Enhancing Student Group Projects' Experience Through Learning Analytics with Moodle OU Wiki

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1 Abstract

This research is a pilot study of structuring student group project learning experience that allows for formative assessment and feedback. In many cases, assessment and feedback of student project work are summative in nature. One reason is that there is usually no platform for a teacher to continuously document the participation of project group students. It is argued that the benefits offered by a more transparent environment to student project work is multi-fold. Students sometimes experience free-rider problems or non-contributing team members. Thus, some students are reluctant to embrace a group project assessment. In other cases, students find it very hard to substantiate a free-rider case as the project work environment is un-structured in such a way that it is hard to collect bit and pieces of evidence from various platforms and channels. That may translate into frustration and unfairness. If analytics are also provided by the collaboration environment, it will facilitate a teacher to make data-driven decisions to follow up, to assess, and to feedback on any group dynamics with evidence. All these calls for a pressing need for a more structured and accountable environment for students to collaboratively develop a group project to maximize the learning outcome while enabling formative assessment and feedback. The research seeks to leverage and customize the existing university-wide Moodle E-learning platform's tool – the OU wiki, which is a generic collaboration environment, to enhance the project's feasibility and extendibility while minimizing any associated costs for a large-scale implementation at a later stage. It is posited that the proposed environment would empower students as a learner where their contribution and participation is accounted for and well- documented.

Keywords: Learning analytics, Formative feedback, Group collaboration, Moodle, OU wiki

2 Introduction

2.1 Research Objectives

1. To pilot study whether a structured E-learning environment such as the OU wiki would enhance students' group project collaboration and learning experiences;
2. To investigate whether a well-documented collaboration environment with analytics would facilitate formative assessment and feedback; and
3. To customize the Moodle built-in tool – the OU wiki for project group collaboration to maximize the effectiveness of Moodle as an E-learning resource

2.2 Research Questions

The following research questions guide this research.

1. What are the antecedents for determining the perceived learning value of university students adopting the OU wiki as an E-learning platform for collaborative work?
2. Can the OU wiki make an impact to university students' learning experiences?

2.3 OU wiki

A wiki space enables students to collaboratively develop an online document through composing and editing webpages. The idea resembles Wikipedia (Milne & Witten, 2008). The Moodle wiki (https://docs.moodle.org/311/en/Using_Wiki) differs from other collaborative platforms, e.g. Google Docs, in a way that it is standard Moodle activity. Thus, no additional permission is required for a Moodle user. The wikis are not limited to collaborative use. A user can create his/her own wiki space too. As the name suggests, the OU wiki was created by The Open University (https://moodle.org/plugins/mod_ouwiki) that has extended the standard Moodle wiki and is available on a standard Moodle platform. The OU wiki is full-featured and designed to be easy to use. It provides reports and analytics. There is a page-wide and activity-wide history management tool that allows for version comparison.

3 Model Development and Hypotheses Formulation

3.1 Model Development

The research model considers four factors in terms of evaluating the subject matter. There are four latent constructs with 19 indicators adapted/adopted from other research and four to five indicators for each latent construct (Cassidy & Eachus, 2002; Doll & Torkzadeh, 1988; Hazari et al., 2009; Selwyn, 1997; Shroff et al., 2008; Tsai et al., 2001; van Braak & Tearle, 2007; Yoo & Alavi, 2001).

3.1.1 Learning Value (LV)

In the current research, the Learning Value construct taps into students' interest in course, student-centered learning, use of materials, and achieving course objectives that closely tie with learning (Centra & Gaubatz, 2002; Emaliana, 2017; Greitzer, 2002; He et al.; Tran, 2014). If a student is more interested in a course, it is more likely that he or she has developed a deeper learning (Schiefele, 1991). When a student has demonstrated some student-centered learning behaviors, it is quite possibly that he or she is internalizing the learning (Wright, 2011). When course materials are kept by students in the future, it may infer that they value the learning experience (Crossgrove & Curran, 2008; Douglas & Van Der Vyver, 2004). Achieving course objectives or not is a useful for benchmarking a student's learning outcome, which is captured by LV (Lin & Chen, 2017). LV is the only endogenous variable in this research. With the OU wiki, students are able to collaborate in an E-learning environment. Technology-enabled learning (Bell, 2011) is supposed to more effectively engage students (Ertmer & Ottenbreit-

Leftwich, 2013) and encourage them to achieve active learning (Prince, 2004). The effects of the use of the OU wiki on both student engagement and active learning are collectively studied here. This research seeks to assess the respondents' LV in an technology-enabled environment through five questionnaire items.

