

# Conceptual Model for Profiling Student Behavior Experience in e-Learning

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**Abstract**—Most e-Learning web application known as Learning Management Systems are associated with collaboration in a web page. It allows a user to interact directly with multiple application in any web platform together with other users. However, the action of the users has not been thoroughly analyzed. Due to the medium of teaching, implementation is through online. It is necessary to analyse each student behaviour characteristics of blended learning implementation so that lecturer can adjust how online activities are performed. In this paper, we propose a conceptual model in profiling student behaviour in e-Learning based on metadata approach and Community of Inquiry Model. We adopt a metadata approach in collecting student experience in e-Learning and Community of Inquiry Model to mapping the online student experiences. This conceptual model provides the basis for evaluating student behaviour characteristics in online learning with the goal of improved student engagement and online activity design.

**Keywords**—e-Learning, Analytics, Engagement, Student Behavior

## 1 Introduction

A learning process involves the process of acquiring and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviours [1]–[3]. This process also involves cognitive, linguistic, motor and social skills [4]–[7]. The term learning also has been used to show the behaviour of a person who is not only able to do something different but also be able to engage in implementing and building new actions and modify existing ones [1], [5], [6].

Technology has now made learning more open. It is no longer using the traditional approach but has entered a new era with the use of various technologies. The use of online learning and the use of web 2.0 applications have increased learning opportunities [8]–[10]. Typically, to apply e-Learning, most universities will use a system application to simplify the management of learning. It is known as a Learning Management System (LMS) [11]. The use of this application provides various advantages either as

instructors or students in facilitating learning and potential to attract students to conduct independent learning [11], [12].

Blended learning (BL) offers an attractive education program by combining teaching and learning (T&L) activities through the use of information technology [13]. In this mechanism, a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path or pace [14], [15]. In blended learning, a form of learning called flipped classroom is perceived to be a suitable technique for T&L [14], [15]. As the practice involves in online education, it is hard for the lecturer to monitor student engagement in the course. The data collected from the activity necessary to improve the quality of learning and optimise the teaching mechanism and help lecturer push the course accurately. One of the methods of studying student profile is to study their behaviour. Through analysing student behaviour, can help lecturer understanding individual student characteristic and plan the guidance process.

The student profiling in e-Learning comes from the concept of web user profiling which is involved in building semantic-based user profile (consist of contact information, educational history, demographic, and preference/interest, etc.) from the unstructured web [16]. It is fundamental issues for understanding user behaviour on the online platform. The process involves the collection, processing and analysis data generated from student action or behaviour [16].

Given the e-learning data, the Metadata approach is used to collect student activity using the Experience API. Experience API (xAPI) is a standard in storing the person or group activities from many technologies. Clustering and prediction method then applied to analyse the e-Learning characteristic based on defined student profile model.

## **2 The Definition of Engagement**

Engagement is considered a desirable human response to technology-based activities. To ensure learning take place with the way of technology teaching or content provided, the material developed should engage their audiences.

### **2.1 Student engagement**

Engagement consists of users, activities, attitudes, goals and mental models, and motor skills and can be shown in the form of attention, intrinsic interest, curiosity and motivation [17]–[20]. Student engagement generally described as a student actively engages with the content provided in the course in the way of thinking, talking and interacting with[21]. Student engagement is essential to keep the student connected throughout the sessions [17], [22], [23]. Student engagement also used to describe to the ability of the student to participate in sessions activity such as attending class, submit assignment and follow the classroom activity.

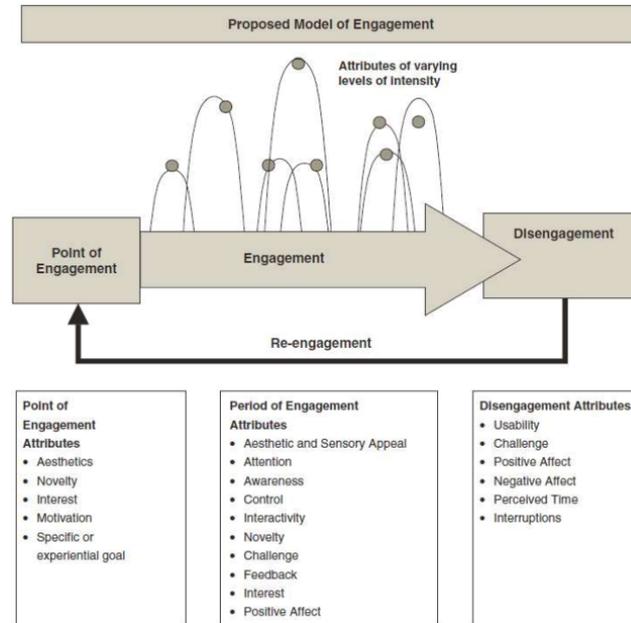


Fig. 1. A proposed model of Engagement [17]

