Faculty of Cognitive Sciences and Human Development

DESIGN AND DEVELOPMENT OF ARTIFICIAL INTELLIGENCE WEB-BASED CONTENT FOR ONLINE LEARNING AMONG UNDERGRADUATES

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DESIGN AND DEVELOPMENT OF ARTIFICIAL INTELLIGENCE WEB-BASED CONTENT FOR ONLINE LEARNING AMONG UNDERGRADUATES

NUR HASHEENA BINTI ANUAR

This project is submitted
in partial fulfilment of the requirements for a
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The project entitled 'Design and Development of Artificial Intelligence Web-Based Content for Online Learning among undergraduates was prepared by Nur Hasheena Binti Anuar and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfilment of the requirements for a Bachelor of Science with Honours (Cognitive Science).

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ABSTRACT

The Artificial intelligence (AI) course has been challenging for the undergraduate due to its approach in understanding the problem solving techniques and the algebraic equations that has been applied in the real world. This study aims to evaluate the effectiveness of the content using web-based learning for Artificial Intelligence course among undergraduates. This study was conducted using quasi-experimental design with pre-test and post-test. Constructivist principal and Jonassen's model has been adapted and applied in the delivery of AI content using Schoology learning management system. Quantitative statistics was applied on the questionnaire to analyse the data based on the treatment group of students' satisfactions. There are 100 students participated in the study. The valid scores data collected from the both group are 22 and the valid survey data collected is 24. The control group of students learned the AI content through traditional lecture while the treatment group of students learned through an online platform called Schoology. The data were analysed using descriptive analysis and inferential analysis. In conclusion, the study found that learning through constructed online platform as effective as learning in traditional classroom. Collaboration between course instructor and peers is the key to successful learning in both online and traditional classroom.

Keywords: effectiveness, Artificial Intelligence, Online Learning, constructivist instructional design, collaborative learning environment, student performance

ABSTRAK

Kursus Kepintaran Buatan telah mencabar bagi mahasiswa kerana pendekatannya dalam memahami penyelesaian masalah teknik dan persamaan algebra yang telah digunakan dalam dunia sebenar. Kajian ini bertujuan untuk menilai keberkesanan kandungan menggunakan pembelajaran berasaskan web bagi kursus Kepintaran Buatan dalam kalangan mahasiswa. Kajian ini dijalankan menggunakan reka bentuk kuasi-eksperimen dengan pra-ujian dan pasca ujian. Principal konstruktivis dan model Jonassen ini telah disesuaikan dan digunakan dalam penyampaian kandungan AI menggunakan Schoology sistem pengurusan pembelajaran. Statistik kuantitatif telah digunakan pada soal selidik untuk menganalisis data berdasarkan kumpulan rawatan untuk kepuasan pelajar. Terdapat 100 pelajar telah mengambil bahagian dalam kajian ini. Data skor sah dikumpulkan dari kumpulan kedua-duanya adalah 22 dan data kajian sah dikumpul adalah 24. Kumpulan kawalan pelajar belajar kandungan AI melalui kuliah tradisional manakala kumpulan rawatan pelajar belajar melalui platform atas talian yang dinamakan Schoology. Data dianalisis menggunakan analisis deskriptif dan analisis inferensi. Kesimpulannya, kajian ini mendapati bahawa pembelajaran melalui platform atas talian dibina sama berkesan sebagai pembelajaran dalam bilik darjah tradisional. Kerjasama antara pengajar kursus dan rakan-rakan adalah kunci kepada pembelajaran yang berjaya dalam kedua-dua bilik darjah atas talian dan tradisional.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

In this advanced technology of 21st century, internet has become a basic need or a medium for learners to search for resources and knowledge. This change the way people learn and practice online learning based on their preferences of time. This project focus on the design and development of artificial intelligence web-based content for online learning among undergraduate students. This chapter describes the background of study and pinpoint the problem statement followed by the research objectives and specific objectives of study. Then, the research questions are identified. Finally, significance of study and scope of the research also will be explained before the summary is provided.

