Methods for Measuring Engagement in the Blended Learning Environment: A Review Paper

Reem Sulaiman Baragash

Centre for Instructional Technology and Multimedia, Universiti Sains Malaysia, Pulau Pinang, Malaysia

Earlier studies were concerned directly or indirectly with the impact of engagement on the improvement of student learning, these studies were used multiple approaches to measure the engagement in blended learning. Thus, the purpose of this review is to synthesize the evidence in the literature on different methods for assessing engagement in this environment. Moreover, to identify strengths and limitations of these measures and recommend the potential approaches to improve the assessing of student engagement. This paper attempts to conduct a narrative review related studies in the period between 2004 and 2018 to provide a comprehensive overview of relevant research regarding various methods used to measure the engagement in the blended environment. Search terms used in the literature review included varied terms for blended learning, learning system, measure, and terms relevant to the computer assisted instruction and engagement in this environment. The findings of this literature review and implications were discussed within the setting of blended learning and suggestions were given to future research.

Keywords: Blended Learning; student engagement; measurement; e-learning system.

I. INTRODUCTION

Learning engagement depends on a range of interactions between teachers, students, and content, including active and collaborative learning, participation in academic activities, formative interaction with academic staff, and involvement in enriching educational experiences (Beer, Clark, & Jones 2010). Increasing engagement is taken as an essential part of enhancing learning outcomes (Gurung and Schwartz 2013).

Researchers have identified blended learning as having potential to enhance and increase student engagement (Oncu & Cakir, 2011). A growing number of studies focus on student engagement in blended learning environment (Picciano, 2014). One of the challenges among the studies on student engagement is the different measurement of this construct, which has made it challenging to compare findings across the studies. These studies used different approach to measure engagement in blended learning, such as data analytics using e-learning system log-data only as (DeNeui & Dodge, 2006; Hussain, Zhu, Zhang, & Abidi, 2018), using e-learning system log-data and engaged time (Zimmerman, 2012; Zacharis, 2015), others using self-report survey (Vaughan, 2010; Manwaring *et al.*, 2017) or using mixed methods (Vaughan,

2014; Venugopal & Jain, 2015; Baragash & Al-Samarraie, 2018).

Student engagement provides a metric for measuring learning experiences and success in education (Gurung and Schwartz 2013). Thus, to understand how blended permits a greater student engagement and to evaluate the learning efficacy of various learner activities, there is a need to a useful measures of student engagement (Oncu & Cakir, 2011). Thus, this review contributes to examine and understanding different methods for assessing student engagement in blended learning environment, such as self-report measure, direct measure using logs-data, engaged time and mix methods.

II. METHOD

This review was conducted a comprehensive search of several education and technology online data-bases. The Search strategy used to identify studies to be included in this review, the databases were used offered through Google Scholar were including Taylor & Francis, Elsevier Science Direct Journals, ERIC (Education Resources Information Center), The EBSCO e-Journals and conference papers were also included

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*Corresponding author's e-mail: reems@usm.my

in the search. Additional sources included manual searches of reference lists and bibliographies from key articles.

Keyword search terms included were blended learning, computer assisted instruction, learning systems and engagement. The results obtained using these search terms were further filtered through the measurement, survey, analysis and undergraduate students to narrow results to articles conducting studies that measured student engagement. Thus, this paper attempts to review related studies in the period between 2004 and 2018 to provide a narrative overview of relevant research regarding the engagement measurement methods in the blended environment.

III. RESULT

Student engagement in blended learning was measured using different methods as shown in Figure 1.
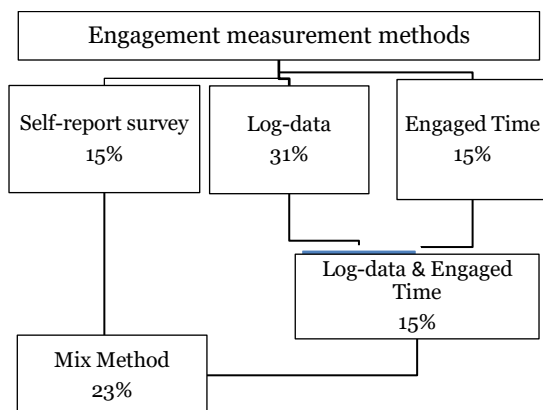

Figure 1. The engagement measurement methods.

