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Analysis and Categorization of e-Learning Activities based on Meaningful Learning Characteristics

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***Abstract*—**Learning is the acquisition of new mental schemata, knowledge, abilities and skills which can be used to solve problems potentially more successfully. The learning process is optimum when it is assisted and personalized. Learning is not a single activity, but should involve many possible activities to make learning become meaningful. Many e-learning applications provide facilities to support teaching and learning activities. One way to identify whether the e-learning system is being used by the learners is through the number of hits that can be obtained from the e-learning system's log data. However, we cannot rely solely to the number of hits in order to determine whether learning had occurred meaningfully. This is due to the fact that meaningful learning should engage five characteristics namely active, constructive, intentional, authentic and cooperative. This paper aims to analyze the e-learning activities that is meaningful to learning. By focusing on the meaningful learning characteristics, we match it to the corresponding Moodle e-learning activities. This analysis discovers the activities that have high impact to meaningful learning, as well as activities that are less meaningful. The high impact activities is given high weights since it become important to meaningful learning, while the low impact has less weight and said to be supportive e-learning activities. The result of this analysis helps us categorize which e-learning activities that are meaningful to learning and guide us to measure the effectiveness of e-learning usage.

***Keywords*—**e-learning system, e-learning activity, meaningful learning characteristics, Moodle

I. Introduction

E-LEARNING is complicated. Underestimating that complexity will lead to underestimating needs, future problems, and costs [1]. E-learning is not just web-based courses. It is a skill and competency development based in a wide set of technology-based applications and processes, including, but not limited to, web-based learning, computer-based training, virtual classrooms, digital collaboration and distance learning. Course content is available to the learner via internet, intranet/extranet, local servers, individual computers, and CD-ROMs. Actually, e-learning can take many forms other than course delivery. E-learning can be applied to apprenticeships and internships and, through applications as simple as threaded e-mail or online "blogs", can be used to build communities of learning.

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Novak argues that learning by doing personal connections between materials gives raise to a better quality of learning, and calls this approach "meaningful learning" distinguishing it from mnemonic learning, in which no meaningful connections are made by the learner between the contents he/she learns [2]. He proposes to use concepts maps as tools for organizing materials according to semantic connections. Novak's ideas had a great impact in the technology-mediated learning field due to the potential of technologies coherent with meaningful learning assumptions. For this reason, in learning environments, the ways of interacting with the environment can also be expressive with strategies carried out by learners during the learning process. Hence, they could reveal interesting characteristics of the learner and/or of the learning process, if properly and coherently interpreted.

The new technology can be one of many tools that produce the effectively e-learning and can be a good impact for learners and lecturers to increase their performance, because they involved in the e-learning process [3]. Personal characteristics have been found to influence e-learning implementation [4] and most universities are still struggling to engage a significant percentage of students and staff in e-learning [5]. E-learning utilizes information and communication technology to improve the educational process and to increase interaction between students and teaching staff [6]. But, how about the learners, are they have a meaningful learning experience from e-learning?

In e-learning systems, learning activities are based on learner autonomy and interactive learning actions; in addition, learning instruction is based on multiple media and ill-structured formats. Furthermore, e-learning also offers cooperative learning opportunities. So, from the cooperative aspect can be one of the complementary from five characteristics of meaningful learning [7]. The aim in this paper to analysis and identification students activities on e-learning based on meaningful learning characteristics. This paper is divided into several stages, the first is identification what kind of activities are contained in e-learning UTM (Universiti Teknologi Malaysia), the next step is to categorize that activities into meaningful learning characteristics, and the end of this paper can find which activities that fit into a meaningful learning characteristics.

II. Literature Review

A. Meaningful Learning

Theory of Ausubel, who is a cognitive psychologist, focuses on meaningful verbal learning or advance organizers [8]. This theory which is also called expository teaching includes descriptive principles for both how a person learns, and features of an instructional activity and how it should be

organized. The method described in this article is quite widely applicable in which it examines changes in the learning approaches of the students. The learning approaches used by students are taken as an indicator as to whether or not meaningful learning has occurred.