As shown in Figure 1, O'Brien and Toms [17] provide a conceptual model to study human engagement with technology. This model explains that the entire process of engagement consists of four stages; the point of engagement, a period of sustained engagement, disengagement and re-engagement. Point of engagement is recorded when the first time of the user performs the first action to the system. The period of sustained engagement is when the same action periodically performs by the user. Disengagement is shown when the period of sustained engagement ends. In web system analytical it is also known as exiting the page. There are three types of engagement as listed by Davis [24] Behaviour Engagement, Relational Engagement, and Cognitive Engagement.

## 2.2 Student behavior

One component in student engagement is student behaviour [25], [26]. In research done by J.S. Lee showed that behavioural engagement partially mediated the effect on overall engagement [27]. Online student profiling can be described as a unique characteristic of student behaviour in the online environment taken from metadata inclusive of student activity, object and verbs. It is recorded as multi-dimensional and in multi-angle. The analysis factor can be derived from human engagement theory which includes analysis indicator, influence factor such as student behaviour, data collection, data cleaning and student profile building and analysing

### 2.3 Student behavior profiling

To described and profile student action in e-Learning, We use the Community of Inquiry model to relate the student action in e-Learning towards learning experience. Community of Inquiry (CoI) model [28] is a description of how learning happens through the experience in education. As shown in Figure 2, The CoI model listed three intersections that presence through educational experience, which is social, cognitive and teaching presence [28]–[30].



Fig. 2. Community of Inquiry Model Diagram [28]

Social presence is the ability of participants to project their individual personality to identify and communicate with the community and developed inter-personal relationships. In the e-Learning system, this can be found when the student or participant had interaction with the group or discussion done in the courses [29], [30]. Cognitive Presence is the extent to which learners can construct and confirm meaning through sustained reflection and discourse. This type of presence can be seen when a student or participant participate in the activity by showing and demonstrate cognitive engagement in the event. Teacher Presence is the design, facilitation, and direction of the social and cognitive processes to realising the relevant learning outcomes

The mapping between activity trail in metadata e-Learning with learning design elements and participation experience as a table in table 1. The mapping use design elements in a classroom situation according to output with the student experience. This based on the theory of CoI that adopted, and we match up with the activity in e-Learning elements. With the metadata that we received from student online e-Learning experience, it matches with e-Learning experience obtained when student involves in e-Learning elements that suggested.

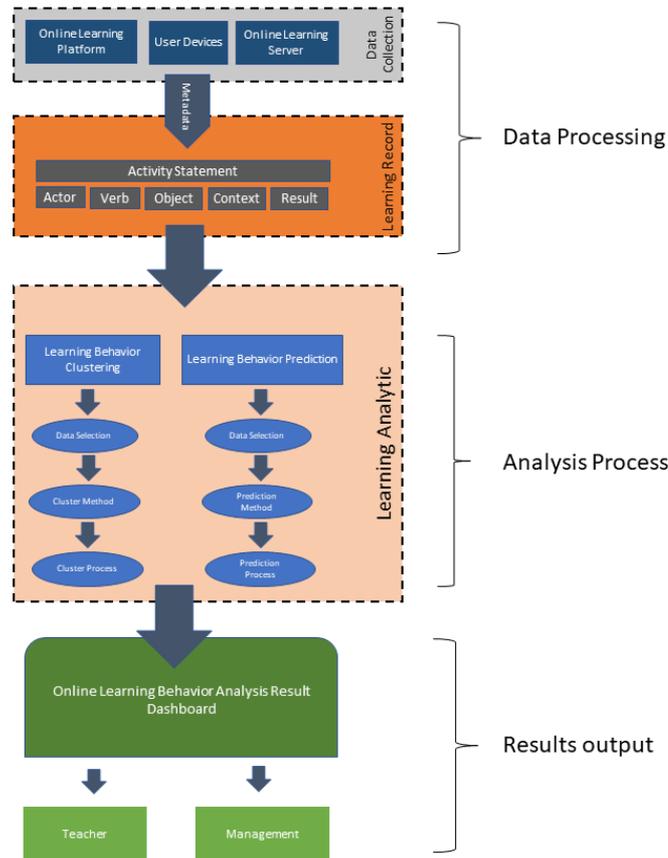
**Table 1.** Mapping of e-Learning Design element and Behaviour Learning Path

