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A Novel Learning Engagement Data Model (LEDM) for Online Attendance System

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A Novel Learning Engagement Data Model (LEDM) for Online Attendance System

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Abstract. Student engagement is a very interesting subject in higher education. While many studies assess student engagement through survey, this approach claimed in literatures is lack of contextual analysis for decision making. Our motivation in this study is to integrate a simple way to assess student engagement of face-to-face session in blended learning approach within the online attendance system by identifying the data model supporting insightful analytics. This study aims to propose a new learning engagement data model incorporating behaviour, emotional and cognitive engagement for online attendance system. We found an interesting insight which there is a relationship of student engagements with the learning outcomes attainment. Initial findings in this study show potential values how our proposal may benefit higher education in adopting smarter way to measure student engagement while taking student attendance during face-to-face session in blended learning implementation.

1. Introduction

Student engagement is a very important indicator in measuring student success in their study. With digital technology advancement, particularly Internet, many higher education institutions start to explore and adopt blended learning approach as it is claimed[1] can engage student in learning. Since the approach still require physical presence of both teacher and student[2], student attendance system has potential to be used as a medium to understand student engagement. There are claims [3,4] that class attendance has strong relationships with academic performance. The claims used attendance data to indicate student physical presence in class. However, it did not indicate a complete student engagement during the class either student did achieve the learning outcomes during the class session. A complete student engagement should include all the dimension of student engagement theory which are cognitive, emotional and behaviour engagement.

Existing attendance system especially the one used manual signature disturbed student's attention since student need to write down their initial by queuing. Technology based attendance systems mostly are designed with the goal or emphasize on process efficiency in recording the data but not on learning engagement aspect. Therefore, this study aims to propose a novel engagement data model that act as a foundation towards measuring complete student engagement in class with analytics. This study is been facilitated with the following research questions: -
RQ1: How behaviour, emotional and cognitive engagement affect student learning outcomes attainment?
RQ2: How online attendance system can support learning engagement?

2. Literature Review

2.1. Student Engagement

Student engagement can be conceptualized as integration of three interrelated learning dimensions or domains which are cognitive engagement, emotional engagement and behavioural engagement. According to literature[5], these three dimensions can be described as:-

- behavioral engagement: students' participation in education, including the academic, social and extracurricular activities of the school
- emotional engagement: students' emotional reactions in the classroom and in the school (a sense of belonging or connectedness to the school)
- cognitive engagement: students' investment in their learning (motivation and self-regulation).

There is a claim[6] that face-to-face or in class activities comes with "*more engagement*" and "*immediate feedback*" which are foundation for student to progress in learning. But measurement and statistical methodologies are yet another challenges highlighted in literature[7] regarding student engagement especially on the most complex one, emotional engagement. Many research and implementation to measure or assess student engagement adopt a survey approach[8–10] at the end of semester which lack of insight for effective decision making. To facilitate better teaching practice, a contextual analysis is required for instructor to understand a complete dimension of student engagement and how it affects the attainment of the learning outcomes.

2.2. Online Attendance System

In general, student attendance or absence is a very practical indicator in assessing student engagement[11], managing student at risk[12] and predicting academic performance[13]. Student attendance is useful as a direct representation of student behaviour engagement in the class. However, conventional student attendance system only captured student identity either student's signature or the instructor's notes based on his observation, which is not productive nor smart when it comes to large number of students. Student attendance system that integrate biometrics[14], Quick Response or QR code[15], Radio Frequency Identification (RFID)[16] and voice recognition [17] mostly focusing on the technological aspect to acquire identity data of student. It however never about measuring student engagement. With more online services offered through cloud technology, there is a promising opportunity how a simple and smart attendance system that integrate student engagement can be developed using cloud technology.

2.3. Blended Learning

Blended learning can be easily understood as combination of face-to-face and online learning. It means, physical presence of both teacher and student is still required in blended learning strategy[18]. Blended learning is claimed to has an impact on student engagement[19], academic performance[20] and student learning outcomes[21]. One example of blended learning approach is flipped classroom[22] which is helpful for instructor and learner in making the class (face-to-face) session enrich with enquiries and promote student with high order thinking[23]. Blended learning implementation can be instrumental for institution strategic planning in transforming institution towards the concept of smart university[24].

3. Method

3.1. Participants and Procedure

The data were collected from the students who enrolled in a course Semester 2 in 2018/2019 session. Table 3.1 indicates the profile of the target population and selected course.