3.1.2 Group Engagement (GE)

The Group Engagement (GE) construct in the current research examines students' interaction with group members, group's consensus, peer learning, and collaborative learning promotion. In the context of this research which lies with studying the group project work environment, it is of critical interest to investigate how the OU wiki facilitates group-based learning (Kirschner et al., 2009; Strijbos et al., 2004). It is evidenced that student performance is positively related to learning effectiveness (Cybinski & Selvanathan, 2005). Peer learning plays an increasing role in learning and enhances knowledge generation (Boud et al., 1999, 2014; Topping, 2005). Business major students, which include the majority the respondents of the current research, need to possess high level of teamwork skills for their future career path (Hobson et al., 2013). Collaboration skills and experiences are inevitable and crucial for business major students and graduates. Such soft skills are life-long and portable. If the OU wiki could be able to enhance students' their group performance as a team member, it would be of value for universities and particularly business schools to further consider a deployment the OU wiki or similar technologies. Technology-enabled collaborative environment is emerging and shaping the business education (Alavi et al., 1995; Keser et al., 2011). This research examines this aspect of education in the context of the OU wiki. The questionnaire has employed five items to tap into Group Engagement.

3.1.3 Perceived Benefit (PB)

If students perceive the short-term and long-term benefits of using the OU wiki, they may formulate their Learning Value in a positive manner. The Perceived Benefit (PB) construct in this research is evaluated regarding the OU wiki by willingness to pay extra time and effort, preferences over courses, recommendations, and interest. Perception of short-term and long-term benefits always largely determines whether a user adopt and uses a technology. The Technology Acceptance Model (TAM) strongly advocates and supports that (Amoako-Gyampah & Salam, 2004; Chau, 1996; Lee, 2009; López-Nicolás et al., 2008; Rauniar et al., 2014). When students are convinced that the OU wiki offers benefits for studying and performing tasks, they actively embrace the technology now and sustain their interest in it in the future. A continued use of the technology may be expected and more invaluable than an one-time experience (Chen et al., 2011; Wangpipatwong et al., 2008). They may tend to welcome any another learning experience that is associated with the OU wiki (Szajna, 1996) and even recommend the OU wiki to others simply because of their own positive perception and experience (Masrom, 2007). The impact of Perceived Benefit on Learning Value has been studies in this research. The questionnaire has formulated five items to capture the determining factors of PB.

3.1.4 Technological Experience (TE)

The experience of students using the OU wiki as an IT tool is studied by this construct. The Technological Experience (TE) construct relates to the user-friendliness, power, features, and technical challenges offered by the OU wiki. Thus, TE is about whether the OU wiki is perceived as a tool that is easy to use with features and power. IT tools come with a wide spectrum of functionalities and features that may or may not be compatible with users' own know-how. Such a compatibility issue always decides a system success (Abdullah et al., 2016; Iivari, 2005). What is a right portfolio of features, power, and ease of use always determines a user's experience with an IT tool (Hassenzahl & Tractinsky, 2006). It is not an easy task to determine what a right portfolio is (Galitz, 2007). Yet, user experience is so critical that we cannot afford to undermine whenever it comes to system usage (Buxton, 2010; Hassenzahl, 2013; McCarthy & Wright, 2004). The OU wiki as an E-learning tool offers its own user experience that is investigated by TE. It has factored how the students evaluate the OU wiki from a technical perspective in their whole E-learning experience which may have an impact on LV. Thus, the questionnaire has operated four factors to reflect TE.

3.2 Hypotheses Formulation

To address the research objectives and questions, the following three hypotheses are proposed.

