

Business Intelligence Model for Monitoring Blended Learning Usage

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Abstract—Online learning for students and for lecturers are one of the fastest learning trends in Institute of Higher Education (IHE) in Malaysia. The Ambient Insight Comprehensive Report (2015) estimated that Malaysia is 3rd top self-paced e-Learning growth in Asia, since 2010. In April 2011, Malaysia launched the Malaysia Education Online (MEdO) national online learning portal. The goal of new National e-Learning Policy is to have 30% of all higher education courses delivered online by 2015. Moreover, 90 percent of higher education already has an e-Learning policy, and most 70 percent make use of online learning or blended Learning compulsory among their lecturers and students. The internet-based learning application, interactive blended learning approaches, and which blended learning is effective for supporting lecturers teaching competencies were explored. This paper demonstrates the integration several data sources of online learning systems in UUM (known as UUMLearning) to systematically monitor the usage of blended learning tools. The Blended Learning is defined as using several items in an online learning system (UUMLearning), which is complying with the requirements setting by the IHE. The information required to be captured and analyzed is determined prior to perform the data pre-processing and produce results of monitoring blended learning usage. Therefore, the Business Intelligence and Data Warehouse approach have been used to capture, process, integrate and analyze data on blended learning utilization in order to understand the usage of blended e-learning technology among the lecturers in Universiti Utara Malaysia (UUM).

Index Terms—Blended Learning; Business Intelligence; Data Warehouse; Online Learning.

I. INTRODUCTION

Institutes of Higher Education (IHE), is expectedly passionate about the actualizations of their goals and attainment of their visions to be an eminent university in this region. This undoubtedly brought a fair apprehension to the decision making process of the university, and the need to compete with other universities to achieve edge-cutting decision making abilities that have necessitated a heavy investment in human resource development, and infrastructure that included training technology [1]. According to [2], human capital development which is determined by the quality of teaching and learning delivered by the IHE should take a prominent attention because it serves as the primary metric through which the performance of the university is measured and the quality of service is ranked.

Currently, most of the IHE's interest is accompanied with appropriate college, goal, and the corresponding learning strategies. Moreover, IHE is positioned to be the engine room for national human resource development due to their capacity and capability of providing human and intellectual resources, and competencies that tally with the Malaysia

Education Blueprint 2013-2015 [3][4]. Indeed, as IHE evolved to both internal and external pressures, depending on output of academic research and publication, teaching and learning, human capacity building, and innovation are topmost of their focused service delivery. This is essentially done with a high degree of well strategic planning, in a competitive environment that rewards success, and an entrepreneurial approach to attracting the resources necessary to be successful. Universiti Utara Malaysia (UUM) as one of the well-establish IHE in Malaysia continuous enhance performances through improving their teaching and learning facilities. A meta-analysis of more than 1,100 empirical studies published between 1996 and 2008 concluded that blended learning proves to be more effective than either online learning or face-to-face instruction [5].

As shown in Figure 1, 75% lecturer needs to use Blended Learning in 2025. Currently, 90% of higher education already has an e-Learning policy, and most 70% make compulsory the use of online or blended e-Learning. Since the goal of National e-Learning Policy is to have 30% of all higher education courses delivered online by 2015, and 50% by 2025, thus the university should strategically provide the facilities for blended learning, especially on software, hardware and technology.

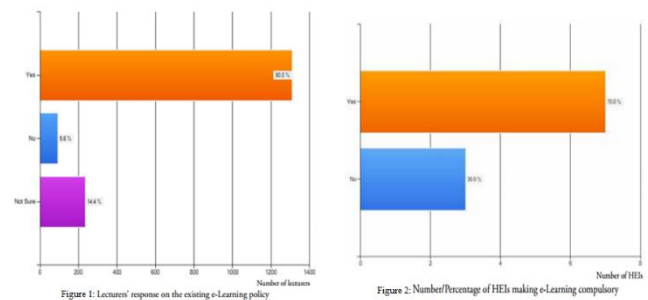


Figure 1: Lecturer's Response on the e-Learning Usage

Using an advanced technology for teaching and learning (T&L) (i.e., e-Learning) is one of the UUM approaches to support the high level of educational implementation. The completed documents for T&L, preparing by the lecturers is used together with the teaching technology to accomplish a blended learning implementation. However, in the university organizational structure, the usage of the e-Learning technology was not properly monitored. The current usage of e-Learning technology with the university's missions and goals have bring responsible for management to make a decision about the T&L direction [6]. This required university to explore of its data and devising means of how to implement

best T&L approach, and makes more sense of the data in view of supporting decision making process for enhancing UUM T&L system. Therefore, it is responsible for researchers to extract, transform, drill, and analysis the data produced by e-Learning technology implementation by using Business Intelligence and Data Warehouse (BIDW) approach. The BIDW is mainly employed to improve the quality of the decision making process by combining operational data with the appropriate analytical technologies to produce information and knowledge. Moreover, BIDW is an excellent framework for maintaining the historical data for the purpose of data analytic in a very efficient way [7].

