

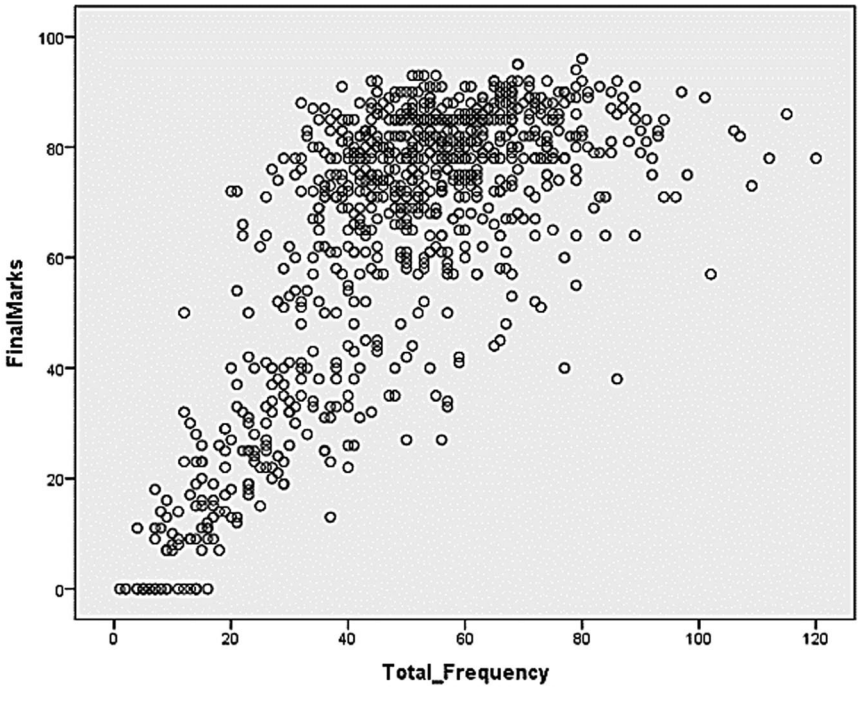

Figure 6. Scatter plot for total frequency and final marks.

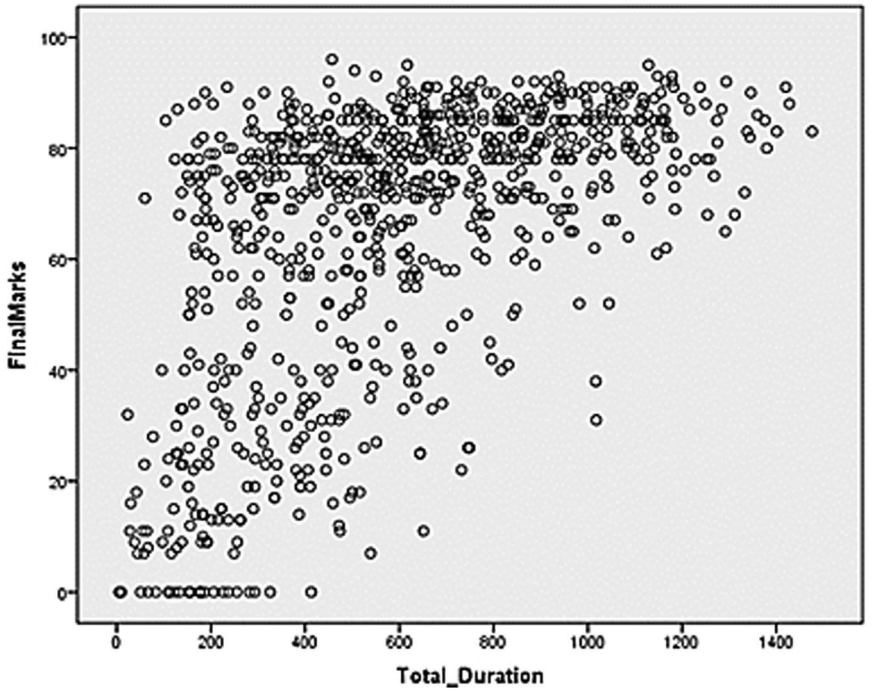

Figure 7. Scatter plot for total duration and final marks.

In Step 4, the associations between the Total_Frequency and FinalMarks, and the Total_Duration and FinalMarks were investigated using the Spearman's ranked correlation test. Table 5 shows a moderate correlation between Total_Frequency and Total_Duration, Total_Frequency and FinalMarks, and Total_-Duration and FinalMarks with a correlation coefficient of 0.447, 0.621 and 0.548, respectively.