Online learning is defined as the technology medium or context with which it is used (Moore, Deane, & Galyen, 2011). According to Benson and Conrad (2002), they identified online learning as a relatively new version of distance learning which increase access to educational opportunities for students characterized as both non-traditional and passive (as cited in Moore et al., 2011). Based on other authors, they agreed that it is not only about the openness of online learning and not limit to its connectivity, flexibility and capability to enhance varied interactions (as cited in Moore et al., 2011). This will open opportunities for learners to expand their knowledge through online learning which gives more advantages than the bad.

In general, online learning offers several advantages over traditional settings. Wachull states that web-based learning ease whose schedule or location makes it troublesome to attend a traditional classroom (as cited in Broadbent & Poon, 2015). Based on U.S. Department of Education in 2009, studies have found that students who study online have more chances to study information in additional access to learning resources, and higher

opportunities for collaboration, compared to those in traditional classrooms. Digital Learning Commons' Meeting 21st Century Learning Challenges in Washington State, the DLC has focused their evaluation research on the impact from online courses and have obtained consistent results. They obtained two important results after DLC has launched which are the increased graduation rates and college and workforce readiness. These may lead by several factors such as collaborations with other learners during the learning process, actualization of learning, and individual comprehension in a social manner (Aydemir, Özkeskin, & Akkurt, 2015).

The history of Open and Distance Learning (ODL) has been reviewed by Anderson and Dron in 2011 that it has undergo three pedagogical approaches which are cognitive-behaviourism, social-constructivism and connectivism (as cited in Aydemir et al., 2015). They claim that Cognitive-Behaviorist (CB) model as the primary generation of individualized distance education, which support many learners to get education at cheap costs than normal education (Aydemir et al., 2015). These may be one of the reason many learners prefer to take online learning than go for traditional classroom. The theory is supported by Daniel where he states that ODL allowed flexibility to learners (Aydemir et al., 2015). Thus, there are widely free online learning resources available in the Internet which provide new learning experience to tbose who has never taken online courses.

In a recent survey released on January 15th, 2014 by the Sloan (Allen & Seaman, 2014) "Grade Change: Tracking Online Education in the United States" most academic officers considering online education as a crucial fundamental to their long-term strategy has risen from 50% in 2002 to about 70% in 2012 but dropped to 65% in 2013 due to institutions without online offering as stated in the report (Brahimi & Sarirete, 2015). The result can be seen through the interest of academics and students at higher education, also the interest of students and teachers at high schools where top Universities has turned to new forms of

educational delivery called "MOOCs" (Massive Open Online Courses) (Brahimi, 2015). For instance, the most popular MOOCs provider like Coursera (US) has the largest and enormous range of courses covering many subjects and areas where the highest number of courses available is relevant to Computer Science and Humanities (Brahimi, 2015).

The fact that online learning offers many benefits to learner in terms of flexibility of time, cost and learning spaces, however, one might overlook on the deliverability of the online content. Before the content is deliver to learners, the learning application such as Blendspace, Moodle, and Schoology should design and structure carefully to support learning process at universities. According to Sun, Williams, and Liu (2004), they found that solely depending on technologies might not have much advantages and are not the key source for courseware design. Therefore, researchers noted that it is important to look at the technique of content delivery as well as the application of appropriate learning theory and paradigms, organisation of contents online as aspects in e-learning.