H1: Group Engagement (GE) has an impact on Learning Value (LV)
H2: Perceived Benefit (PB) has an impact on Learning Value (LV)
H3: Technological Experience (TE) has an impact on Learning Value (LV)

4 Methodology

An introductory undergraduate course at a university was selected for the research. The course involves a variety of assessment tasks including a group project item where the students are required to collaborate to project a written report and a verbal presentation. A customized OU wiki collaboration space was created and structured by the instructor for each group to guide the students to develop the various parts of the projects. That is, each group was able to work on their own OU wiki space to co-develop a project. Learning analytics (Viberg et al., 2018) were collected regularly to monitor the continuous contributions and participation of the students at individual level. With the help of such analytics, individualized and data-driven feedback on each student's engagement in the OU wiki space was possible and sent to each student on a regular basis. Formative feedback was also periodically provided by the instructor in the same OU wiki space for each group on different ideas, sentences, sections, or phrases for the students to further develop and consider. After the end of semester and the release of final grades, the students were invited to fill out an online questionnaire that has incorporated the four constructs in the research model. The timing for inviting for participating in the survey was intentionally set after the final grade release date to avoid any potential teacher-student conflict of interest (Jamieson & Thomas, 1974; Spilt et al., 2011) and to ease the pressure and bias of mandatory participation (Cheung et al., 2017). A drawback of such an arrangement is that the students would probably be less motivated to participate as the semester is over and they would have difficulties recalling their experience. That may help explain a relatively low response rate of the survey even after numerous rounds of email re-invitations and reminders. Data was collected by the online questionnaire using a five-point Likert scale (Joshi et al., 2015) indicating a spectrum from “Strongly Disagree” to “Strongly Agree”.

Data was then statistically analyzed by Partial Least Squares (PLS) based Structural Equation Modeling (SEM) approach using SmartPLS 3.0 (Ringle et al., 2015). The PLS does not require the limiting assumptions, e.g. residual distributions and multivariate normality (Falk & Miller, 1992). Moreover, the PLS is appropriate for predictive analysis where the sample size is not large (Wynne W Chin, 1998). In addition, the PLS requires no distributional assumptions (Fornell & Bookstein, 1982). Furthermore, the PLS can work with all ordinal, nominal, and interval variables. In view of the above, the SmartPLS 3.0 (Ringle et al., 2015) was selected as the tool for analysis for this research.

5 Research Model Assessment Results

5.1 Demographics

Twenty-four respondents returned their online questionnaires with the demographic information as shown in Table 1.

Table 1 Demographic Information

Gender	**Percentage**
Male	41.7
Female	58.3
Age	
19	45.8
20	37.5
21	12.5
Above 23	4.2
Previous experience with OU wiki	
Beginner	79.2
Intermediate	20.8

5.2 Assessment of Measurement Model

Convergent and discriminant validities seek to assess the measurement construct validity. With regard to a measurement item’s assigned construct (Davis, 1985), construct validity attempts to examine its systematic variance in a measurement item. Cook et al. (Cook & Campbell, 1979) have defined construct validity as *“the degree to which the measures’ true score corresponds to the conceptual variable that the measure is intended to operationalize”*. Simply speaking, whether a measurement instrument is valid or not is determined by construct validity.

5.2.1 Convergent Validity

Item reliability, composite reliability and average variance extracted (Chau, 1997) together examine convergent validity. The sections below delineate the performance of the research model in each aspect of construct validity.

5.2.2 Item Reliability of Measurement Model

By checking each manifest indicator's item loadings on the corresponding construct, Item Reliability examines whether the manifest indicators measure only a particular construct. An Item Reliability is considered to be highly acceptable if it is 0.7 or above (Götz et al., 2010; Henseler et al., 2009). There is a more stringent rule of thumb which requires item loadings should be equal or exceed 0.707 (Carmines & Zeller, 1979). For a more relaxed threshold, an item loading is required to be at least 0.5 (W. W. Chin, 1998; Hair et al., 1998). As revealed by Table 2, all the item reliabilities of the manifest indicators are well above the thresholds where TE1 is more than 0.66 and the rest is above 0.707 which is the more demanding assessment. The Convergent Validity of the measurement model is established.

Table 2 Convergent Validity

Latent Construct	Manifest Indicator	Item Reliability	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Group Engagement	GE1	0.874	0.959	0.968	0.859
	GE2	0.943			
	GE3	0.911			
	GE4	0.949			
	GE5	0.954			
Learning Value	LV1	0.944	0.947	0.959	0.795
	LV2	0.850			
	LV3	0.929			
	LV4	0.761			
	LV5	0.918			
Perceived Benefit	PB1	0.938	0.928	0.947	0.781
	PB2	0.951			
	PB3	0.847			
	PB4	0.876			
	PB5	0.797			
Technological Experience	TE1	0.665	0.877	0.916	0.735
	TE2	0.923			
	TE3	0.916			
	TE4	0.898			