II. BLENDED LEARNING TECHNOLOGY USAGE

Currently, online learning overlaps with the broader category of distance learning, which encompasses earlier technologies such as correspondence courses, educational television and video conferencing. These technologies were not significantly different from regular classroom learning in terms of effectiveness. The question of the relative efficacy of online and face-to-face learning needs to be analyzed, due to enhancement of today's online learning applications, which can take advantage of a wide range of cloud-web resources, rich multimedia contents, web and mobile-based applications and new social media collaboration technologies. These forms of online learning are more advances from the televised broadcasts, video conferencing, and traditional e-learning that characterized earlier generations of distance and self-learning education.

Particularly in UUM, the interest in hybrid approaches that blend in-class and online activities is increasing and compulsory for all lecturers to implement it. With blended learning, the tried-and-true traditional learning methods are combined with new technology to create a synergistic, dynamic learning structure that can propel learning to new paradigm. Blended Learning is defined as using several items (e.g., resources, forum, quiz, assignment) in an online learning system (UUMLearning), which is complying with the requirements setting by the IHE. However, the usage of this blended e-learning technology is still questionable. The UUM management and lecturers want to know the status of blended e-learning usage and under which conditions are the blended e-learning is effective, especially for building lecturers teaching competencies. By knowing this, a management can take necessary actions to improve the e-learning services, and at the same time a lecturer can take appropriate actions to utilize the e-learning technology. Indeed, this research was performed a pragmatic approach to evaluate the usage of blended e-learning technology, and has focused on lecturer, school, course, and semester status. Based on current planning for blended learning implementation, only 30% of the courses are required to be in blended status.

A. Data Warehouse Requirement for Monitoring Blended e-Learning Usage

According to the university authority, the implementation of blended e-learning technology required to perform the following tasks: i) to perform a data gathering and integration based on existing blended learning usages from several of data sources, ii) the collected data will be used to analyze requirement of analytic that determined prior for performing the analyses, iii) the effectiveness of this blended learning

approach is still questionable and need to be identified, iv) to analyze the usage of blended learning approaches, and v) based on the analyses, related stakeholders can take necessary actions to improve the e-learning services and utilization. Therefore, this research developed a data analysis model to monitor the usage of blended e-learning, especially the using of blended learning technology by the lecturer. The usage of blended learning can be defined as number of T&L elements provide in the blended learning system. The amount of elements will determine blended status of each subject taught by the lecturer. Therefore, the data analysis model was developed by using Business Intelligence and Data Warehouse (BIDW) approach to capture, process, integrate and analyze the blended usage by using data provided from the blended learning system. The model utilized the data warehouse (DW) schema for data storage and the data produced from the DW will be further analyzed, and used for monitoring the usage of blended e-learning technology.

B. Current Research in Blended Learning Technology

Current works on online learning or blended learning is focused on evaluation of the effectiveness of this technology by using a survey method. However, very few study using an "evidence" based method, which is the evaluation data taken from the blended learning system itself. This is important approach in this research to perform analysis from the data captured, cleansed, and transformed from the blended learning system. As comparison from the previous works, Table 1 shows the summary of the research work.

Table 1
Research Works on the Online Learning or Blended Learning

Researcher	Description
Sulaiman [8]	This study concerning of Malaysian undergraduate science physics students' and pre-service science teachers' perceptions of learning through online.
Al-rahmi et al. [9]	This study is centered on evaluating the e-learning effectiveness in UTM. And in this study, the critical factors affecting e-learning effectiveness were investigated through a survey conducted on students as participants.
Azizan [10]	Conducts an exploratory study of blended learning in higher education institution (HEI) in Malaysia. The focus is on understanding what it means by blended learning and benefits that can be identified.
Hussain [11]	Study about strategic planning and implementation of e-Learning in several higher education institution (HEI) in Malaysia. The method is based on Roger Kauffman n's (1992).
Fadzil et al. [12]	Study about the implementation of Massive open online courses (MOOCs) in Malaysia that are very recent development and progress.
Sun et al. [13]	This study developed an integrated model with six dimensions: learners, instructors, courses, technology, design, and environment.

