DATA WAREHOUSE SYSTEM FOR BLENDED LEARNING IN INSTITUTIONS OF HIGHER EDUCATION

*Azman Ta'a, Mohamad Shahbani Abu Bakar, Suwannit Chareen Chit, Mohd Hafeez Mohd Soid

School of Computing, College of Arts and Sciences, Sintok, Malaysia

*Corresponding author's email: azman@uum.edu.my

Abstract

Online learning is a growing trend for lecturers and students in Malaysian Institutions of Higher Education (IHE) today. Malaysia's National e-Learning Policy aims that 30% of all higher education courses is delivered online by 2015. Currently, 90% of Malaysian IHEs have online learning policy, and almost 70 percent have imposed it on their lecturers and students. However, there is a lack of approaches to systematically monitor the effectiveness of online learning implementation. This paper demonstrates the integration of several data sources of online learning systems in UUM (known as UUMLearning) to systematically monitor the usage of blended learning system. The information required to be captured and analyzed is determined prior to performing data preprocessing, and produce results of monitoring blended learning usage. The Business Intelligence and Data Warehouse method have been used to capture, process, integrate and analyze the blended learning data in order to monitor the usage of blended e-learning technology among the lecturers. The results have shown that the usage of blended learning can be monitored successfully by lecturers and university management.

Keywords: Online Learning; Blended Learning; Business Intelligence; Data Warehouse; Data Analytic;

1.0   INTRODUCTION

Malaysian Institutions of Higher Education (IHE) are expectedly passionate about the actualizations of their goals and attainment of their visions to be 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 cutting edge decision making abilities that have necessitated a heavy investment in human resource development, and infrastructure that included training technology (Ayodele & Sotola, 2014). According to Commonwealth of Learning (2010), human capital development which is determined by the quality of teaching and learning delivered by the IHE should be given 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 (Embi, 2011; MOHE, 2013). 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-planned strategies in a competitive environment that rewards success, and an entrepreneurial approach to attracting the resources necessary to be successful. Universiti Utara Malaysia (UUM) is one of Malaysia's well-established IHE is continuously seeking to 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 online learning and face-to-face instruction (Means et al., 2009).
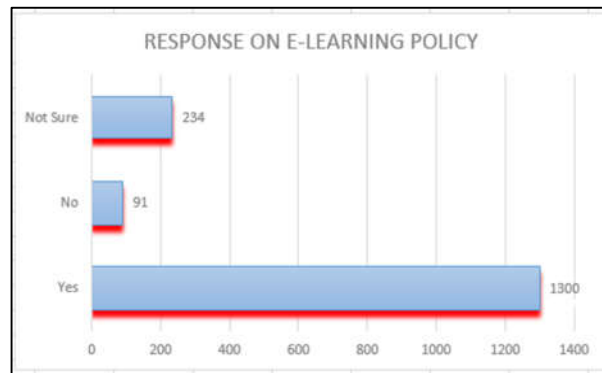

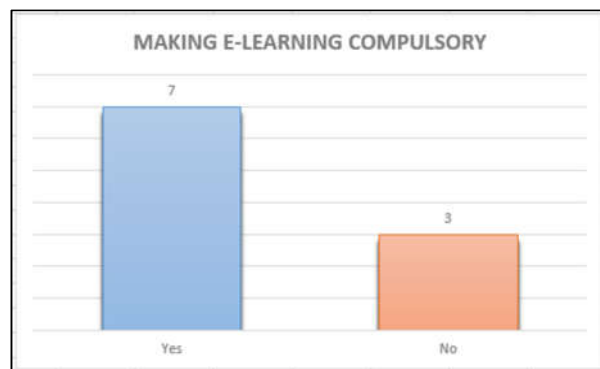**Figure 1 Lecturers' Response on the e-Learning Policy**

Figure 2 IHE Making e-Learning Compulsory

As shown in Figure 1-1, 80% of lecturers are already aware of Malaysia's online learning policy. It is worth noting that 90% of IHE already has an e-Learning policy, and 70% of IHE have imposed compulsion on the use of online learning as illustrated in Figure 1-2. 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, universities should strategically provide the facilities for blended learning, especially on software, hardware and technology.