	<b>Design Elements</b>	<b>Student Experience</b>	<b>e-Learning Elements</b>	<b>e-Learning Experience</b>
Cognitive Presence	Challenge or Question Exploration of Problems Proposing Solution Resolution	Sense of Puzzlement Information Sharing Connecting Ideas Apply New Ideas	Courses Assignment Content Quiz Feedback	View courses Submit assignment View content Download content Interact with feedback
Social Presence	Communication Group Cohesion Collaboration	Valuing of Learning Opportunity to Express Views Encouraging Collaboration	Forum Discussion Workshop Databases Chat BigBlueButton	Reply to the forum Involve in discussion Submit group assignment
Teaching Presence	Instructor Guidance Building Understanding Motivating	Defining and Initiating Discussion Topics Sharing Personal Meaning Focusing on Discussion	Assignment Feedback Q & A Forum	Create an assignment Create a Quiz Grading Quiz Upload Notes/Content

The output of the implementation of this collaborative inquiry process is engagement [27], [29]. As the CoI is designed around the Practical Inquiry Model, The purpose of the model is to engage learners in deep and meaningful learnings.

### 3 Conceptual Model

A Conceptual model is a representative of the whole system that made on the composition of the theoretical and concepts. This to help people to understand and give guidance in the development and represent abstract ideas of the arrangements.



**Fig. 3.** Proposed Conceptual model Diagram

The conceptual model shown in Figure 3 is the complete model to guide us for our objective for visualising and analysing online student behaviour. The conceptual model includes three major parts, which are data processing, analysing and result in output. The first phase of the model is data processing. In the data processing part, it is consisting of the platform itself and the method of student experience tracking using metadata. As shown in Figure 4, is the example view of the learning management systems (LMS). Each activity in the order will be tracked. The data obtained from an online student from different sources, which is from an online platform, user devices or learning server data log. The data pushed to learning records server via metadata in the form of an activity statement. This type of data structure describes the packaging and transmission of learner action between any tools in the online learning platform. As shown in figure 5 is the example appearance of learning records store that serves metadata records received from LMS. This record store stored each action performed by the student, including results obtained from each activity.



Fig. 4. Main view example of Learning Management System

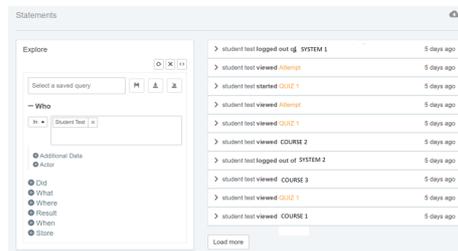


Fig. 5. Example of record store source view

In the 2<sup>nd</sup> phase will be the analysing part that divides into two sections; cluster analysis and learning behaviour prediction. At first, data will be going for cleaning and pre-treatment process. In this part, the data pre-processing technique will be done to removes redundant data, discard unwanted data and retain user data for the next operation. As the data already push from the sources in a standard format, there is no need for standardising data after the cleaning process as regulating information already done in the first phase of data acquisition. After that, the method of processing will be chosen, and the analysis will be processed. As shown in Figure 6 is sample data in JSON format before the data exported into CSV.

The analysis then performed using Weka (Figure 7). In this paper, we use KMean analysis in performing clustering technique. Data in Weka imported using CSV format.



Fig. 6. Sample data in JSON format

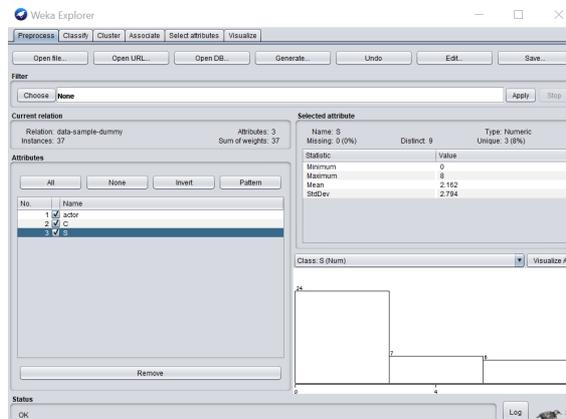


Fig. 7. Example preprocessing process of sample data using Weka for kMean Analysis

The 3<sup>rd</sup> phase is the final part that concludes the output into the result that understands by end users. The result will be visualized as a dashboard system.

