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ONLINE LEARNING: TRENDS, ISSUES, AND CHALLENGES IN THE BIG DATA ERA

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Nowadays, many students access online resources using their mobile devices, substituting this for traditional learning interactions. However, the new concept of 'big data' in recent ICT discussions extends the promising research direction on online learning and big data integration. Big data promises content that can be tailored for each student based on the context and Internet behaviour of users in online learning. This study examines recent Internet activities and literacy in Brunei Darussalam (Brunei) relating to the Internet behaviour and online learning of residents. The study highlights milestones in terms of recent issues, challenges, and trends in Internet activities, focusing on online learning and its potential in the big data era. An extensive nationwide survey was conducted to ensure the reliability of the data. The survey revealed that people in Brunei expect and demand better learning services and experiences through an online learning system

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to improve literacy as well as the quality and efficiency of learning. Regardless of the limitations of the survey, the general public has shown great support for online learning systems. The results of the survey provide a solid argument for further research on big data in online learning by developing a framework incorporating the expectations of the people. Finally, the study provides a baseline for future studies of Internet adoption in Brunei.

1 Introduction

The use of online learning in the Internet era is not new. Deploying online learning has helped education providers to improve the efficiency and effectiveness of their services (Puzziferro & Shelton, 2014; Su *et al.*, 2014; Park & Lim, 2015). Online learning systems can be referred to as electronic learning (e-learning) or mobile learning (m-learning), and their use in managing the processes of teaching and learning through information and communication technology (ICT) has become standard practice by many education providers worldwide.

However, providing better online learning services has become a challenge in response to the advancement of ICT, especially in the era of big data. As the use of big data has spread, businesses have started to accommodate the idea of big data into their strategic information systems to gain a competitive advantage (Lu *et al.*, 2014; Wixom *et al.*, 2014; Couldry & Turow, 2014; Morabito, 2015; Anshari, Alas, & Guan, 2015). Similarly, the use of big data in the educational context promises better delivery of teaching and learning, thereby enhancing the quality of services. Therefore, this study is significant in shaping the development of education-related technology that is more responsive in terms of context and content-based adaptability. To this end, big data offers more customization and personalization of services included in the educational process.

To explore the expectations of students in relation to online learning, we conducted a nationwide survey of online learning in Brunei. The survey was designed to reveal the demographic traits of potential users and their views on e-learning services, as well as disseminating the potential benefits of e-learning to the public. The objective of the survey was to assess the respondents' awareness of and demand for various Internet activities, as well as online learning. The study provides core information about Internet literacy in Brunei and public opinions regarding online learning services. It provides a basis for further research into education technology focusing on big data and online learning. The survey is also part of further research into the key features in the implementation of online learning systems that will assist users and improve customer satisfaction and literacy among the population, which may lead to a reduced economic burden in the long run. The results also help to portray the current state in terms of demographic patterns and public opinion regarding

the online learning initiative.

The survey revealed that Brunei has a well-educated and highly skilled population, especially in terms of applying ICT skills. The survey also revealed that the majority of respondents like to use the services provided by online learning. The rest of the paper is organized as follows. In Section 2, we present the background of the study. The technical details and analyses of the survey are presented in Sections 3 and 4, respectively. Section 5 provides future directions for research, and we present our findings in Section 6, which concludes.

2 Literature Studies

The adoption of online learning programs in education has provided a new experience for students, education providers, instructors, and the community (Anshari & Alas, 2015b). Innovations in learning technology will continue to have a major impact on approaches to teaching and learning over the coming years. With recent developments in ICT, especially the adoption of Web 2.0 technology such as social networks, blogs, wikis, and video sharing, online learning technology can be enhanced further. In addition, the emergence of cloud computing has improved the capabilities of the online learning process whereby online learning providers can offer electronic learning (e-learning) or mobile learning (m-learning) that is more cost efficient, easier to access, and more reliable. Online learning providers can be either government organizations or private institutions. In this section, we briefly trace the adoption of ICT by educational institutions and portray it in the context of Brunei.

2.1 ICT and Education

Education providers have pushed to integrate the latest technologies into their study modes, content delivery, management, and curriculum. Alas and Anshari (2014) noted that e-learning is able to connect diverse audiences, who all have the same access to high-quality learning. The adoption of online learning can benefit institutions by enabling them to strengthen their position in the community, and at the same time, the use of advanced ICT can provide the institutions with a competitive marketing strategy.