Using an advanced technology for teaching and learning (T&L) (i.e., e-Learning) is one of the UUM's approaches to support the implementation of high-level education. The completed documents for T&L, prepared by the lecturers are used together with the teaching technology to accomplish blended learning implementation. However, in the university organizational structure, the usage of the e-Learning technology is not properly monitored. The adoption of e-Learning technology is aligned with the university's missions and goals. Therefore, it is imperative that the university management makes strategic decisions on the T&L direction (Bakar & Ta'a, 2014). This required university to explore its T&L data and devising means of how to implement the 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 analyze the data produced by e-Learning technology implementation by using the Data Warehouse system approach. The DW is mainly employed to improve the quality of decision making process by combining operational data with the appropriate analytical technologies to produce information and knowledge. Moreover, DW is an excellent framework for maintaining the historical data for the purpose of data analysis in a very efficient way (Sidorova & Torres, 2015).

2.0 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 advanced 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 is compulsory for all lecturers to implement it. With blended learning, the tried-and-true traditional learning methods combined with new technology creates a synergistic, dynamic learning structure that can propel learning to the new paradigm. Blended Learning is defined as using several items (e.g., resources, forum, quiz, assignment) in an online learning system (UUMLearning), which complies with the requirements set by the IHE. However, the usage of blended e-learning technology is still questionable. UUM management and lecturers are curious about the status of blended e-learning usage, and under which conditions are the blended e-learning is effective especially for building lecturers teaching competencies. Having this information, 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 is carried out using a pragmatic approach to evaluate the usage of blended e-learning status, and focusses on lecturer, school, course, and semester. Based on current planning for blended learning implementation, only 30% of the courses is required to be in blended status.

2.1 Data Warehouse Requirement for Monitoring Blended e-Learning Usage

The university has outlined a set of guidelines required for the implementation of blended e-learning technology. Generally, e-learning needs to encompass 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 is determined prior for performing the analyses, iii) the effectiveness of this blended learning approach that 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 usage of blended learning technology by lecturers. The usage of blended learning can be defined as number of T&L elements provided in the blended learning system. The amount of elements will determine the blended status of each subject taught by a lecturer. Therefore, the data analysis model is developed by using Data Warehouse (DW) system approach to capture, process, integrate and analyze the blended usage by using data provided from the blended learning system. The model utilized the 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.

2.2 Current Research in Blended Learning Technology

Current work 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 use the "evidence" based method, which is the evaluation of data taken from the blended learning system itself. This is an important approach in this research, particularly to perform analysis from the data captured, cleansed, and transformed from the blended learning system. A comparison of previous work is tabulated and summarized in Table 1.

Table 1 Research Work on the Online Learning or Blended Learning

Researcher	Research Work	Description
Fauziah Sulaiman (2014)	Online Learning in Higher Education in Malaysia: A Case Study of Students' Future Expectations	This study concerning Malaysian undergraduate physics students' and pre-service science teachers' perceptions of learning online.
Waleed Mugahed et al. (2015)	The Effectiveness of Using E-Learning in Malaysian Higher Education: A Case Study Universiti Teknologi Malaysia (UTM)	This study is centered on evaluating the e-learning effectiveness in UTM. In this study, the critical factors affecting e-learning effectiveness were investigated through a survey conducted on students as participants.
Farahiza Zaihan Azizan (2010)	Blended Learning In Higher Education Institution In Malaysia	This study conducts an exploratory study of blended learning in higher education institutions (HEI) in Malaysia. The focus is on understanding what it means by blended learning and benefits that can be derived.
Raja Maznah Raja Hussain (2004)	e-Learning in Higher Education Institution s in Malaysia.	Study about strategic planning and implementation of e-Learning in several higher education institutions (HEI) in Malaysia. The method is based on Roger Kauffman n's work (1992).
Mansor Fadzil (2015)	MOOCs In Malaysia: A Preliminary Case Study	This project studies the implementation of Massive Open Online Courses (MOOCs) in Malaysia that is a very recent and still progressing in Malaysia.
Pei-Chen Sun et al. (2006)	What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction	This study developed an integrated model with six dimensions: learners, instructors, courses, technology, design, and environment.