Artificial intelligence subject has been adapted as the content of study for the online learning. This topic is relatively new because the term "artificial intelligence" (AI) was only first introduced approximately fifty-years ago in the International Joint Conference on Computer Science in 1969 (Kornienko et al., 2015). The definition of artificial intelligence can be various. One of them is "the study of the computations that make it possible to perceive, reason, and act" adapted from a digital textbook "Artificial Intelligence" by Winston (1992). Nowadays, AI has become an important subject to learn where its application can help human solve real-world problem. For instance, we can use machine to control pests, prune trees, and selectively harvest mixed crops in farming (Winston, 1992). Furthermore, we can use a machine to replace human to do dangerous, inspection, and maintenance tasks in manufacturing. In schools, artificial intelligence is applied where a computer is used to help students with schoolwork and make sense of why the students

commit mistakes, not just respond to find the errors. This could help the students to understand more about the subject via online learning. However, this project only covers one learning unit from the course syllable as the online content.

1.1 Problem Statement

One of the major issue in online learning is that there is a gap between the learning environment and the deliverability of the content itself. Bates argued that the current MOOC platforms only focus on broadcasting content and assessments and not accommodate in the relation-making process (as cited in Zawilska, Jirotka, & Hartswood, 2014). Morris mentioned that the MOOC interface have been developed without a clear goal for participation of learners who are interested to take online classes (as cited in Zawilska et al., 2014). Therefore, there is a need to revisit the designing of the online learning environment and construct a meaningful online content for learners to enhance their learning experience.

Based on the literature review, the effectiveness of e-Learning is documented using mixed method meta-review by building up the data of several quantitative studies (Noesgaard & Ørngreen, 2015). It describes the state of research, explain how the studies evaluate different outcomes and discusses different aspects of learning effectiveness. This is quite similar to this study. Nonetheless, this paper is not involved with re-investigating how effective online learning, but comparatively with understanding the measurements and factors improving web-based content effectiveness. Through the findings, researcher could help to enhance learners' ability to learn better through online learning. Therefore, the online learning content should be carefully designed to ensure the goal of effectiveness of e-Learning is met.

The purpose of this work is to present a study on design and developing Artificial Intelligence web-based content for online learning among undergraduates, by constructing an online learning environment using constructivist principle and adapted some components of

the Jonassen's model that directly addressed understandings to learners brought for learning Artificial Intelligence. In addition, the focus of the online content remains on providing factual content. In this study, the quality of the web-based instruction was examined using a questionnaire based on student's perceptions on seven main aspects: appearance of web pages, hyperlinks and navigation, technical issues, online applications, content delivery, instructor and peer interaction. Thus, students' activities on the designed course was examined by administering standard tests with multiple choices answers, quizzes and forum based on the content provided.

1.2 Research objectives

The main objective of this study is to design and develop artificial intelligence web-based content for online learning among undergraduate students. However, the study is focus on the two specific objectives:

- To develop an online learning content for learning artificial intelligence.
- To evaluate the effectiveness of the online learning content.

1.3 Research questions

1. What were the students' perceptions regarding the quality of online learning content in following aspects: appearance of web pages, hyperlinks and navigation, technical issues, online applications, content delivery, instructor and peer interaction ?
2. Were there any differences of students' performance in traditional class and online learning based on the student's post-test score ?

1.4 Significance of the study

1.4.1 Knowledge and theory.

This work will contribute to the knowledge for educators and students where they will discover the construction of the online content learning is equally important as learning strategy. The learning theory used during the learning process will be

improved and the success of it will be shared among students. The development in designing online materials will also be improved for better learning.

1.4.2 Practice.

In practice, online learning can help learners to gain more experience through online learning management system and be familiar with current technology for better learning. This could benefits the student to look for available online course that they are interested in and collaborate with instructors, lecturers, and students from different countries.

CHAPTER TWO

LITERATURE REVIEW

2.0 Online learning

Based on recent research in the development of education and academic, European authors adopt a statement from Schmidt and Cohen of "rising connectivity that reshapes traditional routines and offers new paths for learning" education in the digital age which is relevant to the current context on online learning (Atabekova, Belousov & Shoustikova, 2015). Online learning started with informal learning where learner begin with searching for additional resources by browsing the internet. Initially, it comes from learners' initiative where it starts from the formal learning (FL) at educational institutions (Atabekova, 2015). It is important to note that changing the way of learning does not necessary changing one's motivation to learning. Based on Coombs and Ahmed, informal learning "is shaped as systematized, structured and organized activities that are addressed to a particular subgroup of social community" (as cited in Atabekova, 2015). By using a various set of technologies which including YouTube, messaging and chat, Podcasts, blogs, online grading and more, online tool like Web 2.0 allows manifold users make use of the content (Atabekova et al., 2015). In turn, this will enhance learners' experience in online learning and promote the advantages of learning online.