Hirumi also mentioned meaningful interaction emphasizing the quality of interaction on learning [9]. Meaningful interaction is not just sharing person opinions. Instead, the interaction must stimulate the learners' intellectual curiosity, engage them in productive instructional activities, and directly influence their learning [9][10].

Meaningful learning theory covers principles and strategies that can be used in class environments where face-to-face communication occurs. In this regard, teaching-learning process includes determination of advance organizers, installation of them into appropriate materials and presentation of these materials to the learner [11]. Meaningful learning, on the other hand, is a kind of learning where the subject is learned meaningfully in an integrated way through incorporating the new subject or concept into the relevant subjects and concepts. In fact, it is through establishing connections between the new subject or concepts and the existing information of the learners. Therefore rote learning is forgotten rapidly whereas the meaningful learning is not [8][12].

Jonassen has stipulated that any pedagogically significant use of technology must allow learners to engage in meaningful learning [13]. Recently, several studies have tried to use information or communication technologies to support the achievement of meaningful learning [14][15][16]. There is also evidence that creativity flourishes when learning is meaningful, linking new experiences with information stored in long-term memory [17][18].

Meaningful learning is active and constructive, taking place when people develop knowledge in response to their environment, reflecting on activity and articulating what they have learnt. It is authentic and intentional, situated in a meaningful context in which learners are motivated by working towards a goal. It is also cooperative, relying on socially negotiated understanding and the shared construction of knowledge [7]. This ethos supported five key elements of meaningful learning. Furthermore these five elements offer opportunities for the development and deployment of creativity which include intentional, constructive, active, cooperative and authentic [7]. Fig1 shows the interrelationship between the five characteristics of meaningful learning [19].

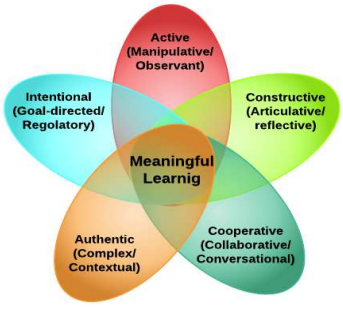

Fig. 1 Characteristics of Meaningful Learning

- *Active (Manipulative/Observant)*

Active learning is an instruction method in which students actively participate in their learning process [20] via learner-centered activities that exercise the higher-order thinking skills of analysis, synthesis, and evaluation [21] rather than passively listening to a lecture.

Learning is natural, adaptive human process. When learning about thing in natural contexts, humans interact with their environment and manipulate the objects in that environment, observing the effects of their interventions and constructing their own interpretations of the phenomena and the results of their manipulations [19].

Meaningful learning requires learner who are active—actively engaged by a meaningful task in which they manipulate objects and parameters of the environment they are working in and observing the results of their manipulations [19].

- *Constructive (Articulative/reflective)*

Activity is necessary but not sufficient for meaningful learning. Learners integrate their new experiences with their prior knowledge about the world or their establish goals for what they need to learn in order to make sense out of what they observe [19].

Learners begin constructing their own simple mental models that explain what they observe with experience, support, and more reflection hence their mental models become increasingly complex. Learners mentally represent their understanding in different ways using different though processes. The active and constructive parts of the meaning-making process are symbiotic [19].

- *Intentional (Goal-Direct/Regulatory)*

All human behavior is goal directed [22]. When learners are actively and willfully trying to achieve cognitive goal, they think and learn more because they are fulfilling an intention. Technologies have traditionally been used to support teacher's goals, but not those of learners. Technologies need engage learners in articulating and representing their understanding, not the teachers [19].

When learners use technologies to represent their actions and construction, they understand more and are better able to use the knowledge that they have constructed in new situations. When learners use computers to do skilful planning for doing everyday tasks or constructing and executing a way to research a problem they want to solve, they are intentional and are learning meaningfully [19].