3.0 RESEARCH METHODOLOGY

This research adapts the design science approach (Vaishnavi & Kuechler, 2015), which emphasizes the understanding, development, execution and evaluation of information system. This approach describes the process to identifying, developing and evaluating the DW system model for analyzing the usage of blended e-Learning used in the IHE. The DW system model utilized DW schemas to capture and transform relevant data required for monitoring blended learning usage. Therefore, this research focuses on building and evaluating the new DW system model for analyzing the usage of blended e-learning, which comprises of three phases as illustrated in Figure 2.
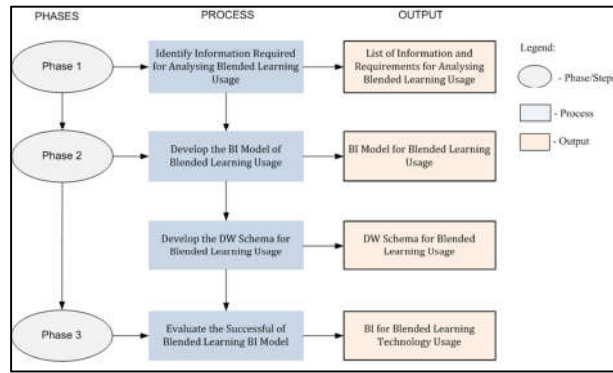
Figure 3 Research Methodology

In Figure 2, Phase 1 is conducted to get better and clear understanding of all information required for the DW. Several issues such as what is blended learning (BL), what are the components to measure BL, what are the formulas to calculate BL, what are the reports to generate, who are the stakeholders using BL and many more that are related to BL can be answered. Table 2 shows the summary of UUMLearning components and the minimum requirement for learning used to qualify a subject a blended learning.

Table 2 UUMLearning Components

UUM Online Leaning Module / Components				
No	**Information**	**Resources**	**Activities**	**Assessment**
No. of Components	2	7	12	3
1	File / Syllabus	Book	Chat	Assignment
2	Label	File	Choice	Quiz
3		Folder	Database	Turnitin Assignment
4		IMS Content	External Tool	
5		Label	Feedback	
6		Page	Forum	
7		URL	Glossary	
8			Lesson	
9			Scorm Package	
10			Survey	
11			Wiki	
12			Workshop	
Minimum Requirement	1	7	3	2

Based on Table 2, the requirement of the DW is to calculate measurement of the total number of information (TI), total number of content (TC), total number of activities (TA), and total number of assessment (TAS). Later, these measurements will be used to calculate the status (i.e., blended or not blended) of the lecturer's online learning usage. Figure 3 shows the formula that is currently used to calculate the blended learning status.

$$\text{Blended Course} = (TI >= 1) + (TC >= 7) + (TA >= 3) + (TAS >= 2)$$

Figure 4 Formula to Calculate Blended Learning Status

Based on the formula, the term of Total Information (TI) means a lecturer needs to upload at least 2 items under information part. The Total Content (TC) refers to the need to upload at least 7 items under content part. The Total Activities (TA) is a matrix which requires the lecturer to conduct at

least 3 activities, while the Total Assessment (TAS) requires the lecturer to make at least 2 assessments for that academic session. However, the formula can be changed by Malaysian Ministry of Higher Education (MOHE) from time to time. Currently, the minimum requirement of blended learning (MRB) used in this research is in ratio of 1:7:3:2. A lecturer needs to fulfil for at least 1 Total Information (TI), Total Content (TC) of at least 7, Total Activities (TA) of at least 3, and lastly, Total Assessment (TAS) of at least 2. MOHE is responsible to monitor the success of BL implementation and already set a target for every IHE to achieve 40% of the total course offered for that semester to be blended.