Of the 26 articles we reviewed, 31% of the studies were using log-data, while 15% were using self-report survey, 15% were using the engaged time, 15% used logs-data and engaged time, and the studies that combined various measures (23%). Table 1 shows the studies and their methods for measuring student engagement.

Table 1. The studies & the engagement measurement methods

The study	The sample & course	Method
Wellman & Marcinkiewicz (2004)	120 undergraduates & pharmacy courses	Log-data
Morris et al., (2005)	354 undergraduates & 3 courses (English, history and Geology	Log data & engaged time

DeNeui, & Dodge, (2006)	80 undergraduates & 2 introductory psychology courses	Log-data
Beer et al., (2010)	2,714 undergraduates & 3 different courses of two universities	Log data
Phillips et al., (2010)	435 undergraduates & 3 majors Education, Psychology and Environmental studies	Log data
Chen et al., (2010).	17,819 first-year students and seniors	Self-report (NSSE)
Vaughan (2010)	& 9 redesigned courses	Self-report (NSSE)
Macfadyen & Dawson 2010	118 undergraduates & five Biology courses	Log-data
Calafiore & Damianov (2011)	438 undergraduates & 10 Economics and Finance courses	Engaged time
Romero & Barberà (2011)	48 master students & course learning scenarios in online learning	Engaged time
Abdous et al. (2012)	1,144 students & 138 courses	Log-data & text mining
Demian & Morrice (2012)	211 undergraduates & civil engineering courses	Log data
Zimmerman (2012)	139 undergraduates & one courses	Engaged time
Korkofingas & Macri (2013)	314 third-year level course students in business forecasting	Engaged time
Vaughan (2014)	273 first-year blended courses	Self-report & focus groups
Raspopovic et al., (2014)	414 undergraduates & 6 courses in three different areas: management, graphic de-sign and information technology.	Log-data & engaged time
Chowdhry et al., (2014)	257 undergraduates in 3 courses	Log-data
Jo, Kim, & Yoon, (2014)	200 undergraduates in financial business	Log-data & engaged time
Henrie et al., 2015	20 students junior and senior years	Self-report & Log-data
Tempelaar et al., (2015)	922 freshmen in math course	Log-data, self-report, and e-tutorials data.
Zacharis, 2015	134 undergraduates in computer science	Log-data & engaged time
Venugopal & Jain (2015)	28 undergraduates on Mobile Technologies course	Self-report (OSEQ) & Log-data
Mohd et al., (2016)	329 undergraduates & the Faculty of Business and Management	Developed self-report
Manwaring et al., (2017)	68 undergraduates & 6 different blended courses at two universities	Self-report (ESM)
Hussain et al., (2018)	329 students in a faculty of Business management	Log-data
Baragash & Al-Samarraie (2018)	196 undergraduates two blended courses	Log-data & survey

A. Self-report survey

Student self-report was widely used as a measure of student engagement at the college level in online and face-to-face environments as it is the most practical and easy method to gather data in learning settings and compare results. A popular self- report used in numerous studies is the USA National Student Engagement Survey (NSES) developed by Indiana University (Kuh, 2001).

In both studies by Vaughan (2010) and Chen, Lambert & Guidry (2010) the authors measured students' engagement using (NSES) to evaluate their outcomes. Vaughan (2010), used three of the five scales of NESE to measure the engagement; active and collaborative learning, student interactions with faculty and level of academic challenge. While Chen et al., (2010), used a set of items developed by NESE.

Manwaring et al., (2017), conducted a study to investigate student engagement in blended courses used repeated experience sampling methods (ESM) surveys, twice a week repeatedly during the semester, they found that course design and student perception significantly affected student engagement. Another study by Mohd, Hussein, Aluwi & Omar (2016), developed a questionnaire survey to measure their behaviour, experiences, perspectives and feelings towards their learning engagement.

The self-report survey method is easy to distribute and to use in face to face and online environment. Furthermore, it is beneficial for perception and none or less observable indicators and it is considered as an effective method when study at the course and institution levels. Yet, it is not reflecting their actual behaviours or actions and it is regularly including general items may not fit the particular tasks and situations.