- *Authentic (Complex/Contextual)*

Herod presents a clear description of authentic learning as follows: "In this type of learning, materials and activities are framed around "real life" contexts in which they would be used [23]. The underlying assumption of this approach is that material is meaningful to students and therefore, more motivating and deeply processed. Inspired by situated learning theory, [24] proposed a modern pedagogical concept named "authentic learning". Authentic learning typically relates to real world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice. Going beyond

content, authentic learning intentionally brings into play multiple disciplines, perspectives, ways of working, habits of mind, and communities [25].

Physics course is the prime example. Teachers read a simplified problem and immediately represent the problem in a formula. Students may learn to get the correct answer, but what are they learning? The students learned to understand the ideas only as algorithmic procedures outside of any context, so they have no idea how to apply the ideas to real world contexts. Learning should be embedded in real life, useful contexts for learners to practice using those ideas [19].

- *Cooperative (Collaborative/Conversational)*

Humans naturally work together in learning and knowledge building communities, exploiting each other's skills and appropriating each other's knowledge in order to solve problems and perform tasks. With collaborative learning principles, the hardest part of applying your beliefs will be assessing learners. Most of technology based activities described throughout this book are more effectively performed collaboratively in groups, so we must assess the performance of the groups, as well as individuals [19].

Learners are strategic enough to know "what counts" in classrooms, so if they are evaluated individually, collaborative learning activities will fail because students realize that their outcomes are not important.

Collaboration most often requires conversation among participants. Learners working in groups must socially negotiate a common understanding of the task and the methods they will use to accomplish it [19].

People naturally seek opinions and ideas from others. Technologies can support this conversational process by connecting learners in the same classroom, across town, or around the world. When learners become part of knowledge building communities both in class and outside of school, they learn that there is more than one way to view the world and there are multiple solutions for most of life's problems. Conversation should be encouraged because it is the most natural way of making meaning [19].

B. E-learning Activity

Activity theory claims activity and consciousness are the central mechanisms of learning because conscious learning and activity (performance) are interactive and interdependent [13]. From activity theory point of view, meaningful learning is an active, intentional, conscious, constructive, and socially medicated practice that includes reciprocal intention–action–reflection activities [13]. Learning activities include complex cognitive and social processes that necessarily interact with the world around it. E-learning systems provide opportunities for learners to communicate the real world and to search interdisciplinary domains [26].

The e-learning activities proposed were of various types, aimed at consolidating the content of face to face lessons. On the one hand, there were individual activities intended to achieve a better understanding of concepts (crosswords, matching, gap filling, multi-choice tests), while others reinforced accounting procedure skills (on line exercises).

A second group of activities was of a participative, cooperative nature (wikis aimed at strengthening the grasp of concepts, and forums to underpin aspects concerning accounting representation or procedures). These activities were evaluated online [27].

According to learning models, a great deal of learning performance requires the execution of complex principles for processing instruction or activities. Learning to do things, such as developing computer skills, involves the acquisition and refinement of complex motor skills which become faster, more accurate, and more automatic with the accumulation of experience and expertise. In addition, learning to solve educational problems requires the attainment and development of many learning principles and procedures which in turn, make it possible to devise and execute learning activities or solutions [28]. Learners engagement during learning activities is an important and heavily researched educational construct [29][30][31][32][33].

Analysis of activity on E-learning is based on customization of specific E-learning application in some institution and from standard activity on LMS (Learning management System) Moodle application [34].