5.2.3 Cronbach's Alpha, Composite Reliability and Average Variance Extracted (AVE)

As part of convergent validity, construct reliability (Werts et al., 1974) assesses the internal consistency of a construct. It evaluates whether the items indeed measure the same construct (Spector, 1992). There are two approaches to evaluating construct reliability, namely Cronbach's alpha and composite reliability. The Cronbach's alphas of all the constructs range from 0.877 to 0.959 (Table 2), which are above the threshold 0.70 and the preferred value 0.80 (Cortina, 1993). The composite reliabilities of all the constructs of the research model are in the range of 0.916 and 0.968, as shown in Table 2. Essentially, they all have exceeded the established threshold 0.70 (Nunnally, 1975) for the reliability of construct which is also applicable to PLS analysis (Hulland, 1999). As evidenced by the favorable results of both tests, the measurement model has demonstrated its internal consistency.

By examining the average amount of variance that a construct shares with its indicators, Average Variance Extracted (AVE) should be at least 0.50 to ensure that more variance is explained than error in a construct's measurement (Fornell & Cha, 1994; Fornell & Larcker, 1981). All the constructs of the research model carry an AVE above 0.50 within the range of 0.735 to 0.859 (Table 2) which satisfies the acceptable criterion.

As a result, the Cronbach's alpha, composite reliability and average variance extracted have confirmed the convergent validity of the measurement model.

5.2.4 Discriminant Validity

Discriminant validity estimates uniqueness of constructs (Hair Jr et al., 1995). Uniqueness here is defined as the extent that manifest indicators of a construct can significantly differ themselves from those in other constructs. Statistically, if manifest indicators of a construct's manifest indicators correlate more higher among themselves than with indicators in other constructs, then discriminant validity is confirmed (Barclay et al., 1995). All the manifest indicators of the measurement model possess loadings that are higher on their corresponding construct than other constructs except GE3, PB4 and TE4 that have a very slightly lower than loading than with another construct, as shown in Table 3. Given the relatively small sample size, the deviations are not uncommon (Wolf et al., 2013). Hence, it is argued that the research model has demonstrated the discriminant validity.

Table 3 Loadings and Cross-loadings of Manifest Indicators

	Group Engagement	Learning Value	Perceived Benefit	Technological Experience
GE1	**0.874**	0.826	0.773	0.801
GE2	**0.943**	0.884	0.834	0.828
GE3	**0.911**	0.908	0.919	0.859
GE4	**0.949**	0.881	0.849	0.825
GE5	**0.954**	0.898	0.891	0.853
LV1	0.897	**0.944**	0.914	0.881

LV2	0.764	**0.85**	0.842	0.801
LV3	0.867	**0.929**	0.899	0.834
LV4	0.777	**0.761**	0.685	0.711
LV5	0.881	**0.918**	0.869	0.816
PB1	0.882	0.872	**0.938**	0.878
PB2	0.891	0.905	**0.951**	0.908
PB3	0.692	0.77	**0.847**	0.752
PB4	0.854	0.907	**0.876**	0.824
PB5	0.732	0.759	**0.797**	0.75
TE1	0.502	0.523	0.521	**0.665**
TE2	0.846	0.891	0.907	**0.923**
TE3	0.728	0.733	0.787	**0.916**
TE4	0.925	0.917	0.907	**0.898**

At both the convergent validity and discriminant validity levels, the measurement model has delivered a satisfactory result and thus the construct validity of the measurement model is confirmed.

5.3 Structural Model Assessment

Regarding the structural model assessment, Bootstrap re-sampling (Cotterman & Senn, 1992) was applied to estimate the respective t-value for the path coefficient to assess each hypothesized path in the research model for its significance.