Table 3.1. Participants of study

Course Name	Web Engineering (BCS2243)
Student Size	38
Enrolment duration	28 Jan 2019 – 26 May 2019
Number of week	14 weeks
Number of lecture session	1 session per week (2 hours)
Number of laboratory session	1 session per week (2 hours)
Total face-to-face session for student	28 sessions

3.2. Data Model

This study adopted quantitative method for data collection. A simple online attendance system which include all dimension of student engagement during the face-to-face class. The data model designed in this study that been integrated in the system is shown in figure 3.1.
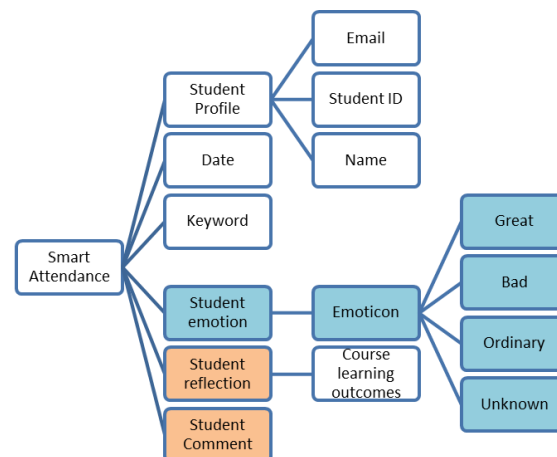

Figure 3.1: Proposed Learning Engagement Data Model (LEDM)

Based on figure 3.1, student profile, date and keywords are data that categorized for behavior engagement. The 'keyword' is used as a field for student to fill based on the instructor's random keywords mentioned during class. It is used to allow only students who are attend physically to the class can fill the field and submit their attendance form. This should minimize the attempt of student who do not attend to fill the online attendance form since it is accessible on Internet. The calculation model to assess behavior engagement is by calculating the total number of attendances relative to total face-to-face session student should attend in a semester as shown in equation (1).

$$B = \frac{\sum Attended}{total\ session\ per\ semester} \qquad (1)$$

'Student emotion' category represent the emotional engagement which represented in emotion icon or also known as emoji in the online attendance system. Table 3.2 shows the category of emoji used as emotional identifier in this study.

Table 3.2 Emotional Engagement Scale

Emoji	Emotion description
Great	Student feel great with the class learning experience.
Just so-so	Student feel ordinary with the class learning experience.
Not Telling	Student choose to not inform his/her feeling.
Got a bad day	Student feel bad with the class learning experience.

In order to measure emotional engagement level, we develop our own emotional engagement index based on the frequency of each emotion relative to the total number of class attended by student. In other words, we try to measure student's feeling during the class session. The calculation model of the index is shown in equation (2).

$$E = \frac{\sum Emoji}{total\ class\ attended} \tag{2}$$

For cognitive engagement, we integrate a self-rating mechanism where student need to do quick reflection of the lesson oriented to the course learning outcomes that clustered to cognitive domain. The scale and cognitive engagement item in online attendance form is shown in figure 3.2. The calculation model for cognitive engagement is formulated in equation (3). It calculates the ratio of total score of student attendance based on the level of learning experience against the maximum score student could get based on highest level of learning experience. In this case we used 3 level of attainment measured in online attendance system as shown in figure 3.2.

$$C = \frac{\sum(level \times attendance)}{total\ class\ attended \times 3} \tag{3}$$

Figure 3.2: Cognitive Engagement Scale

3.3. Learning Impact Analysis
In order to justify the impact and value of our proposed model, we analyse the engagement level for each dimension with the summative assessment in the final exam (controlled environment) represents course learning outcomes in cognitive category. Scatter plot has been selected for clustering and visualize the relationship between student engagement with the course learning outcomes attainment (cognitive) assessed in summative assessment (final exam score).

4. Results and Discussion

4.1. Learning Engagement vs Learning Outcomes Attainment
Our first research question is to understand how behaviour, emotional and cognitive engagement affect student learning outcomes attainment? The following subsections explain how each dimension of student engagement are affecting student learning outcomes attainment.