The evolution of ICT in education started when Massachusetts Institute of Technology (MIT) used a computer-based flight simulator to train pilots. Then, IBM released the first commercialized computer into the market. In 1967, Apple introduced the Apple II, also known as the personal computer. By 1996, one in twelve students in the United States had computer access (Arora, 2007). The Internet boom of the 1990s was another milestone in terms of asynchronous forms of education, and distance learning captured the attention

of students. Asynchronous education is a mode of content delivery whereby participants are not required to access materials at the same time, but can do so according to their own schedule. This can be in the form of email, voice mail, or audio or video recordings. However, synchronous technology requires participants to be present at the same time, for example to participate in video conferencing, Internet radio, live streaming, etc. In 2007, one in five university students was enrolled in an online education program in either a synchronous or an asynchronous mode (Arora, 2013). The other form of online education technology is adaptive learning, whereby the online education system modifies the presentation of each student's contents in response to observed aspects of student performance (Venkatesh *et al.*, 2014). How can content be tailored for each online learning student based on their Internet behaviour? The answer to this question lies in the concept of big data.

As students become more attached to ICT, they use a variety of tools that enable them to interact, generate content, and share information via social media platforms (Anshari & Alas, 2015a). The adoption of Web 2.0, in particular social networks, in education settings can increase students' participation. For instance, less sociable students become more confident and participatory, ensuring that all students are engaged. However, there is little evidence of any positive correlation between social networking and students' performance. Furthermore, the adoption of mobile learning (m-learning) in education gives students the opportunity to learn anywhere and anytime.

ICT offers students the opportunity to browse for information quickly, and allows them to collaborate on projects in the learning process. However, they should view technology as a means to enhance their learning. In addition, while social networks allow students to interact, there is a lack of emotional relationships compared with face-to-face interaction. Therefore, how do institutions balance technological demands, social needs, and educational achievement?

Finally, in terms of adoption, a major trend in educational technology is cloud computing. In relation to Learning Management Systems (LMS), cloud computing has fundamentally changed the ability of higher-education institutions to adopt online learning tools. Cloud computing gives them the ability to adopt the latest online learning systems without investing heavily in IT infrastructure. It also offers reliability of service, because resources are managed in a trusted environment.

2.2 Big Data

Massive amounts of data are being created every second across the Internet. In a competitive environment, the ability to explore data and understand customer (student) behaviour, offer personalized and customized services, and gain

insights from data from multiple sources is key to maintaining a competitive advantage. The concept of big data provides new opportunities to maximize the potential of data collection in relation to online learning systems. These opportunities can be viewed from the perspective of both students and service providers (universities, institutions, government departments, and policy makers). Big data offers more precise customization and personalization of knowledge and services for each student than ever before. Consider the following scenario. Students take an online learning IT course, and prior to each online lecture, materials are provided by the instructor. In addition, the system supplies relevant and reliable links to resources for each topic of discussion. Whenever they complete a quiz or test, the students are provided with the answers and feedback, as well as further links to material related to the concepts covered by the questions. Based on big data analytics, it is possible to forecast which students have the potential to pass the subject or course. Service providers can also evaluate the most appropriate content to transfer to students based on their personal interests. Policy makers are able to use big data analytics to develop forecasts and plans in relation to their vision. With the advancement of social networking sites, students generate records of their lives by frequently posting details of activities they undertake, events they attend, places they visit, pictures they take, and things they enjoy and want. This massive amount of data is what is collectively known as big data (McAfee & Brynjolfsson, 2012; Franks, 2012). Previous studies have utilized various tools such as Social Networks Adapting Pedagogical Practice (SNAPP) to understand various students' blogs so that the instructor understands the students' quality and therefore how to develop the course structure or make decisions based on this context (Purba *et al.*, 2013). However, social networks are not the only source of big data. Social networking sites can be considered as sources of structured data that are voluntarily generated by students. There are also huge amounts of unstructured data from various sources that can be integrated into big data analytics. However, there are always challenges in creating value added in online learning from big data gathered from both structured and unstructured data sources (Yu, 2013). This paper aims to suggest future directions in online learning systems using the concept of big data deployment based on the current Internet behaviour of people in Brunei.