III. RESEARCH METHODOLOGY

This research adapts the design science approach [14], which has emphasized the understanding, developing, executing and evaluating of information system. This approach describes the process to identify, develop and evaluate the BIDW model for analyzing the usage of blended e-Learning Technology used in the IHE. The BIDW model utilized DW schemas to capture and transform relevance data required for monitoring the blended learning usage. Therefore, this research focuses on building and evaluating the new BIDW model for analyzing the usage of blended e-

learning technology, which comprise of three phases as illustrated in Figure 2.

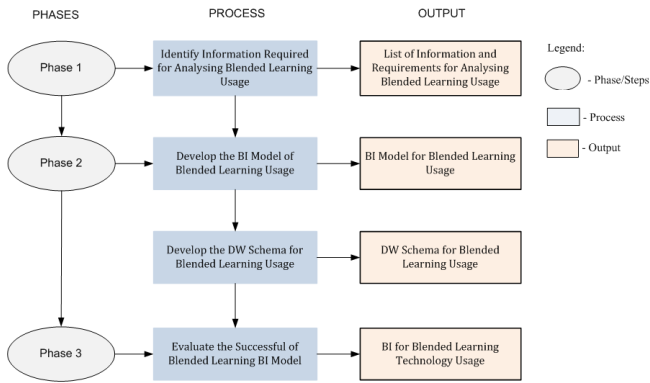


Figure 2: Research Methodology

In DW, measure is used for data analysis, therefore the identified measures for the usage of blended e-learning technology is identify as information required for analyzing the blended learning usage. The entire process to capture, clean, transform, and loading the required data for analyzing is shows in BIDW model as illustrated in the Figure 3.

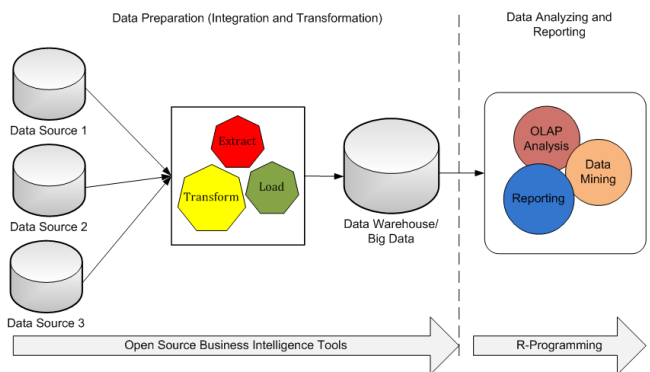


Figure 3: BIDW Model for Blended e-Learning Technology Usage

These measures used for blended learning technology is based on the “Fact” or “Evidence” of learning practices in the IHE [4], especially the used of e-learning technology in UUM. The success of the objective to develop BIDW model is achieved, and implementation of BIDW model was carried out by using appropriate tools. Several tools was used for particular purpose such as: MySQL and Excel used for DW storage, Talend Open Studio for Data Preparation and Big Data for data cleaning and transformation, and PHP and R Programming used for data analysis and reporting. Therefore, the usage of blended learning technology can be understood, and the improvement of the blended learning implementation are suggested.

IV. FINDINGS

The findings of this research are to identify measures to be analyzed that determine the used of blended learning, and to define the BIDW model for supporting the analyzing blended learning technology usage. This is important to ensure the usage of blended learning technology will fulfill the University requirements, and consequently support lecturer responsibility to deliver quality T&L to the students. Therefore, by understanding the requirements of blended learning usage through University management and the

blended learning system it helps research to design the DW schemas accordingly. Based on the user requirements and current data provided by the blended learning system, the DW schemas for blended learning usage is designed as illustrated in Figure 4.