In UUM, the University Teaching Learning Centre (UTLC) is a unit responsible for implementing online learning. The researchers have held several discussions UTLC to gain greater insights on the real issues in implementing the UUM online learning system (UUMLearning). From the discussions, the requirements for BL usage are identified and used to model the DW. Generally, in DW the measure is used for data analysis. Therefore, the identified measures for the usage of blended e-learning are identified as information required for analyzing the blended learning usage. The entire process to capture, clean, transform, and loading the required data for analyzing in DW system model is illustrated in Figure 4.
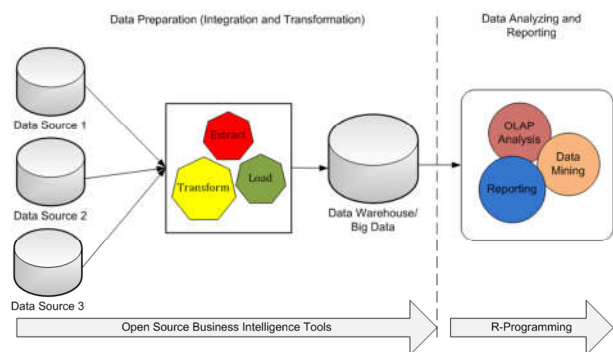

Figure 5 DW System for Blended e-Learning

These measures used for blended learning technology are based on the "Fact" or "Evidence" of learning practices in the IHE (Means et al., 2009), especially the use of e-learning technology in UUM. The success of the objective to develop DW model is achieved, and implementation of DW model was carried out by using appropriate tools. Several tools were used for particular purpose such as: MySQL and Excel were used for DW storage, Talend Open Studio for Data Preparation and Big Data for data cleaning and transformation. PhP and R Programming were used for data analysis and reporting. Therefore, the usage of blended learning technology can be understood, and the improvement for blended learning implementation can be proposed.

4.0   FINDINGS

The findings of this research are to identify the measures to be analyzed which determine the use of blended learning, and to define the DW model for supporting the analysis of blended learning technology usage. This is important as to ensure that the use of blended learning technology will fulfill the University requirements, and consequently support lecturer responsibility to deliver quality T&L to the students. Therefore, having a clear understanding of BL requirements helps IHE management as well as providing the researchers a clear guideline 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 5.

The measures were identified as total number of assignments, 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 learning usage is determined by analyzing the data provided in measures and dimensions. Figure 6 shows the logical data map (LDM) for data transformation design of the DW.

LDM is used to design the data integration and transformation process in DW system (Ta'a, Abdullah & Norwawi, 2011). The LDM presents the data transformation process starting from four (4) various data sources that are required to be extracted for transformation and preparation in the DW blended learning. The four (4) data sources are Personnel Information System (PERSIS), Graduate Affairs Information System (GAIS), Academic Student Information System (ASIS) and UUMLearning System. Prior to analyzing the data, the data preparation that has been presented by LDM is performed by using Talend tool . This task is known as extract, transform, loading (ETL) as illustrated in Figure 7-1 and 7-2.
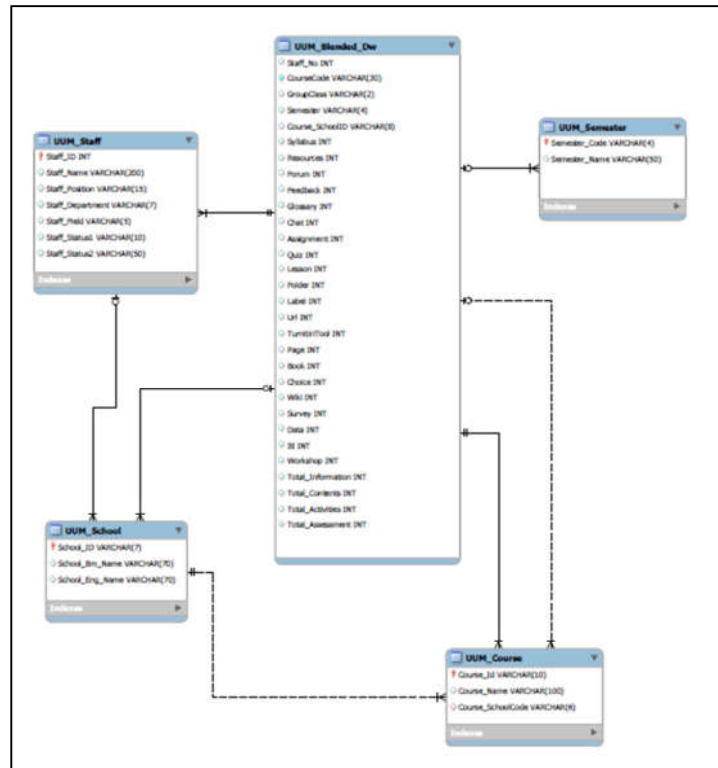