B. Log-data

In blended learning the greatest proportion of learning-related activities occur online using different tools, such as observing lectures, gathering information, interacting with peers or submitting assignments (Jo, Kim, & Yoon, 2014). Log-data is the number of mouse clicks on the learning content and activities of each student that are captured by the e-learning system when they logged in, this type of data is providing the frequency of the students' contribution in online learning activities. Therefore, analysing this rich

source of data can be used as an observational method to study student engagement (Beer et al., 2010). Many Studies examined the student engagement in a blended learning environment using this method, Phillips et al. (2010) who examined how students engage with a recorded lecture in the LMS in three different courses of two universities. They developed ten different usage behaviours according to LMS logs frequencies of the students. They found a relationship between these learning behaviour patterns and the learning outcomes. Similarly, Macfadyen and Dawsaon (2010) investigated LMS logs data of five Biology courses to determine the best engagement factor predictor of academic success. They found a statistically significant correlation between the logs data and the final grades. The data was including the total number of discussion posts, total online time and the number of web links viewed.

In addition, Beer et al. (2010) reported the analytics of the data represents indicators and patterns of student engagement in online learning environments. His study is on 2,714 courses for online under-graduate students who interact with their instructors, peers, and instructional material via LMS. Ap-plying both Blackboard and Moodle as data sources for student logs; the number of student clicks on LMS courses is correlated to their scores. Hussain et al., (2018) used the behavioural features related to student interaction by the number of clicks on virtual learning environment (VLE) activities to predict low-engagement students in an e-learning system.

In contrast to previous studies, Abdous, He, and Yen (2012) study illustrated that combining data mining with statistical analysis provides a strong analytical framework for a deeper understanding of learning behaviours and experiences of students. They found that the number of student logs, whether for questions, chat messages, or login times in blended courses is not correlated to the success of students. Chowdhry, Sieler, and Alwis (2014) results also, showed that the number of e-learning system logs did not have any direct impact on the student's final scores. Further, Demian and Morrice (2012) concluded that there is a weak relationship between students' academic performance and the e-learning system logs. The data collected from a civil engineering course student. Wellman and Marcinkiewicz (2004) found that the content page hits and practice quiz access by online learners was weakly correlated with learning, whereas the use of online practice quizzes had a relatively stronger correlation.

The e-learning log-data may become more genuine when compared with those obtained by surveys that highly rely on

student recall. Consequently, we do not have to consider the possibility of distortion or low reliability (Jo *et al.*, 2014). However, the log files of user actions are insufficient to generate a thorough view of activities; more contextual data are required to reconstruct the learning process, and most log-data does not include the activities of online learners outside of the system, such as their activities on social networks or face-to-face interaction data.

C. Engaged Time

The actual engaged time is the time students spent in learning activities that stored in systems, interpreting this time is one of the crucial factors in the engagement and success of e-learning (Raspopovic, Jankulovic, Runic, & Lucic, 2014). Several studies assessed the engagement using the engaged time spent on online learning activities (Korkofingas & Macri, 2013; Romero & Barberà, 2011). Romero and Barberà (2011) examined the influence of the quantity and quality of engaged time spent on learning by students enrolled in online learning programs. They found a positive relationship be-tween the engaged time and academic performance. Moreover, they revealed that higher performance is evident on activities during the morning and weekends. Similarly, an increased length of time spent on using learning materials is related to the increase in passing rates.

Other studies used the engaged-time in the e-learning system, to study the engagement with course content, Zimmerman (2012) indicated that the students who spent more online time using the e- learning system interacting with the course content had a positive effect on their scores compared with students who spent less time interacting with content. The data included time spent reviewing online course materials, such as modules, PowerPoint presentations, and course videos, and time spent completing weekly quizzes. Besides, to address engagement with online activates, Korkofingas and Macri (2013) examined whether a relationship exists between the time spent by a student on an online course and the assessment performance of the student in higher education. The total actual time spent on online activates (the course content and downloading lectures files) were used to extract and calculate time spent each student during the entire semester. The results suggested that the time spent online on the course was related to higher assessment performance.