A hypothesis test was subsequently designed in Step 5 to determine if these associations were significant. The null hypothesis (H_0) was that there is no significant association between *Total_Frequency* and *FinalMarks* and between *Total_Duration* and *FinalMarks*. There was not enough evidence to accept the null hypothesis (i.e. $p = .000 < .05$), thus, concluding that there is a significant association between each of the two variables and the final marks.

Finally in Step 6, a Multiple Linear Regression (MLR) was utilized to find a model that could be used to predict the final mark and also predict a causal relationship between the factors and final marks. The MLR modeling showed an adjusted $R^2 = 0.579$, which meant that 57.9% of the variation in the final mark could be explained by the two predictors of the study (see Table 6). Table 7 provides ANOVA which indicates a significant effect of the two predictors on the final mark at p-value = .00 < .05.

The regression provided in Table 8 shows a summary of predictive factors in terms of coefficients, B, for each variable obtained from the regression analysis. The results indicate that both variables, *Total_Frequency* and *Total_Duration* have shown to have significant positive effects on students' performance (i.e. $p = .000 < .05$) with *Total_Frequency* being the stronger of the two predictors. We construct to the following predictive model:

$$Y = 15.88 + 0.724 * \text{Total\_Frequency} + 0.023 * \text{Total\_Duration} \quad (1)$$

The model indicates that for every additional unit in *Total_Frequency* we can expect *FinalMarks* to increase by an average of 0.724 if *Total_Duration* is kept constant. Similarly, for every additional minute in *Total_Duration* we can expect *FinalMarks* to increase by an average of 0.023 if

Table 5. Correlation between variables.

			Total_Frequency	Total_Duration	FinalMarks
Spearman's rho	Total_Frequency	Correlation Coefficient	1.000	**0.447****	**0.621****
		Sig. (2-tailed)		0.000	0.000
		N	873	873	873
	Total_Duration	Correlation Coefficient	**0.447****	1.000	**0.548****
		Sig. (2-tailed)	0.000		0.000
		N	873	873	873
	FinalMarks	Correlation Coefficient	**0.621****	**.548****	1.000
		Sig. (2-tailed)	0.000	0.000	
		N	873	873	873

Table 6. Model summary.

Model	*R*	*R* square	Adjusted *R* square	Std. Error of the estimate
1	0.762[a]	0.580	0.579	16.042

Table 7. ANOVA.

Model		Sum of squares	df	Mean square	*F*	Sig.
1	Regression	309754.471	2	154877.240	601.799	0.000[b]
	Residual	223900.714	870	257.357		
	Total	533655.184	872			

Table 8. Multiple linear regression.

Model		Unstandardized coefficients		Standardized coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.888	1.528		10.400	0.000
	Total_Duration	0.023	0.002	0.287	11.738	0.000
	Total_Frequency	0.724	0.030	0.591	24.153	0.000

Total_Frequency is kept constant. It can also be noticed from the model that if a student has both the total frequency and total duration equal to zero then his/her final marks can be at most 15.88. The constant in the regression model is due to the fact that students who do not have any online presence in the course can still achieve some marks by attending the face-to-face components where the topic activities are normally assessed by the facilitators during the class itself.

A 3D plot of the predictive model is presented in Figure 8. The model shows that frequency and duration are statistically significant indicators of students' performance in a blended course in higher education in the Pacific.

A newly proposed *Slingshot model* given in Figure 9 conceptualizes the results of this research. The handle or stem of the slingshot signifies the blended learning environment where the 2 main indicators of online presence from this research study – *frequency* and *duration* are incorporated as the two branches from the stem. The two ends of the rubber strip tied to the branches signify the importance of these 2 indicators. The end with more knots around the branch is denoted as the *frequency constant* which is taken from analytics to be from the more effective indicator (*frequency*) of student final marks between the two measurements. We note that the frequency measurement incorporates all the lessons and online activities of the blended course. On the other hand, the end with less knots is denoted as the *duration constant* which is taken from analytics to be from the lesser effective indicator (*duration*) of student final marks between the two measurements. We note that the duration measurement incorporates all lessons but 5 out of the 13 online activities only. More knots indicate a high tension in the rubber strip which in turn stems a greater contribution