4.1.1. Behaviour Engagement vs Learning Outcomes Attainment
There is weak negative correlation with $r = 0.15$ between behaviour engagement and cognitive attainment in the summative assessment (final exam) as shown in figure 4.1. This finding suggest that the attendance may not significance to certain student based on two arguments (1) there are student who got good score in final exam with poor number of attendances and (2) there are student who got poor score (<50 points) but attend more than half of the session. The potential implication from this initial finding is the institutional policy in providing more flexible learning experience. Common administrative issues like scheduling in course offering due to lack of resources (instructor or location) affect significantly the opportunity for student to enrol the courses that been offered. As a result, student may extend their semester to complete the required course enrolment and this directly affect their graduation duration.
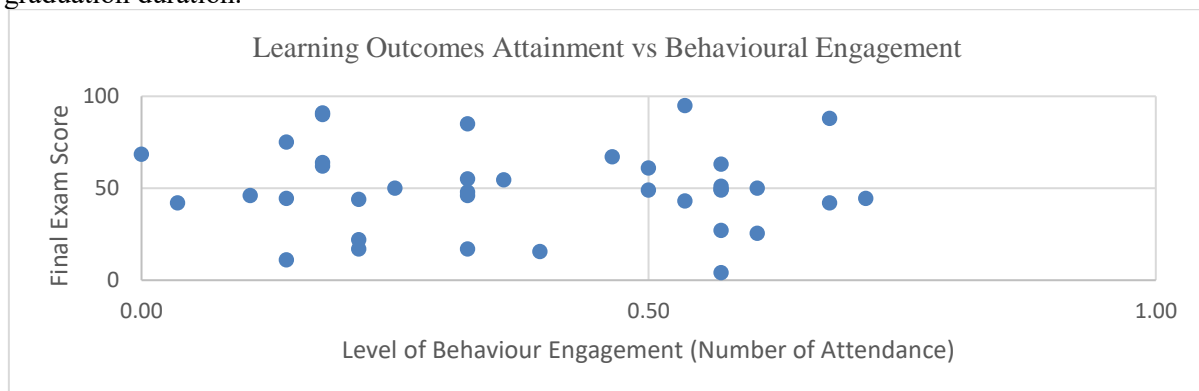

Figure 4.1: Behaviour Engagement Analysis

4.1.2. Emotional Engagement vs Learning Outcomes Attainment
There are four different emotion used in our study. Before we analyse them, we perform a simple test to identify outliers in order to produce better analysis. Figure 4.2 shows the outliers for the data captured in four type emoji used in the system. Based on the figure, we suggests that the emotion with label '*Got a bad day*' which represent negative emotion during the class is not significant to be analysed due to lack of data value variation in dataset and most student do not experience that feeling during class. Another data that will be ignore for analysis is the emotion with label '*Not telling*' due to it does not indicate any feeling. The rationale to include this type of emotion is to give an option to student for not informing their feeling to instructor during online attendance taking. In this section, we only analyse the positive emotion with label '*Great!!!*' and how it relates with learning outcome attainment.
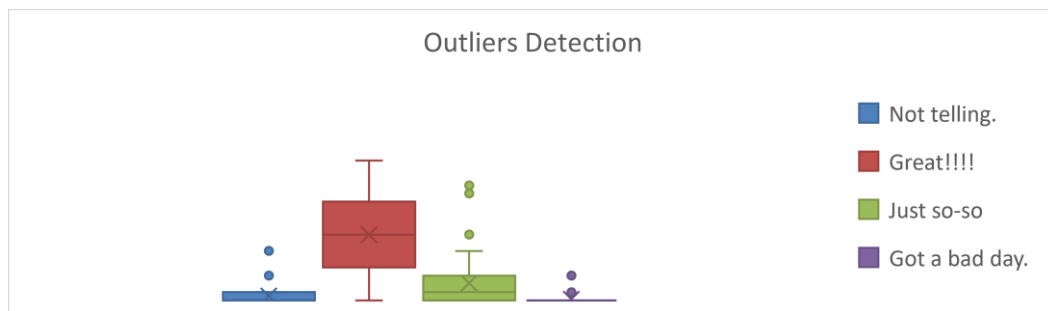
Figure 4.2: Outliers Analysis