Figure 6 DW Schemas for Blended e-Learning Usage

Table Name : UUM_Blended_DW
Table Type : Fact Table

Target							Source					
Column Name	Description	Data Type	Size	Primary Key	Foreign Key	Default Value	Source System	Table Name	AttributeName	Data Type	Size	ETL Rules
Staff_No	Refer to Staff UUM ID	int	8	No	Yes	0	PERSIS	AcademicStaff	StaffID	int	8	Dimension Table
CourseCode	Refer to Course ID	varchar	30	No	Yes	NULL	GAIS / ASIS	Course	CourseID	varchar	30	Dimension Table
GroupClass	Refer to Group Class for every subject	varchar	2	No	Yes	A	UUM Learning	Group	GroupID	varchar	30	Set Default Value = 'A'
Semester	Refer to Academic Semester	varchar	8	No	Yes	NULL	GAIS / ASIS	Semester	SemesterID	varchar	15	Dimension Table
Course_SchoolID	Refer to which school that offer that course	varchar	8	No	Yes	NULL	GAIS / ASIS	School	SchoolID	varchar	15	Dimension Table

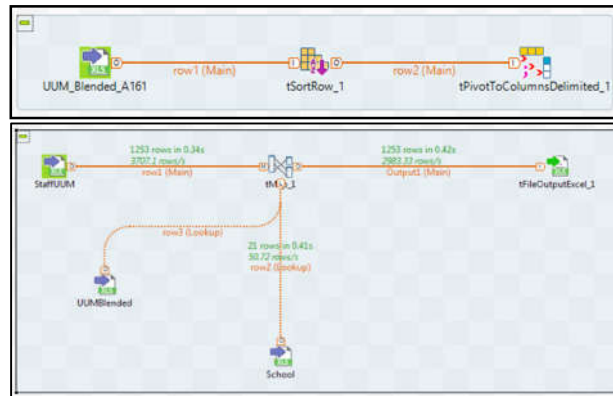**Figure 7 LDM for the DW**

Figure 8 Some tasks in extract, transform, loading (ETL)
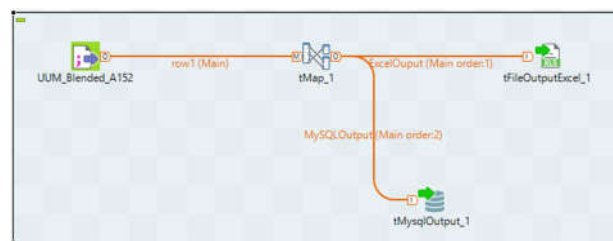

Figure 9 Some tasks in extract, transform, loading (ETL)

The final result gathered from the ETL process is then loaded to the DW. However, this data will be updated if the data sources for blended learning usage are changed. For data analysis, the usage of blended learning according to lecturer, school, subject and session has been carried out. 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 8.
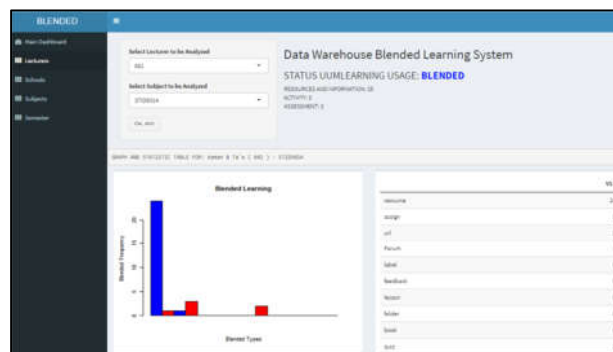