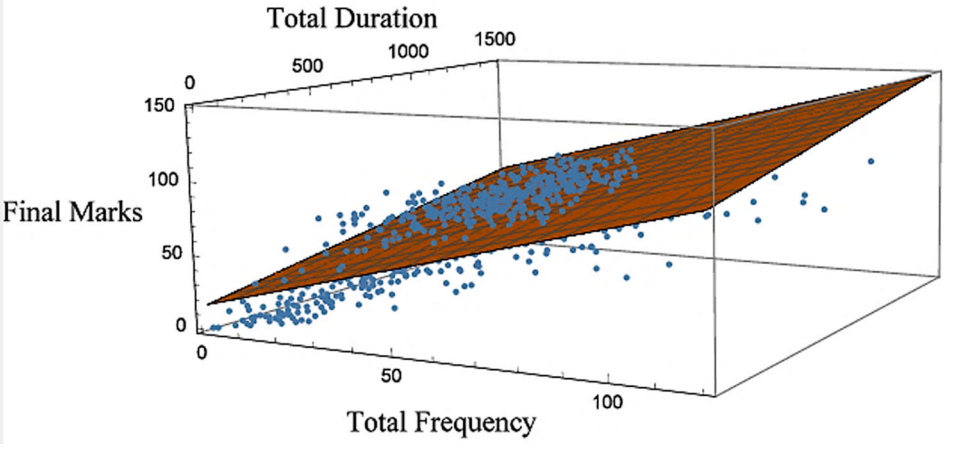

Figure 8. Visual representation of the MLR model.

to the force generated for the slingshot. The ball sitting inside the pouch is the total mark, which increases and decreases based on a student's online and F2F performances.

When the ball sitting inside the pouch is pulled with great strength (frequency and duration), it increases the chances of the better final mark. Once the pouch is released, depending on the impact level of each variable the ball may pass through the branches or not. If it goes through the

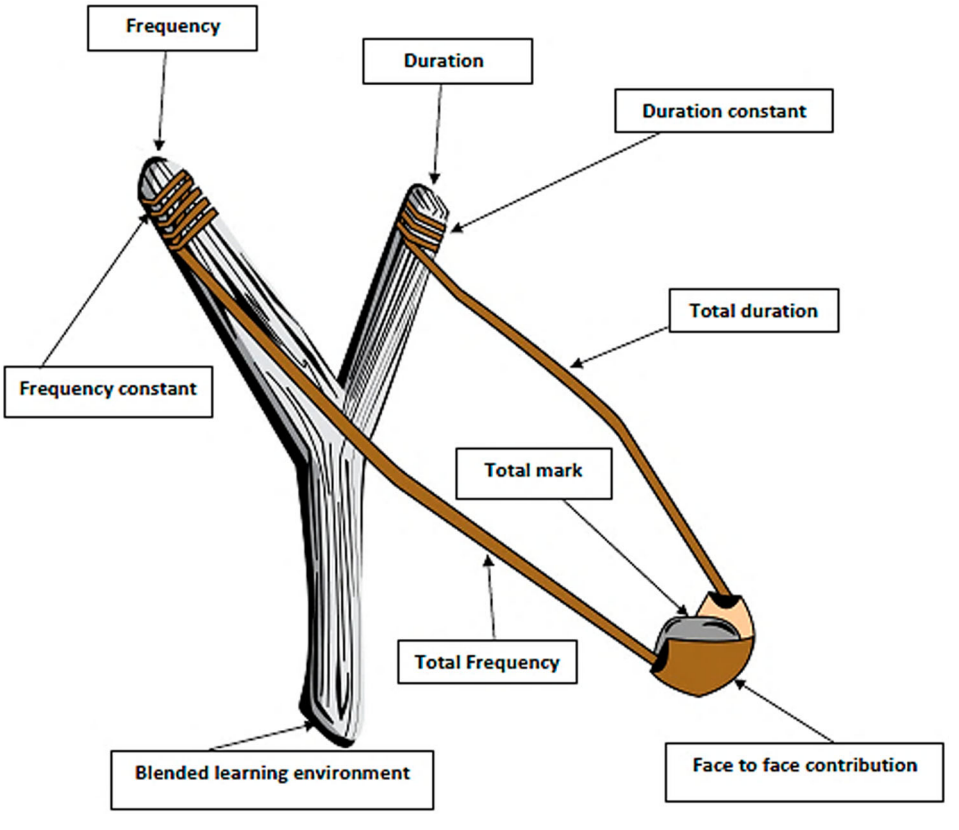

Figure 9. Slingshot model showing frequency and duration as online presence measures in a blended course.

branches the student is deemed to have performed well and this also denotes the effectiveness of his/her online presence. However, it does not mean that higher frequency and duration would guarantee better marks, it would depend on the impact factor of variables given in Table 2. Therefore, the ball may end up hitting the handles or not going through the branches and falling short of the cut-off (target). Figure 8 illustrates the cases where students with high frequency and high duration would have underperformed.