Online learning can also be known as e-Learning due to similar learning environment which is in virtual setting (Moore, Dickson-Deane, & Galyen, 2011). It is confirmed by Triacca et al. (2004) that e-Learning was a type of online learning (cited in Moore et al., 2011). Both terms are commonly accepted that learning content can be offered in different formats such as text or video images, and computer hardware like CD-ROM etc. (Omar, Hassan, & Atan, 2012). However, researcher claim that it is mostly delivered by electronic media such as the Internet, intranets, extranets, and hypertext/hypermedia documents (cited in

Omar et al., 2012). Further, e-Learning offers several advantages where it helps to lower the cost of gaining alternate knowledge, its content is accessible at any time and any place, it builds universal communities where all learner come together to learn the content and connect to share their experiences and it brings valuable learner service at one place (cited in Omar, 2012). Thus, these increases the chance for learners to get a good academic achievement guided by some learning strategy.

A study has shown that a major benefit of web-based learning is that it allows for self-paced learning and reflection, as two central establishment of constructivist epistemology, where students can interact at their own paced without physically walking into a classroom (Bellefeuille et al., 2005). By adopting existing work from previous scholars, Table 1 illustrates how variables were integrated across five foundational areas of course and program design. These design frameworks can be adapted in this study which is drawing strength on web-based approach to learning online so that constructivist principles can be applied to curriculum development projects using a various of innovative strategic approaches (Bellefeuille et al., 2005).

2.1 Instructional aspects in online delivery

A suitable design of every elements in online courses is highly essential to the quality and effectiveness of the online learning. Course design can bring great influence on the achievement of an online learning experience which is reported by online learners (Song, Singleton, Hill, & Koh, 2004). The difficulty in designing the online course often associate with the management and course construction (UDI Online Project, 2010). So, the literature reveals the concern of flexibility and modularization in the course construction. Shea, Swan, Fredericken, Pickett (2002) and Swan et al. (2000) found that the higher levels of flexibility in online course management and easiness of navigation in the course were linked to greater levels of student satisfaction. As such, developer should note that student satisfaction on the

course element is important as design the content which could bring positive outcome for the online course. Toven-Lindsey et al. (2010) found that clear objectives and requirements of the course also boost student satisfaction. In contradiction, poorly managed online course could bring dissatisfaction to learners (UDI Online Project, 2010).

Another importance of the content design is that the course contents should be the latest with the current academic material, complex, and delivered in a way that drives the learner (as cited in Soffer, Kahan, and Livne, 2016). Video, lectures, presentation slides, and multiple communication methods devotes to the effectiveness of online learning as in a rich learning environment (as cited in Soffer, Kahan, and Livne, 2016). Learners who took online courses reported that they can gained more access to different information and data sources in a richer learning environment (Daugherty & Funke, 1998). The most significant trigger in learners' perception of the quality of the online learning experiences is the course content (Peltier, Schibrowsky, & Drago, 2007).