2.3 Brunei Context

As an emerging country in Asia, Brunei has embarked on a progressive program of human capital development through learning and education. Brunei is a small country located on the island of Borneo in Southeast Asia, with an estimated population of 422,675 people. The level of Internet penetration in

Brunei is very high, among the highest in Asia at 75.4%. There is no doubt that Internet-based activities and transactions, including online learning systems, will increase in the future. Brunei shares a similar Malay culture to those of its neighbouring countries such as Indonesia and Malaysia, so that the results of the survey conducted in Brunei are representative of the general outlook of Southeast Asian countries. In terms of Internet literacy, according to the Oxford Business Group's 2010 report, the statistics on Brunei Internet users from 2006 to 2009 show an increase in the level of penetration to 78.5%. Brunei's network infrastructure was upgraded to a fibre-optics broadband service by August 2011. More recently, high-speed broadband has been deployed with a maximum data transfer rate of 150 megabits per second, more stable and wider network coverage (Abu Bakar, 2011). This is a promising development in relation to the online learning initiative. Both private and public education institutions in Brunei have adopted learning management systems in support of their teaching and learning. Nevertheless, online learning is not yet fully available in Brunei. Future online learning services may be promoted by a variety of providers, including the Ministry of Education, and public and private higher-education institutions.

3 Methodology

We used the convenience sampling method in which participants were selected from among colleagues, friends, families, and people in higher-education institutions across the country. The survey was conducted from October to November 2014. Most of the 856 respondents were local Bruneians and their ages ranged from 10 years old to more than 40 years old. Therefore, they represent a fair sample of the general population. The average time taken to complete the questionnaire was 8 minutes. There were no major problems in understanding the questionnaires because the majority of respondents were young, and nowadays the younger generations use the Internet and other electronic media far more than the elderly. The 24-item survey instrument that was tailored to the population for this study was divided into four sections. The first section included five items related to demographics. Four items in the second section related to the respondents' Internet usage habits. In addition, we gave the respondents the opportunity o provide additional comments. The responses to the items, as well as the comments, were analysed to explore the relationships among several of the variables and used to form future recommendations. In addition, the researchers employ meta-synthesis to

4 Results and Findings

Because no research has been published to date on online learning and recent trends in Internet activities in Brunei, this study aims to fill that gap. Many aspects are covered, including Internet literacy, Internet activities, and preferred online learning courses. Data gathered from the survey will be used to formulate recommendations and provide future directions and references for online learning in Brunei. From the survey, we found that expectations in relation to online services are high, which creates challenges for the government and education providers. In response to these expectations, it is necessary to develop strategies that incorporate components and features of ICT best practices as discussed in the Introduction.

4.1 Demographic Information

The first section of the survey questionnaire gathered data about respondents' gender, age, employment type, level of education, and residential district. The majority of respondents (73%) were undergraduate students. This is justified, because this age group is more exposed to online activities, including online learning. 12% of respondents worked in the government sector, while 8% of respondents worked in the private sector. The survey included more women (61%) than men (39%). This indicates that there are more female students than male students in higher-education institutions.

The majority of respondents (86%) were 11–30 years old, while 12% of respondents were aged 31 and above. This indicates that people aged from 11 to 30 years old are the most approachable, and their command of English is better than that of the other age groups, and so they were better able to understand the questionnaire. In terms of education level, the different education levels of the respondents might reflect their perspectives regarding online learning. 59% of respondents had either completed a degree or were studying at undergraduate level, while 10% had either completed or were studying for a postgraduate degree. 20% of respondents had completed high school, while 11% had only completed secondary school or below. This indicates that the majority of respondents had a relatively high education level. These findings regarding education levels might be reflected in the results in relation to other factors, such as their understanding of modern technology, especially ICT.

4.2 Internet Literacy

The respondents were questioned on how frequently they used the Internet. The survey revealed that almost all Bruneians, regardless of their age, had ready access to the Internet. 39% of the respondents use the Internet for 5–8

hours daily, 20% used the Internet for 9–12 hours daily, 17% used the Internet for more than 12 hours daily, and 24% used the Internet for less than 4 hours each day. The results show that the majority of the respondents were exposed to the Internet, and tended to use the Internet every day. It was interesting to learn that the majority of respondents connected to the Internet using both their personal computer (PC/laptop) and their mobile phone (72%), while 23% only accessed the Internet from their mobile phone, and 5% relied solely on their PC to access the Internet.

The majority of respondents (53%) described themselves as moderate users, which means that they know how to access and use the Internet, while 31% were advanced users who were aware of security and privacy issues in relation to Internet activities. Ten per cent of respondents were developers, meaning that they were able to develop websites or apps, while 6% were beginners who were still learning how to use the Internet. This indicates that Internet literacy in Brunei is high, a fact that is supported by the results regarding average daily use of the Internet, and is also in line with educational levels.