Actual engaged time is an appropriate method to understand how study time affects engagement in online courses, contradict to the previous studies that rely students self-report the time they spent studying. However, this time measures the quantitative aspect of student's learning effort. Further, this method does not measure the studying time offline using textbooks or teaching materials and does not indicate that they engaged all this time using e-learning systems resources and tools.

D. Log-data & Engaged Time

Studies also examined the student engagement using both the log-data method (frequency of usage) and engaged time method (time spent online). Morris *et al.*, (2005) examined the student engagement and its relationship with persistence and achievement of three undergraduate courses. They analysed the frequency and duration of using content pages and discussion boards on the e-learning system. Likewise, Raspopovic *et al.*, (2014) found a significant difference between students who pass or fail an exam based on the percentage of the used materials and time spent.

Jo *et al.* (2014) analysed the log patterns of adult learners using learning analytics and found that an irregularity of the learning interval was proven to be correlative with and predict learning performance. The researchers found that regularity of e-learning system usage was a strong indicator on ex-plaining learners' performance for the courses offered via the e-learning system. While, Zacharis, (2015), built a predictive model consisting of four e-learning system data variables to identify students who are at risk of failure in a blended programming course. A stepwise multiple regression analysis revealed that 52% of the variance in the final student grade was predicted by the four variables: discussion forum contribution, content usage, quiz scores and log-data.

Logs-data and the duration student spent on e-learning system could be used as an indicator of engagements, yet, the number of hours and clicks on the e-learning systems explains only a small pro-portion of engagement, the log records and the time spent would be inflated when the students log in to see their grades or check on postings or updates from the instructors and peers. Furthermore, the e-learning idle time is time not 12 content for example, when a student checks their grades in a course or when logged in and stay away from the computer without logging out.

E. Mix method

Further studies tend to combine between the tracking data from e-learning systems with another type of data using different approaches to measure engagement in blended learning (Henrie *et al.*, 2015; Tempelaar *et al.*, 2015). Henrie *et al.* (2015) measured student engagement using two kinds of measures: self-reported of the students learning activity and e-learning system log data for the actual use. They revealed that the usage of learning tools and previewing assignments and learning activities were useful indicators of successful learning. Moreover, Tempelaar *et al.*, (2015), investigated the predictive power of modelling student performance and their ability to generate informative feedback, using several data sources such as e-learning system data, self-report data and system data extracted for practicing and assessments from the e-tutorials used in a blended environment. They found that data from formative testing are strongly predictive of student performance in blended learning.

Vaughan, (2014), combined the log-data with online survey (NSES), digital record for focus groups using a standardized protocol, and post-course interviews. The author found a relationship between intensity e-learning system use and engagement measures correlations were observed between the intensity of system use and each of the engagement tool. While, Venugopal & Jain, (2015) combined the log-data from e-learning system from within the campus or from outside the campus with the Online Student Engagement Questionnaire (OSEQ). They found that there is no or insignificant relationship between student perceived using LMS and performance. Furthermore, Baragash & Al-Samarraie, (2018) Assessed the student's engagement in blended courses using Log-data (time spent and tools usage) combined with self-report Survey. The study reveals that engaged time and log-data can be considered as the main indicators of students' engagement.

Combining a measure method with other different methods, such log-data method with self-reported, interviews or data form other sources will obtain a fine-grained understanding of student behaviour and a wide variety of learning activities in a blended environment that no type of data on its own could have.

IV. CONCLUSION

Measuring student engagement can provide a valid indicator of the course quality and can improve the teaching practices, thus performance grades. There is a heavy use of survey methods and log-data to measure student engagement. Surveys are easy to scale but disruptive to learning, using log data is a much more scalable and minimally disruptive approach (Henrie *et al.* 2015), however, blended learning environments offers challenges to implement learning data analytics primarily due to the various aspects and multiple modes. This environment is more complex and diverse than a representation of student clicks, logs, or time on a website, these methods worked better for the completely online learning than the blended learning due to the face-to-face part in this learning (Picciano, 2014). There-fore, the mix methods are recommended, it is combining one or more of these approaches to under-stand the variations of engagement across different contexts, subsequently, improve measuring student engagement in the blended environment. Further work on developing effective measures of student engagement will increase our capability to improve the overall learning process and outcomes in this environment.

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