In online learning, easy access to the course could make a different in the learning process. This is supported by Palmer and Holt (2010) that learners benefit in online course by recognizing the ease of access to varied, high quality, and timely learning materials. In addition, students have more autonomy and control over their learning process in term of time and location (as cited in Soffer et al., 2016). The fact that online learning can add more time on learning the materials in comparison to learning in traditional setting (Roberson, Grant, & Jackson, 2005). Other than that, assessment in online course play an important role in students' involvement and engagement in the course. It has been reported that evaluation on assignments is necessary be given in a well-timed manner so that learners participated and motivated in the online course (as cited in Soffer et al., 2016). In contrast, learners can feel disappointed if instructor of the online course did not list the specify expectations for assignments which can lead to student uncertainty towards their instructor's expectations

(Hara & Kling, 1999). Another aspect in designing the course assignments, instructor need to organize the deadlines in proper so that student able to plan their time wisely. Thus, this could help the students to avoid delaying their work and supporting them in self-regulation and administer them a context for connection with the instructor and peers (as cited in Soffer et al., 2016).

Communication in online learning is also one of the crucial basic in the course. According to Soffer, Kahan, and Livne (2016), communication in online course should be cautiously designed to facilitate student-instructor and peers' interactions. This is true because without communication the transfer of information cannot be achieved. Wallace (2004) indicates that communication can take place at discussion forums, chat rooms, e-mails, and synchronous meetings. Fostering a sensibility of connectedness in online learning community among students in communication is crucial according to Sebastianelli et al., 2015 and Wallace (2004). This indicating that peer communication is essential for collaborative learning to occur. The situation is very useful when the instructor is not available to provide an immediate feedback, therefore peer can contribute in the discussion forum. In fact, research have proven that instructor-student and peer communication are picked by students (Northrup, 2002). This is because students feel more engage with the online course when everyone involved. This could bring positive impact on student study and students' contentment (as cited in Soffer et al., 2016).

2.3 Instructional design on collaborative learning environment (CLE)

In 1999, a constructivist designer come out with a model for designing constructivist learning environment (CLE) for guiding knowledge construction and meaning making because he believed knowledge cannot be transferred in constructivism (Leow & Neo, 2015). The model was created by Jonassen which comprises of six components: 1-Problem / Project; 2-Related Case; 3-Information Resources; 4-Cognitive Tools; 5-Conversation /

Collaborations Tools; 6-Social Contextual Support (Leow, 2015). According to Barrows and Tamblyn in 1980, problem-based learning integrates courses at a curricular level, requiring learners to self-direct their learning while solving numerous cases across a curriculum whereas project-based learning focuses on relatively long-term, integrated units of instruction where learners focus on complex projects consisting of multiple cases (as cited in Jonassen, 1999). The model includes related cases as the component of CLE due to novice learner is lacking experience in problem solving. Based on Jonassen (1999), related cases in CLEs support learning in at least two ways: by scaffolding student memory and by enhancing cognitive flexibility. Besides, he stressed that to examine problems, learners need information to construct their mental models and formulate hypotheses that lead to understanding of the problem space. In CLEs context, it is assuming that information makes the most sense in the context of a problem or application (Jonassen, 1999). Jonassen (1999) used cognitive tools as CLEs component to support learners' performance. The goal of cognitive tools is to engage and facilitate learner in specific kinds of cognitive processing in CLEs. Jonassen (1999) also states that "learning most naturally occurs not in isolation but by teams of people working together to solve problems" which serve the use of conversation or collaboration tools. In designing and implementing CLEs, Jonassen (1999) found that accommodating contextual factors is crucial to successful implementation. He believed it is to train the teachers and personnel who will be supporting the learning and to train the students who will be learning from the environments. Jonassen's model (*Figure 1*) as an integral design tool can be used to enhance online learning experience, and several studies had evidence that it can be applied in different situations. In this work, the model is adapted to strengthen learners' learning experience and desires to achieve positive outcomes.