4.3 Internet Activities

In this section, we discuss the findings regarding the respondents' activities on the Internet. The questionnaire items asked about various online activities such as instant messaging (IM), blogs, Web browsing, etc. Blogging, IM, social networking, online gaming, and online learning were the activities that respondents were mostly engaged in while they were online. The majority of respondents indicated that they were moderately to highly active on IM, for example using WhatsApp, Snapchat, and Viber (67%), while 69% were active on social networks such as Facebook, Twitter, and Instagram. Blogging was also very popular among participants (64%), as was online learning (63%). Online activities in which participants were moderately active were online gaming (55%), file sharing (54%), online shopping (57%), and music or video streaming (41%). In summary, blogging and IM using apps such as WhatsApp or Line are the most popular online activities in Brunei.

4.4 Online Learning

The fourth section investigated the respondents' interest in online learning programs. The results showed that 64% of the respondents were interested in online learning, and most of them were between 20 and 40 years old. Our second question in this section asked, 'Which online program fits your interest?' Figure 1 shows that degree, certification, and training programs were the most popular. Since the majority of respondents were young people who

had been exposed to the Internet in their daily lives, 31% expected that online learning would be available for undergraduate degree programs, either using a blended approach or using online learning systems as the primary means. 29% of respondents expected that online learning would be available for training, followed by online certification programs (25%).

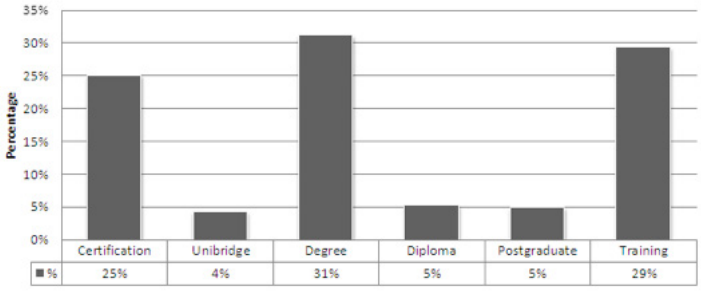

Fig. 1 - Respondents' interest in formal online learning programs.

The next question asked respondents which online courses they were most interested in studying. The results are shown in Figure 2. Since this was the first survey ever undertaken in Brunei regarding online courses, there was a high level of uncertainty. This was reflected in the survey results, wherein the majority of respondents (39%) chose 'Others' as their preferred online course. This may also have been because there were insufficient options provided for the respondents, many of whom were interested in courses such as art and design, sport, education, and engineering. Of the courses listed in the questionnaire, the most popular were information technology (IT), science, management, and social studies.

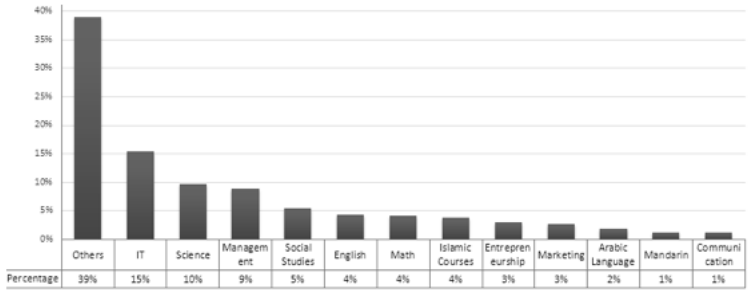

Fig. 2 - Preferred online courses.

Finally, our survey explored respondents' perspectives regarding online le-

arning. The results showed that 67% agreed that online learning would make it easier to learn, 53% were convinced that it would help them to obtain a better grade, and 87% believed that online learning was not limited to regular school hours. Furthermore, 67% felt that online learning would help to improve the quality of their projects and 53% saw it as a tool with which to share information and discuss subject-related matters, although 93% believe that face-to-face interaction with instructors and fellow students is still very important. In this regard, a blended approach can be a means of introducing online learning during the early stages of implementation.

5 Discussion

The survey revealed the key enablers and critical success factors that provide direction and the necessary resources to initiate and realize the potential of online learning from various stakeholders' perspectives. Understanding and managing these critical success factors are crucial for a successful online learning initiative.

The research points to the importance of demographic factors such as age, education level, and Internet literacy as important enablers in typical online learning initiatives. It is important to understand how these enablers have affected users' preferences for the types of online learning services that are offered. This survey examined several key enablers and provided insight into their relative impact on e-learning and m-learning systems. The following section presents some recommendations based on the survey findings.

Level of education affects the acceptability of systems and the competency of people to utilize them. A higher educational level means a higher probability of success. In the case of Brunei, the fact that education is freely available to everyone meant that the majority of respondents had completed high school, confirming that those who are sufficiently literate are more able to understand online learning systems when they are implemented.