Figure 10 Results for Blended Learning Status

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

5.0   EVALUATION

An online survey has been conducted for evaluating the usability of the prototype DW system by using System Usability Scale (SUS) method (Brooke et al., 1996). The selection of SUS is based on the notion that this method is robust and provide valid measurements for a wide range of technologies usability acceptance (Sauro & Lewis, 2011). The survey consists of two parts, namely the demographic question and the usability of the DW system for monitoring blended learning usage.
There are three questions in the demographic part, which are about gender, age and academic background. This type of questions is used to identify the group of users are that involved in the survey. Part two consists of 15 questions that focus on usability of the DW system for monitoring blended learning usage. It is used to identify whether the system is able to fulfill the needs of the users such as the lecturer and management.

A number of 34 participants responded to the survey and most of the participants are from the academic background. These respondents were targeted as they possess great understanding about blended learning and have experienced using it before. Figure 9 shows the interface of the online questionnaire.

Of the 34 respondents surveyed, 68% are female while 32% are male. They are from various academic background, and hold various qualifications such as doctoral degree, Masters degree, undergraduate degree and Diploma. Four (4) types of age group participated in this survey. 35.3% forms the age-group of between 20 -30 years old. 32.4% age between 31- 40 years old while 26.5% age between 41 – 50 years old. The rest of the respondents are between 51 – 60 years old. The results have shown that monitoring blended learning usage system (MBLUS) is simple to use (about 61% agree) as shown in Figure 10. Overall, 64.7% participants are very satisfied with this system as shown in Figure 11.

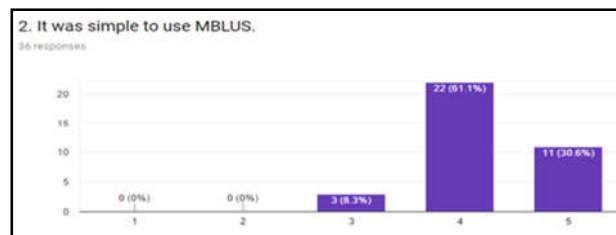**Figure 11 Interface of Questionnaire**

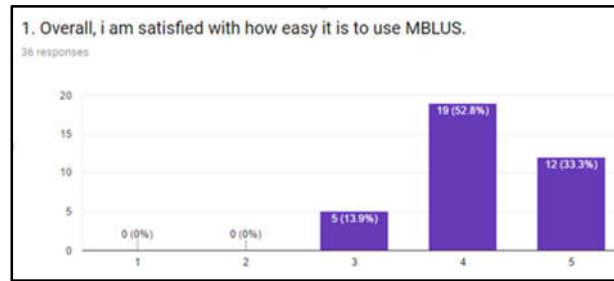**Figure 12 Questionnaire for Simple Use**

Figure 13 Questionnaire for Overall Feedbacks

As the result, the usability survey has shown that, most lecturers are very comfortable with the DW system and satisfied with the design of the system. It also shows that around 85.3% participants believed that the DW system can give clear information (such as contact, online help, on-screen messages and other documentation) that are related to blended learning. Meanwhile, almost 85% of participants agreed the DW system is able to help them in completing the tasks and scenario of blended learning in the future. It shows that 85.3% also agreed that the DW system helps them to solve issues on which part of blended learning item that they still not be able to follow the formula of blended learning, and the DW system will inform them. This is a main part that makes the DW system become interactive to the users. Indeed, at any time the lecturer can check their status of blended learning easily.

This research has produced the model of the DW system for blended learning and the DW schemas for blended learning usage. The proper DW schemas (i.e., star schema) have been designed and implemented sucessfully for the blended learning usage. The DW model follows the dimension modeling approach, which emphasized on summarizing data for data analysis. This research has achieved the objectives to design a DW system for blended learning used in IHE. Finally, the evaluation has been conducted to measure the usability of the DW system. The results from the questionnaire has showed that the DW model can be used to capture the information required by the blended learning, especially information about the blended learning status. Moreover, the DW system can fulfill different types of queries based on the ad-hoc and pre-defined report that is required by the users in the future. However, further analysis of the DW data was not able to be performed due lack of requirements provided by the stakeholders.