As outlined above, the analysis also show that the *Total_Frequency* has a stronger linear relationship on students' performance compared to *Total_Duration*. The factors contributing to this are:

(1) Reinforced learning through re-visits. The number of times a student accesses a topic leads to learning through reinforcement, which allows a permanent change in one's behavior. Lessons could allow more than one attempt to encourage students to gain better marks or provide additional supplementary notes in the form of videos which are accessed through the topics/lessons.
(2) Multiple attempts – most LMS include tools that allow students to attempt online assessments multiple times. Performance of students who attempt online assessments multiple times is better than those who attempt only once (Orchard 2016).
(3) Ineffective learning time – some students may have a huge difference in the log-in and the log-out times leading to a greater *Total_Duration,* but they may not be engaged in quality learning during this time, that is, the student may be involved in other unproductive activities such as watching movies or social networking.

Significance of the model

The Slingshot model builds on a number of relevant work on blended learning in the literature. Moore (1989) argued that student interaction (learner-content, learner-instructor, and learner-learner interaction) is of central importance in a distance or an online environment. Delialioglu and Yildirim (2007) used the frequency counts and activity durations to support the findings from log data on students' perception for effective dimensions of interactive learning. It was seen in Staker and Horn (2012) that time, place, path, and pace are the 4 critical elements of blended learning. Finally, Mödritscher, Andergassen, and Neumann (2013) emphasized that the number of active learning days and topic views are important variables to measure the student performance in blended learning, while Yu and Jo (2014) confirmed that duration in LMS has a positive impact on student performance in courses in higher education. However, due to different learning styles, resource availability and unique cultural norms in the Pacific, the most appropriate variables to capture student effectiveness in a blended learning environment in higher education are frequency and duration which have been proved through the prediction model constructed from the student data on Moodle. The positive coefficients on *Total_Frequency* and *Total_Duration* in the model suggest that regularly accessing course topics and spending adequate learning time on the topics lead to enhanced student performance. In addition, the low and high impact factors of the 2 independent variables and their importance in the blended learning environment further reflect the effectiveness of online presence.

Discussion

The purpose of this study was to investigate the effectiveness of online presence on student performance in the blended mode of study in higher education in the Pacific. The 2 measures of online presence, the number of times a topic is accessed (*Total_Frequency*) and the total amount of time spent on a topic (*Total_Duration*), were selected as the main predictors of student performance using correlation analysis. These two variables were selected in this study because they are amongst the most frequently examined factors of student performance in blended environment (Mwalumbwe and Mtebe 2017).

By looking at the questionnaire, through open-ended questions it was found that the 4 measures related to the study is as follows:

(1) Internet and Intranet usage (ICT comfortability) in Pacific
(2) Virtual learning environment (Moodle) usage in Pacific?
(3) Course Delivery effectiveness?
(4) Course learning expectation by students in Pacific?

The results show a higher mean for each question averaging 4. This high value indicates that students are comfortable with using Information & Communication technology. In addition, students are also comfortable in using Learning Management System such as MOODLE. Moreover, students indicated a positive response towards the effectiveness of the online delivery of the blended course. Lastly, students felt that overall the course met the students learning expectation.

Overall, students showed a highly positive response towards all four elements of ICT. Since students had a highly positive response, it can be deduced that students were able to adapt well to the online delivery of the blended course.

The quantitative research results show that there is a statistically significant positive correlation between *Total_Frequency* and *Total_Duration*, *Total_Frequency* and *Final_Marks* and *Total_Duration* and *Final_Marks*. The findings suggest that students who have higher *Total_Frequency* and *Total_Duration* achieve better grades in the blended course. The findings can be further explained by the Online Measureable Presence Model (OMPM) shown in Figure 10 which consists of 2 elements crucial in increasing the student commitment, retention and overall online fulfillment towards the final performance in a blended environment. The new model is inspired by the CSU Online Learning & Teaching Model designed by Charles Sturt University in 2014 and adds frequency and duration as key components of blended courses (Charles Sturt University 2017). The model proposes how well a student will perform in a blended learning environment based on his/her individual contributions to the 2 measurements of effective online presence. The model designed based on the results of this study is described next.