- *Courses* are the spaces on Moodle where teachers add learning materials for their students. Courses are created by admins, course creators or managers. Teachers can then add the content and reorganize them according to their own needs. The links below will provide more information about creating, organizing and managing courses.
- A ***Label*** serves as a spacer on a Moodle course page. It can be used to add text images, multimedia or code in between other resources in the different sections. It is a very versatile resource and can help to improve the appearance of a course if used thoughtfully.
- A *Resource* is an item that a teacher can use to support learning, such as a file or link. Moodle supports a range of resource types which teachers can add to their course sections.
- A *Role* is a collection of permissions defined for the whole system that you can assign to specific users in specific contexts. The combination of roles and context define a specific user's ability to do something on any page.
- *Upload* is Facility on E-learning to add/attach files.
- *User* is the activity allows users to view, view all or update.
- The *Assignment* module allows teachers to define the task, and collect work from students, review it and provide feedback including grades.
- *Feedback* is for creating and conducting surveys to collect feedback. The Feedback activity allows you to create different kinds of questions: multiple choices, drop-down selection, short answers, and more. You can share the results of a Feedback activity with the students, or keep it confidential.
- *Blog* in Moodle is user based, that means each user has their own blog. Blogs are a form of online journal used by millions of people around the world for self-expression and communicating with family and friends. Blogs are usually organized as a chronological series of postings created by the author of the blog.

- The *Notes* feature is a way to attach information about a user by another user. For example, a teacher might attach a note to a specific student about the hobbies and interests that seems to engage that student.
- *Quiz* allows the teacher to design and set quiz tests, which may be automatically marked and feedback and/or to correct answers shown.
- *Survey* is for gathering data from students to help teachers learn about their class and reflect on their own teaching. In a Survey, you must choose from several pre-built surveys; you cannot build your own surveys.
- *Chat* - Allows participants to have a real-time synchronous discussion. The Chat feature allows participants to have a real-time discussion via the web. This is a useful way to get a different understanding of each other and the topic being discussed – the mode of using a chat room is quite different from typical internet forums.
- *LAMS* stands for Learning Activity Management System and is used for designing, managing and delivering online collaborative learning activities. This is done through a visual authoring environment for creating sequences of learning activities. These activities can include a range of individual tasks, small group work and whole class activities based on both content and collaboration.
- *Wiki* - A collection of web pages that anyone can add to or edit. A wiki is a collection of collaboratively authored web documents. A Wiki is by nature collaborative, and makes a good tool for group work.
- A *Journal* is private, between the student and the instructor. Each Journal is a single online page, of almost unlimited length.
- *Choice* - A teacher asks a question and specifies a choice of multiple responses.
- A *Discussion forum* enables participants to communicate online using text. Moodle allows tutors to set up and configure online forums for groups or sub-groups of students, which can include text and other media. Participants can receive posts by email, and/or log onto Moodle to view them.
- The *Calendar* can display site, course, group and or user events in addition to assignment and quiz deadlines, chat times and other course events.
- *Workshop* is a peer assessment activity with many options. Students submit their work via an on line text tool and attachments.
- The *Book* is independent activity that makes it easy to create multi-page resources with a book-like format. This module can be used to build complete book-like websites inside of your Moodle course.
- *Glossary* Enables participants to create and maintain a list of definitions, like a dictionary. All tables and figures you insert in your document are only to help you gauge the size of your paper, for the convenience of the referees, and to make it easy for you to distribute preprints.

III. Categorization of Activities Based on Meaningful Learning Characteristics

Meaningful Learning Characteristics can be used to define and categorize which activities can be classified into the five elements of Meaningful Learning Characteristics. Table 1 shows the E-learning activities with five elements of Meaningful Learning characteristics. Analysis was performed based on e-learning activities definition compare with five elements of meaningful learning characteristics.

TABLE I
Activities List

E-learning Activities	Meaningful Learning Characteristic				
	Active	Cons-tructive	Coo-perative	Au-thentic	Inten-tional
Course		√		√	√
Label					
Resource		√			
Role					
Upload					√
User					
Assignment	√	√			√
Feedback	√				
Blog	√				
Notes	√	√			
Quiz	√	√			√
Survey	√				√
Chat	√		√		
Lamstwo	√	√	√	√	√
Wiki	√	√	√	√	√
Journal	√	√			
Choice	√	√			√
Discussion Forum	√	√	√	√	√
Calendar					
Workshop	√	√		√	√
Book	√	√		√	
Glossary	√	√	√		

Any activities can be categorized into meaningful learning characteristics. Each activity can be fit into five categories and may not fit into five categories. While the activity that goes into the fifth element is the e-learning activities that has the highest priority in the meaningful learning process. While the activities that do not fit into the five elements mean that the activity does not have any effect on meaningful learning process. This process will be identified and categorized in all activities in e-learning that have the same behavior with every element of meaningful learning.