6.0   CONCLUSION

The aim of this research is to develop a DW model for monitoring blended learning usage, and later used to design and implement the analysis of the blended learning usage. Particularly, the approach to understand the requirement and implement the DW model considers the new elements of the blended learning usage. The process to clean and transform data toward the DW schemas is been implemented by using a free and open source tool called TALEND successfully. Then, the prototype of DW application was developed by using R Programming and the evaluation of usability is performed for ensuring the DW system can be implemented in real teaching and learning environment. Moreover, the DW system for blended learning usage has been developed as the prototype applications, and this can help the IHE management and lecturer to acknowledge the status of blended learning usage instantly. Further research will enhance the level of data analysis, which will utilize the DW schemas accordingly for performing the predictive and prescriptive analytics model of blended learning usage.

ACKNOWLEDGEMENT

Reference

Ayodele, T., & Sotola, O. (2014). China in Africa: An evaluation of Chinese investment. Initiative for Public Policy Analysis, 1–20.

Azizan, F. Z. (2010). Blended learning in higher education institution in Malaysia. In Proceedings of Regional Conference on Knowledge Integration in ICT. pp. 454-466.

Bakar, A., Shahbani, M., & Ta'a, A. (2014). BUSINESS INTELLIGENCE MODELLING FOR GRADUATE ENTREPRENEUR PROGRAMME. Journal of Information & Communication Technology, 13.

Brooke, J., & others. (1996). SUS-A quick and dirty usability scale. Usability Evaluation in Industry, 189(194), 4–7.

Embi, M. A. (2011). e-Learning in Malaysian Higher Education Institutions: Status, Trends, & Challenges. Kuala Lumpur.

Fadzil M., Latif L. A., Shariffadeen, T. A. M. T. M. A (2015). MOOCs in Malaysia: A preliminary case study. Paper presented at E-ASEM forum: Renewing the lifelong learning agenda for the future, Bali, Indonesia. pp. 1-17.

Hussain, R. M. R (2004). e-Learning in higher education institutions in Malaysia. Retrieved from http://library.oum.edu.my/oumlib/sites/default/files/file_attachments/odl-resources/4322/elearning-higher.pdf

Learning, C. of. (2010). Teacher education through open and distance learning. (P. A. Danaher & A. Umar, Eds.). commonwealth of Learning, Vancouver.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. US Department of Education.

MOHE (2013). Education Blueprint Planning. Kuala Lumpur.

Mugahed, A. R. W. , Othman, M. S., &b Mi Yusuf, L. (2015) The effectiveness of using e-learning in Malaysian higher education: A case study universiti Teknologi Malaysia. *Mediterranean Journal Of Social Sciences, 6*(5S2). 625-637. Retrieved from http://www.mcser.org/journal/index.php/mjss/article/view/7686

Pei-Chen, S., Ray J. T. Finger, G., Yueh-Yang, C. Dowming, Y. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers and Education, 50*(4), 1183-1202.

Sauro, J., & Lewis, J. R. (2011). When designing usability questionnaires, does it hurt to be positive? In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2215–2224).

Sidorova, A., & Torres, R. (2015). Business Intelligence and Analytics as a Foundation for Organizational Dynamic Capabilities. In AMCIS 2015. AIS Electronic Library (AISeL). http://aisel.aisnet.org/amcis2015/

Sulaiman, F. (2014). Online learning in higher education in Malaysia: A case study of students' future expectations. *International Journal of Humanities and Social Science, 4*(8), 124-128. Retrieved from http://www.ijhssnet.com/journals/Vol_4_No_8_June_2014/12.pdf

Ta'a, A., Abdullah, M. S., & Norwawi, N. M. (2011). Goal-Ontology ETL Processes Specification. Journal of Information and Communication Technology (JICT), 10, 15–43.

Vaishnavi, V. K., & Kuechler, W. (2015). Design science research methods and patterns: innovating information and communication technology. Crc Press.