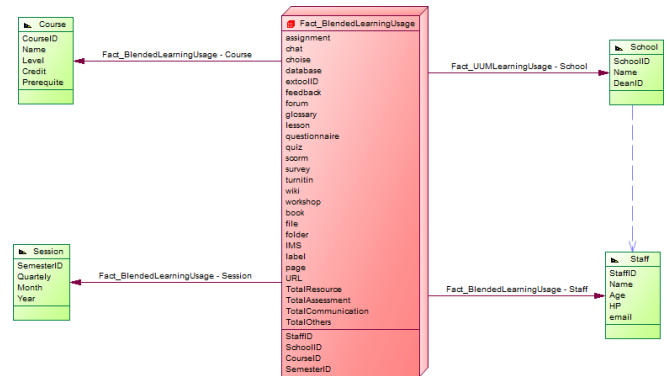


Figure 4: DW Schemas for Blended e-Learning Usage

The measures were identified as total number of assignment, chat, feedback, forum, quiz, files, total number of resources, assessment, communication, and others. These measures were supported by four dimensions such as staff, school, course and session (semester). The status of blended usage determined by analyzing the data provided in measures and dimensions. Prior to the data analyzing, the data preparation has been performed by using Talend tool. This task is known as extract, transform, loading (ETL) as illustrated in Figure 5.

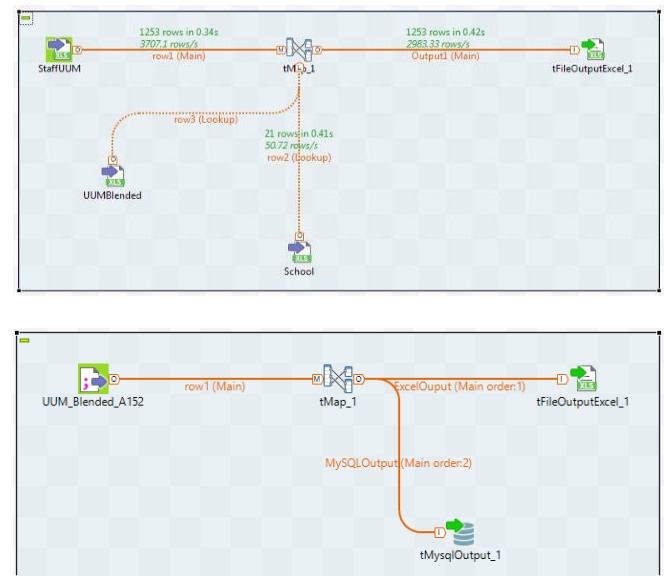


Figure 5: Some tasks in extract, transform, loading (ETL)

The data loading to the DW will be the final results from the ETL process. However, this data will be updated if the data sources for blended learning usage are changes. For data analysis, the usage of blended learning according to lecturer, school, subject and session has been carried out. By using R Programming, the status of blended learning has been analyzed, and example of the results can be published to the web application as shown in Figure 6.

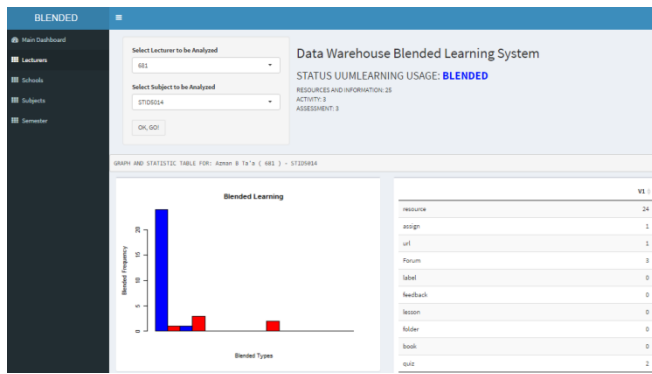


Figure 6: Results for Blended Learning Status

Further research works will explain the evaluation process of the BIDW model, which the work will be focused on the implementation of the prototype BIDW application by the stakeholders such as lecturers and Department of Teaching and Learning (DTL) who have responsible for using the blended learning system.

V. CONCLUSION

The aim of this research is to develop a BIDW model for monitoring blended learning usage, and later it can be used to design and implement the analysis of the blended learning usage. Particularly, the approach to understand the requirement and implement the BIDW model is considered the new elements of the blended learning usage. The process to clean and transform data toward the DW schemas, a free and open source tool Talend has been used successfully. Then, the prototype of BIDW application was developed by using R Programming for ensuring the BIDW model can be implemented in real teaching and learning environment. However, the testing and evaluation of usefulness of the BIDW approach will be conducted later. Moreover, the BIDW model for monitoring blended learning technology usage was shown in the prototype applications, and this can help the university management and lecturer to acknowledge the status of blended learning usage instantly.

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