In order to shift levels in the OMPM the students need to aim for higher impact factors for the two variables of effective online presence. In some instances, with the inclusion of the higher impact factors students will be able to skip levels of OMPM. To move from low frequency and low duration to low frequency and moderate duration, students will have to be actively involved in activities that inculcate deep learning. Students need to spend time reading and understanding the concepts and watching video lessons incorporated within the lessons. As seen from the mountainous terrain

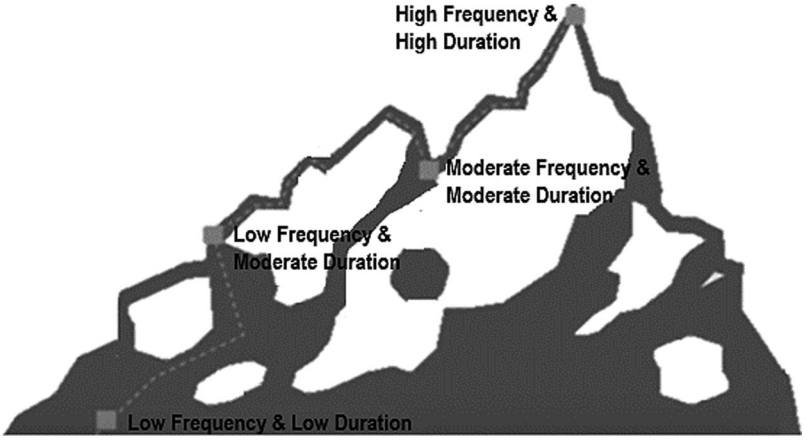

Figure 10. Online Measureable Presence Model (OMPM).

illustrated in Figure 9 the movement to higher levels is non-linear and there are obstacles which need to be avoided and tasks completed first. In the first transfer of levels, the main obstacles include inconsistent and inactive students, not meeting the submission deadlines, and the inability to complete the lesson quizzes. Any student who is not able to spend quality time learning cannot be guaranteed better marks.

To move levels from low frequency and moderate duration to moderate frequency and moderate duration, students need to re-attempt their lessons and activities, improve their understanding of activity completion, and change their attitude to learning. Some of the inherent obstacles in moving to the next level are scrolling and clicking on lessons without spending time on them as well as time-out of LMS due to inactivity or Internet issues.

Finally, to move levels from the moderate frequency and moderate duration to high frequency and high duration, the students need to better manage their time and spend more time to understand the concepts. Also multi-attempts to activities and re-visits to lessons are needed to better understand the concepts and perform better. Students need to balance their course workload taking into account the number and nature of courses taken in a semester to be more productive. The obstacles to overcome at any transfer of levels can be different depending on the type of course and the nature of blended learning. The OMPM strictly shows the interplay between the two variables based on the learning styles and course content in the Pacific.

A major obstacle for students in the Pacific region is the access to the digital technologies and the Internet facilities. However, The University of the South Pacific's recent initiative to provide free tablet PCs to the first year students and the availability of free Wi-Fi in all its campuses and centers should provide suitable interventions to remove the obstacles. These will allow flexible and continuous access to the course materials, subsequently enabling faster and timely completion of course activities and assessments.

The course facilitators can also emphasize to their students the importance of visiting and re-visiting the course topics on a regular basis during the orientation sessions or through motivational Moodle posts and SMS, and also implement strategies to ensure the students spend a reasonable amount of time working on each topic. The latter for the Pacific blended learning can include:

- Giving extra credit for viewing/participating in modules that help students to become successful online learners.
- Contacting students who have not logged in for a while and enquiring if they are facing some technical issues. If so, provide immediate solutions so they can resume with their learning.
- Including resources such as motivational videos on how to become effective online learners in the course.
- Setting conditional restrictions such as time limits as a progression rule.

Conclusion

The paper discussed the design of a new predictive model which illustrates the effectiveness of student online presence in a blended learning environment in the Pacific. The results have provided an insight into the course design for blended environments and recommended an array of activities which would bolster students' online presence. Considering only the Moodle-centric variables, the 2 main predictors of the student performance through their final marks have been found to be the frequency and the duration. The interplay and the effectiveness of these two predictors have been explained with the design of 2 new models: The OMPM and the Slingshot model. OMPM shows the impact of the two variables where students progress to each level based on their individual contribution to online presence. The Slingshot Model conceptualizes the findings of the survey data of the research. In order for the students to achieve passing marks, they need to aim for high impact factors of the two variables and avoid the obstacles. The different learning styles, resource availability

and unique cultural norms in the Pacific played a big role in determining the effectiveness of student online presence in higher education blended environments. However, there is a need to measure the extent of these factors, which provides scope for some future work.

This study is limited in some ways which future research can address. Firstly, a single generic blended course was used in this study. Future work can focus on more subject related blended and fully online courses which will give better insight as to how the different measures of online presence contribute to students performance in various domains. To improve the model accuracy, more attributes can be explored and included in the prediction of student performance.

Disclosure statement

No potential conflict of interest was reported by the authors.

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