#### 4 Result and Discussion

Based on the conceptual model, we have collected some sample data based on metadata that proposed. From the sample data, we have visualised it using simple direct query method to show that based on the activity data, we can track the student activity. As shown in Figure 8 below, is the sample data we collect using JSON and export it into CSV.

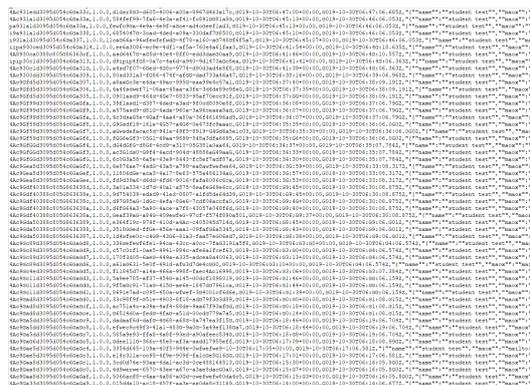


Fig. 8. Example dummy data exported into CSV format

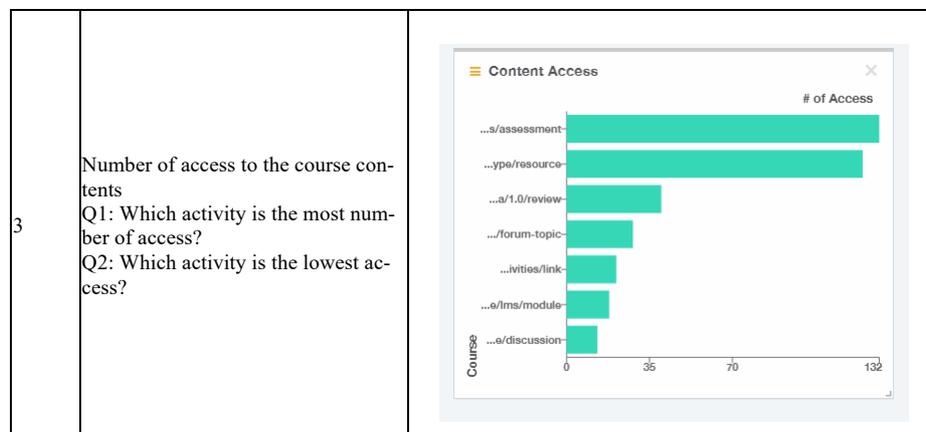


**Fig. 9.** Example Query Statements input

From the data, we use a query language. As shown in Figure 9 is the query statement page to visualise the data according to the query statement. The sample output for each query statement, as shown in Table 2 as below:

**Table 2.** Sample of query statement with visualisation output

No	Query Statement & Question	Visualise
1	<p>Total of activity for the course within 30 days</p> <p>Q1: Which day is the highest activity in a month?</p> <p>Q2: Which day is the lowest course activity in a month?</p>	
2	<p>Number of access to the course within seven days</p> <p>Q1: Which day in a week has high access to the courses?</p> <p>Q2: Which day in a week that has the lowest access?</p>	



For the first and 2<sup>nd</sup> query statement the data intended to view as the number of activities in the course within 30 days, activities here including notes downloading, answer quizzes, submitting assignment and another courses activity. For the 2<sup>nd</sup> query, it shows the number of students accessing the courses within a week with the visualisation that done. The lecturer can see which preferred day/time of student actively use the content in the course so that lecturer can plan to have activity in the day that student highly active in LMS. For LMS administrator, this data gives an overview which time and day that need to have more server resources use. This also helps for the System that hosted in a cloud environment, so an administrator can plan when and how significant resources can be assigned to the system server.

The 3<sup>rd</sup> query is the number of a hit for each activity. This help lecturer to identify which event is the most favourite activity in the course. For the administrator, they can see which modules the highest hit is. Thus, the modules should be well maintained or applying proper server resources for the activity.

With the data and visualisation done, it supports the conceptual model proposed. Although the result only uses simple visualisation technique, it can use other mining technique to support the findings.

## 5 Summary

In this paper, based on the conceptual model that suggested. The theory of mapping student behaviour to the learning experience is defined. The analysis of learner's behaviour and to profile student is done using simple machine learning tools and big data processing technology. The student activity data collected using a metadata approach using Experience API (xAPI) standards. Clustering and prediction method then applied to analyse the e-Learning characteristic based on defined student profile model KMean is used in classifying student behaviour accordingly so that lecturer can decide the best activity for students. Student profiling helps lecturer identify suitable activity to increase engagement in their blended learning implementation.

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