Analysis was performed based on definition of five elements from meaningful learning characteristics. Table I shows the result of activities that can be categorized into five elements of meaningful learning characteristics. The analysis contained in Table 1 shows that there are some activities that do not fit into the five elements of meaningful learning characteristics. It means the activities such as label, role, user and calendar just supported activities in E-learning activities.

Still from table 1 result that shows the most activities are on the active characteristics that have sixteen activities. While, the second largest activity in meaningful learning characteristics is constructive characteristic that has fourteen activities. The third highest position is Intentional characteristic that have ten activities. In the last position with the same number of activities with six activities fit into them are Cooperative and Authentic characteristics.

IV. Priority of E-learning Activities

Based on analysis result on table 1, it can produce a new analysis. The new analysis is the list of activities in the E-learning from the most important activity until supported activity. Analysis of rank order activities based on the number of meaningful learning characteristics that contained in each activities on E-learning. If in that activity, there are five elements of the meaningful learning characteristics, so it will be placed as the top activity. While if that activity does not have the meaningful learning characteristics, so it will be placed at the bottom of E-learning activities list.

TABLE II
List Priority of E-learning Activities

List	Activities	Score/Weight
1.	Discussion Forum	5
2.	Lamstwo	5
3.	Wiki	5
4.	Workshop	4
5.	Glossary	3
6.	Book	3
7.	Assignment	3
8.	Quiz	3
9.	Choice	3
10.	Course	3
11.	Notes	2
12.	Journal	2
13.	Chat	2
14.	Survey	2
15.	Feedback	1
16.	Blog	1
17.	Resource	1
18.	Upload	1
19.	Role	0
20.	User	0
21.	Label	0
22.	Calendar	0

Table II shows a list of activities rank from e-learning application. On the top list activities there are Wiki, Lamstwo and Discussion Forum with a score value 5. Workshop is on the second list with score value 4. And there are 7 activities that have the same score value 3, those activities are on the order of 5 to 11.

The activities that have the score value 3 are Glossary, Book, Assignment, Quiz, Choice and Course. List number 12 to 15 of activities that have a score value 2 occupied by Journal, Chat, Notes, and Survey. Whereas Blog, Feedback, Resource and Upload that have a score value 1 are on list number 16, 17 and 18. At the end of list rank with score value 0 completed by Role, User, Label and Calendar which is on the order 19 to 23.

V. Conclusion

Much kind of activities undertaken by students and lecturer in E-learning, but not all of the activities can be a Meaningful Learning. Successful E-learning and student activity cannot occur just by number of hits, but must be viewed deeper. Meaningful Learning paradigm can be one of the benchmarks to get a successful E-learning implementation and to measure the student activity. From this paper, it can be defined and categorized what kind of activities is meaningful and what kind of activities is not meaningful and purposely serve as supported activities in E-learning. Classified and categorize performed by characteristic of Meaningful Learning, that have five of elements are active, constructive, cooperative, authentic and intentional. From all the activities that are categorized as a Meaningful Learning can be a measure for student activity in E-learning and the other hand can be used to measure a successful of E-learning systems. In this paper we can get the final result about comparison between the old analysis data with e-learning system administrator method as well as the new analysis uses a meaningful learning paradigm that show the process of analysis deeper than old analysis. In the end of discussion section, this paper gets the differences rank of top 5 subjects between the old analysis student activity with the new analysis of student activity using meaningful learning paradigm.

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