Our analyses on relationship between emotion engagement with course learning outcomes attainment are shown in figure 4.3. Based on the visual analysis, there are more student who did not feel positive and excitement during the face-to-face session that manage to get a good score (>50) in final exam. Nevertheless, there are also student who feel positive and excitement but did not doing well during the final exam (score <50).
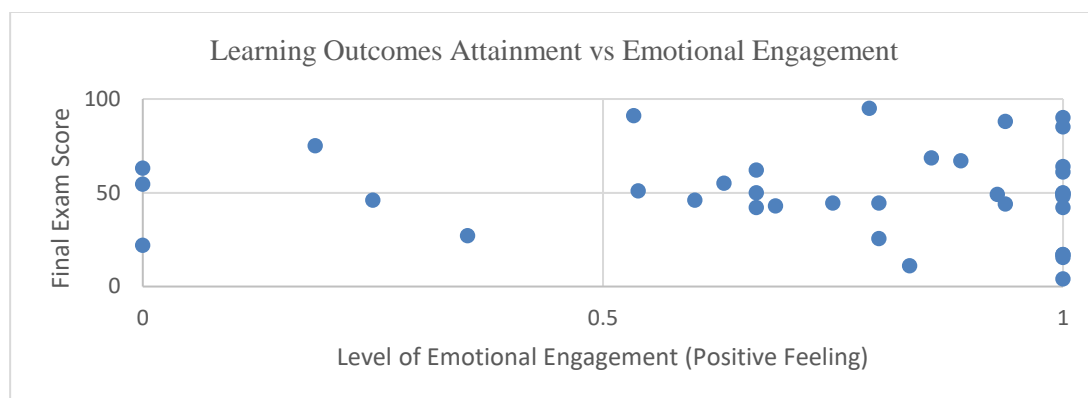

Figure 4.3: Emotional Engagement Analysis

4.1.3. Cognitive Engagement vs Learning Outcomes Attainment
Cognitive engagement is measured based on the self-reflection activity where student need to rate their perceived level of learning experience for each face-to-face session in the online attendance form. Figure 4.4 shows all student have high cognitive engagement during the class session. The findings indicate that there are several students who have very high level of cognitive engagement (perceived score =1) but their score in final exam still in a poor attainment. There are high variations of these two indicators which suggest that more research can be done to uncover the insight from this data.
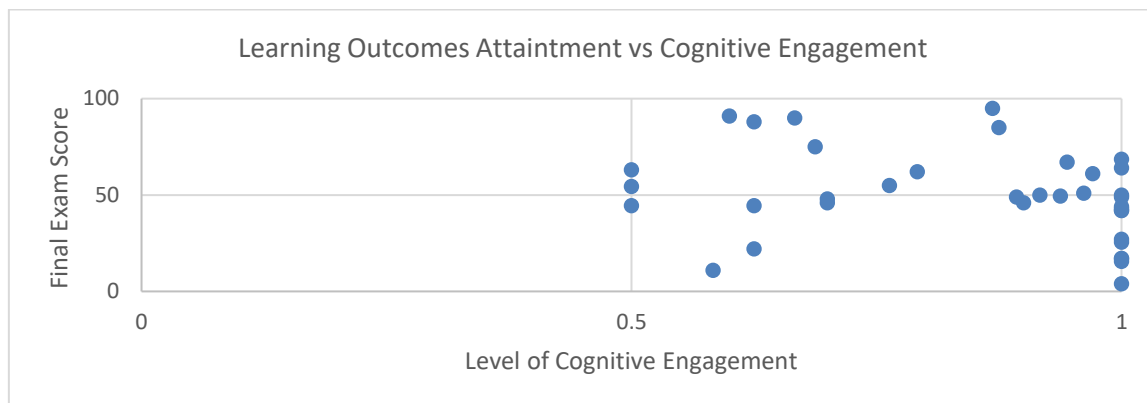
Figure 4.4: Cognitive Engagement Analysis

4.2. Online Attendance, Learning Engagement and Blended Learning
Based on the findings in figure 4.1, figure 4.3 and figure 4.4, we can confirm that our proposed data model integrated in online attendance can support learning engagement analytics. The results answer our second research question on how online attendance system can support learning engagement analytics.

5. Conclusion and Future Works

This paper aims to propose a novel contextual engagement data model that capable to measure student engagement in class using attendance analytics. Based on the findings, the proposed data model (figure 3.1) for online attendance system allowing learning analytics to be implement targeting on all dimension of student engagement. This data model in measuring student engagement is the first to be reported in research.

As for recommendation, the proposed data model can be integrated in existing student online attendance system for campus wide implementation. With the integration, more insight on engagement can be produced particularly on the aspect of curriculum improvement and how institution can further understand and manage student engagement in effective and predictive manner. In the future, we are planning to integrate this data model in online attendance system for the general courses enrolled by large number of students to study either the size of the class and location in the class do affect level of student engagement. Issue on holistic student development associated with the quality of welfare among student who live off-campus accommodation also potential can be studied based on our proposed learning engagement data model. We also plan to adopt emotional engagement elements in our existing research study regarding online divorce management system to study how engagement play a role in the quality of decision making.

6. Acknowledgement

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