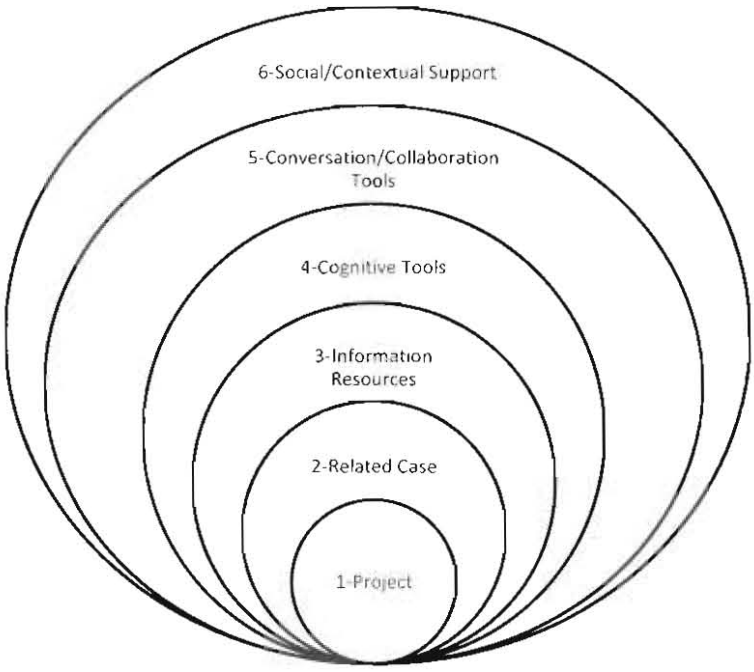

Figure 1: Jonassen's model for designing collaborative learning environment (CLE). Reprinted from "*Designing Constructivist Learning Environment*", by D. Jonassen, 1999, Place of Publication: Publisher. Copyright Holder. Reprinted with permission.

In e-Learning environment, Sun, Williams, and Liu (2004) believe learners usually engage in learning as a personal and social construction of knowledge, and development of critical-thinking and problem-solving skills. Based on constructivist and semiotics theories, it encourages students to take charge for the learning process. This strongly indicate that online learning is an independent learning process with the help of technology such as Internet. Sun et al. (2004) stated that to acquire capability of deep learning, critical analysis and self-reflection is important and philosophical than acquiring knowledge. They also mentioned that as opposed to knowledge transfer, deep learning can only be found when totally engaging the learners in knowledge construction (Sun et al, 2004).

2.4 Factor that influence effeetiveness of e-learning

A literature study from Noesgaard and Orngreen (2015) reviewed that contextual factors could be more critical to e-learning effectiveness compared to prioritise factors that related to e-learning solution and process. Active learning, collaboration, communication,

design, instructional scaffolding, and student-instructor interaction and peer-to-peer interaction are the example of factors that influence the e-learning effectiveness (Noesgaard et al., 2015). They also believed that the contextual factors are understood as too complicated and unpredictable to investigate and control for research, and it is beyond the duty of learning professionals (Noesgaard et al., 2015). Other factor such as individual and context scaffolding also play a role in influencing e-learning effectiveness. Individual factors such as age, previous e-learning experience, language (second language), motivation, learner characteristics and expected workload (Noesgaard et al., 2015), which is varies across individual. Each student has different preferences and challenges. Research data found some of the factors that affect student satisfaction toward online learning is student control, instructor rapport, enthusiasm, social interaction and more (as cited in Boghikian & Mortagy, 2008). In Mahle's (2007) work, he reveals that student academic performance and motivation, and that the level of interactivity plays a major factor in student motivation which need to be concerned. Previous relevant work experience and online experience factors does affect the effectiveness of e-Learning of the experience of learner in online learning (Noesgraard et al., 2015). This statement is supported by Boghikian & Mortagy (2008), where researchers found those factors are beneficial to learners if it is corresponding with the e-Learning.

2.5 Self-regulated learning

Under social cognitive perspective, the relationship between self-regulated learning (SRL) and academic achievement has been hypothesized that self-regulated learning is gained through an interaction three important characteristics: a) self-observation (monitoring one's action) seen as the most crucial of these processes; b) self-judgement (evaluation of one's performance), and c) self-reactions (one's response to performance outcomes) (Broadbent & Poon, 2015). This can conclude that learning is not a fixed character.