In terms of gender composition, female students are more prevalent than male students in educational settings and activities. Female students tend to be more aware of the importance of a higher education level than male students. Regarding age composition, the majority of respondents are young (from 10 to 40 years old). This indicates that younger people are more likely to embrace online learning if it is offered, since they have had more exposure to ICT.

In terms of Internet literacy and accessibility, the majority of respondents are connected to the Internet and tend to use it every day. Furthermore, the level of Internet literacy among youngsters in Brunei provides no major obstacle for online activities, including online learning. Thus, it is expected that online learning will be embraced by the general population, as reflected in the survey.

Similarly, computer literacy in Brunei is an enabler of the online learning initiative, since it was found that the majority of the respondents use their PC or mobile phone on a daily basis. This indicates that most of the population is computer literate, and is able to use their PC and/or their smartphone to obtain information. Therefore, it is believed that online learning services will be accepted and supported by the public. Furthermore, we have already seen a very high positive response from the survey sample. In summary, the majority of respondents are young adults who have completed high school or beyond, which explains their preferences regarding the implementation of these systems.

With regard to future directions for online learning in Brunei, the results send a clear message to the higher-education institutions in Brunei that to take advantage of opportunities in online learning, they must focus on the students' preferences, and on service quality. To help extend knowledge sharing to the community, we propose that they consider innovations in online learning systems based on service excellence. Online learning systems are very popular, and offer convenience for students who lack flexibility in their daily schedules. However, a blended approach is a possible alternative for higher education in Brunei. The reasons for this include the advantages of combining the personal touch with personal technology. The personal touch enables students to interact directly with teachers and fellow students, so that they can ask questions and obtain immediate responses, thereby receiving direct guidance from instructors, which helps to avoid miscommunication and ensures greater conformity with course requirements. In addition, traditional learning systems offer a rich student life that provides a full range of experiences. Meanwhile, personal technology enables students to enjoy flexibility so that they can learn anywhere and anytime using ICT.

6 Challanges & Future Directions

In the era of big data, we are receiving a large amount of data every day from many sources. How big data can be used in the education setting, and how those data can be managed, analysed, and best applied to the teaching and learning process is a challenge facing all education institutions. Big data can be captured from the massive amounts of structured and unstructured data that are being produced, and can be used to create value in the form of patterns or relationships. Integrating big data into online learning has the potential to apply predictive relevant knowledge for each student. By embedding big data analytics within online learning systems, institutions can deliver services that understand contexts, predict outcomes, and continue to learn from the vast amounts of information that are continuously generated and collected.

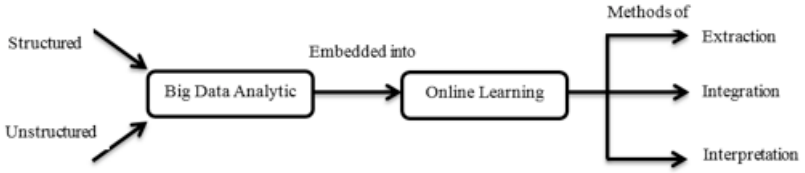

Fig. 3 - Big data research in online learning.

The amount of data generated from both structured and unstructured data sources by various student activities such as tweets, blogs, learning evaluations and social networks can enhance the ability of online learning systems to understand students' preferences and online behaviour. This means that online service providers are able to understand their students' needs, predict their demands, and optimize their use of online learning resources. This adoption of big data will become the future direction of online learning systems. There are at least three main challenges in using big data in online learning, as shown in Figure 3. The first is extraction of data from unstructured sources to be included in online learning systems. Second, there are issues relating to the integration of big data with the multiple platforms used in online learning. Finally, big data analysis requires expertise in interpretation to provide insights that can help users such as policy makers to make quicker and better decisions. Therefore, there is a need for extensive research into the domain of big data tools and analytics and their application to online learning technology in Brunei.

Conclusion

This study reveals important information regarding Internet-based activities and online learning in Brunei. Our survey indicates that there is a trend away from traditional face-to-face learning towards online learning. Respondents perceive that online learning offers benefits such as reduced travelling time for students and flexibility in their schedule. Online learning is convenient, as it can be undertaken anywhere and anytime through a simple click of a mouse or touch of a finger. In addition, online learning systems are very efficient, as learning via the Internet or apps only requires access to a website. The majority of participants are young and highly connected Internet users who like to use online media, although they are unsure about the effects of online learning on their study performance. Online learning systems present opportunities for students who are unable to leave their jobs, but can still enrol for online courses, and students who live a long way from the learning institution they wish to attend.

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