5.3.1 Bootstrap Re-sampling

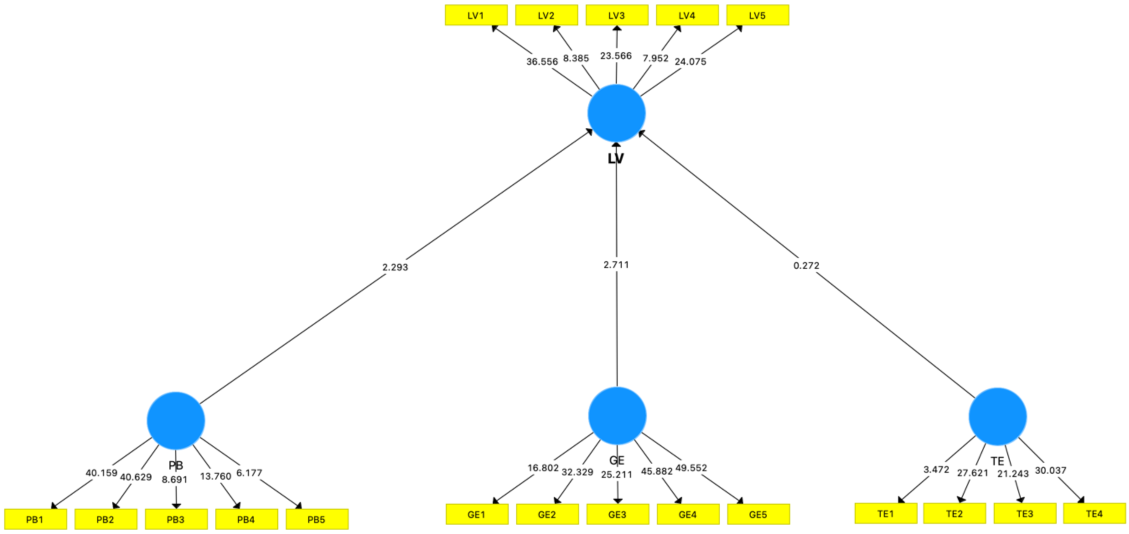
By running a 500-subsample Bootstrapping in SmartPLS 3.0 (Ringle et al., 2015), the t-values obtained show that two out of the two hypothesized relationships among the latent constructs are statistically significant. The results are shown in Table 4 and Figure 1.

Table 4 Hypothesis Test Results

Hypothesis	Path	T Statistics	P Values	Conclusion
H1	GE → LV	2.711	0.007	Significant ($p < 0.01$)
H2	PB → LV	2.293	0.022	Significant ($p < 0.05$)
H3	TE → LV	0.272	0.786	Insignificant ($p > 0.05$)

In summary, group engagement and perceived benefit do have a significant impact on learning value perceived by the students whereas technological experience does not.

Figure 1 Hypothesis Test Results



5.3.2 Explanatory Power

The R^2 value of the endogenous construct (Santosa et al., 2005) indicates the explanatory power or nomological validity of the research model. The R^2 value of LV, as shown in Table 5, is 0.947. It exhibits that the research model is able to explain a very significant portion of the variance (94.7%) in Learning Value (LV). To justify the explanatory power of a model, it is recommended that that R^2 value should be 0.10 or more (Falk & Miller, 1992). With the R^2 value 0.947 which is much higher than the suggested threshold, the explanatory power of the model is considered as very strong.

Table 5 Explanatory Power of Research Model

	R^2
Learning Value	0.947

6 Discussion

This research explored a collection of constructs to investigate how they may contribute to formulating the students' perceived learning experience in a virtual collaboration environment. It was found that the proposed research model is able to explain 95.7% of the variance in terms of learning experience. It is regarded as very high and has suggested that the model is able to capture some critical factors in influencing how the students' learning experience is shaped in a virtual collaboration environment. In particular, the Group Engagement (GE) and Perceived Benefit (PB) constructs have a statistically significant impact on the Learning Value (LV) construct suggesting that they are two critical factors to determine how the students have developed their experience in terms of learning. The findings are consistent with prior research (Abramova & Böhme, 2016; Alhakami & Slovic, 1994; Jung et al., 2002; Lee, 2009). In this regard, educators should always consider whether group interaction is to be enhanced when offering collaborative experience through a virtual platform. Interactions among members help with engagement (Cavinato et al., 2021) where the group dynamics evolve to strengthen the group bonding (Curry, 1991). By the same token, benefits must be there with the virtual environment. What is tricky is that those benefits must be perceived by students (Siegrist et al., 2000). Otherwise, those benefits would not exist in the eyes of students.

TE was found not to have a statistically significant impact on LV. Essentially, it translates into the fact that the learning value of the OU wiki experience is independent of the technological experience with the tool itself. On one hand, it could be that the learning curve of the OU wiki is rather shallow. The OU wiki is a plug-in to the Moodle platform that is designed to be easy to use. Thus, it is not supposed to be technically challenging. On the other hand, it could be that the students' digital literacy is generally proficient which is not uncommon in their generation (born in around 2000) given that they have grown up with technology (Kurniawati et al., 2018; Spires et al., 2019). The students' IT expertise seems to be compatible with the technical requirements of using the OU wiki. In this vein, learning to use the OU wiki is not a relevant issue here. It is evidenced in some qualitative comments received from the students which is to be elaborated in the Recommendations section. Essentially, they expect more sophistication from the OU wiki. With the push and pull factors in place where the IT literacy of students is escalating while the expertise required to use software applications is diminishing, the ease of use of IT tools is an increasingly irrelevant issue in more and more scenarios. Educators should be less concerned about whether an application is easy to use or not. Rather, a more thorough benchmarking should be conducted among all commonly available choices particularly those free applications from giant vendors before a less known or proprietary application is selected for implementation. Thanks to those highly sophisticated free software applications or open-source software (Bruce, 2003; Gallego et al., 2015; Pinto et al., 2017), student expertise has been sharpened and expectations have been raised in such a way that learning to use software applications seldom translates into any challenges.

Data-driven feedback assisted by learning analytics (Elias, 2011; Ferguson, 2012; Greller & Drachsler, 2012; Siemens, 2013) has allowed the instructor involved in this research to gain insights into the individual performance of each of the students and subsequently to provide individualized feedback to him or her. That was appreciated by the students as reflected in the received qualitative comments. With the quantified data, the instructor was able to formulate feedback with better confidence and more evidence. Evidence-based decision making with data analytics is emerging and spreading in the business world (Cho et al., 2017; Rousseau & Olivas- Luján, 2015). It would not be too early for business students to taste the power of data analytics in terms of learning before they graduate. It is suggested that learning analytics be deployed in the business school setting as far as possible to maximize the learning and teaching effectiveness (Stonebraker & Howard, 2018) and to pre-expose business students to the exciting world of business analytics.

7 Recommendation

Some students have suggested that they expect the OU wiki to be more sophisticated. In particular, the absence of real-time editing feature is frustrating. Some students have had experience with other more advanced applications, e.g. Google Docs, where they value a real-time editing function. It seems that collaboration at least equates to real-time editing from the student perspective. To enhance the Moodle environment as a virtual collaborative environment, it is suggested that Google Docs be further integrated to leverage its real-time feature (Dekeyser & Watson, 2006; Spaeth & Black, 2012). It could also be generalized that a real-time feature is key to a well-received virtual collaborative environment by students. Collaboration in a real-time manner seems to be rooted in the mindset of the students that is likely to be shared by other university students. A virtual collaborative environment without real-time exchanges is regarded as a flawed package to students (Jara et al., 2009; Shenai et al., 2014).

In terms of theoretical significance, it is suggested that the perceived benefits and the group engagement enhancement should always be two of the center pieces for studying a virtual collaborative platform in an E-learning environment. There could be other factors to consider but the above two should be visited as constructs in a research model in most cases. They are likely to be salient in determining other factors.

8 Conclusion

This research paper has contributed both theoretically and practically to the research community in terms of studying virtual collaborative environment through the lens of OU wiki in a university environment. Technology is posited to enhance learning (Kirkwood & Price, 2014). But it does not happen automatically. It depends on how to leverage technology. There are various non-technical factors to encompass that may collectively determine the end-result including maximizing learning experience, system adoption, system usage … etc. The current research has empirically validated two such salient factors, namely perceived benefits and group engagement, for determining students' evaluation of E-learning experience through collaboration as a group. Future research direction is in demand to validate further empirically the above two factors in different contexts to establish their validity. One possibility could investigate Google Docs as a subject platform instead of OU wiki. That may help further generalize the findings of this research.

According to the qualitative comments, the students value the instructor's ongoing monitoring and feedback in the virtual environment which would otherwise be not conveniently feasible in a face-to-face environment. It suggests that students do indeed value feedback which is in a continuous manner (Hatziapostolou & Paraskakis, 2010). E-learning environment has further enhanced such a feasibility and practicality. Given the paradigm shift in learning from purely face-to-face to hybrid or purely E-learning (Desai et al., 2008), more tools and/or their applications should be explored to enable feedback in a more timely and documented manner. In this vein, leveraging learning analytics is an area that is worth further exploring for learning and teaching purposes.

9 References

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