A Conceptual Framework for Internet of "Educational Things" (IoET) in Learning

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Article history

Received:
8 Oct 2019

Received in revised form:
15 Nov 2019

Accepted:
4 Dec 2019

Published online:
25 Dec 2019

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Abstract

The paper aims to identify conceptual framework for Internet of "Educational Things" (IoET) environment that facilitate students' reflective thinking. The framework is using theoretical model of Jigsaw-Based Cooperative Learning Model and Interaction Theory, Mezirow reflective thinking model, ADDIE model and usability model. With implementation of IoET system in the teaching and learning of process making will then leads to a deeper understanding in learning.

Keywords: *Internet of "Educational Things", theoretical model, reflective thinking, students' performance.*

1. Introduction

Twenty first century learning has provoked teaching and learning including digital content, critical thinking, communicating and collaborating using technology [1]. The characteristic of 21st century learners indicates that students should be innovators, creators, flexible and critical thinkers. Gartner [2] estimated that 5.5 million new "things" are connected to networks and nearly 21 billion devices will be connected with Internet of Things (IoT) by 2020. IoT is swiftly expanding beyond devices for schools. At present, undergraduate students are those who were born between the years of 1995 to 2000 who populating the digital native generation. They are the first generation born into technology connected world and exposed technology-savvy since childhood [3]. According to Seemiller and Grace [4], digital native students prefer face to face interactive communication. Furthermore, research conducted by Capterra Company founds that about 69% of students wanted to use device in classroom and they want their tasks such as note-taking to be automated and content digitalized. Malaysia Education Blueprint 2015-2025 is a developed framework 4.0 (MyHE 4.0) emphases on students' reflective thinking. IoT is transforming traditional teaching and learning in classroom into new ways of learning. Implementation of IoT will provide more affluent learning experiences and improved operational efficiency. By gaining real-time, actionable insight into student performance can enhance learning outcomes [5]. The aid of

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digital technologies helps to improve teaching and learning process [6],[7],[8]. The new ways of learning in classroom supported by IoT will be better equipped for learning. IoET is emerging technology integrated with smart object such as mobile device and sensor using in education.

There are many potential of IoET to be implemented for Science, Technology, Engineering and Mathematics (STEM) disciplines such as smart classroom [9], smart attendance system [9], smart monitoring student [10],[11]. This study will propose the conceptual framework for IoET which consist of theoretical model, design, development, implementation and evaluation.

2. Methodology

Research requires the literature review has been used to identify the component in conceptual framework. Thorough reviews of the fundamental theories or models related to reflective thinking are identified. A theory makes simplifications of observations and consists of an interrelated, coherent set of ideas and models.

3. Related Works

Internets in "Educational Things" (IoET) are flexible, allow hyper-connectivity between physical and virtual objects, adaptable, accessible and scalable which becomes properties of the IoT [12]. The expected deliverables of this phase will be the conceptual framework for IoET to help facilitate reflective thinking.

3.1 Jigsaw-Based Cooperative Learning Model

Students' learning performances in the classroom can be measured using the effects of jigsaw cooperative learning method. In a classroom, participation of all students is required in learning activities such as during task distributions among all group members. By using this method, it does not only increase students' interaction, but it will also enhance students' performance and thinking skills. Students' performance is proven increased after using Jigsaw-based cooperative learning [13]. According to Johnson et al.[14], in order to achieve the success each student must serve as a valuable information resource and they must cooperate with each other. All students are empowered through being attendants of knowledge. In given position to share knowledge with classmates, making them feel validated by helping others to learn. The jigsaw method also proved accommodating in enhancing students' understanding. Students' self-esteem, self-confidence, and enjoyment of the learning experience can be observed using Jigsaw method in classroom [15]. As a result, students have less anxiety hence enjoy and willing to participate in in-class activities.

3.1.1 The Instrumentation of Jigsaw-Based Cooperative Learning Model

The instrumentation of Jigsaw Cooperative teaching and learning strategy [16],[17] is carried out work order as the following steps:

1. Select a group project or topic to be discussed.
2. Break the class into groups of students and each assigns a number of 1 to 5 to each student in each group. This group is called the 'expert group'.

3. Assign each student in the group a topic and assigned number. He or she will become an expert.

4. Rearrange the students in a group based on their expertise and assigned topics.

5. Provide the experts with the materials and resources needed to support their topics. The experts would be given the chance to obtain knowledge through reading, research, and discussion.

6. Reassemble the expert group.

7. Experts teach what they have learned to the rest of the Jigsaw group members.

8. Take turns until all experts finish presenting their information.

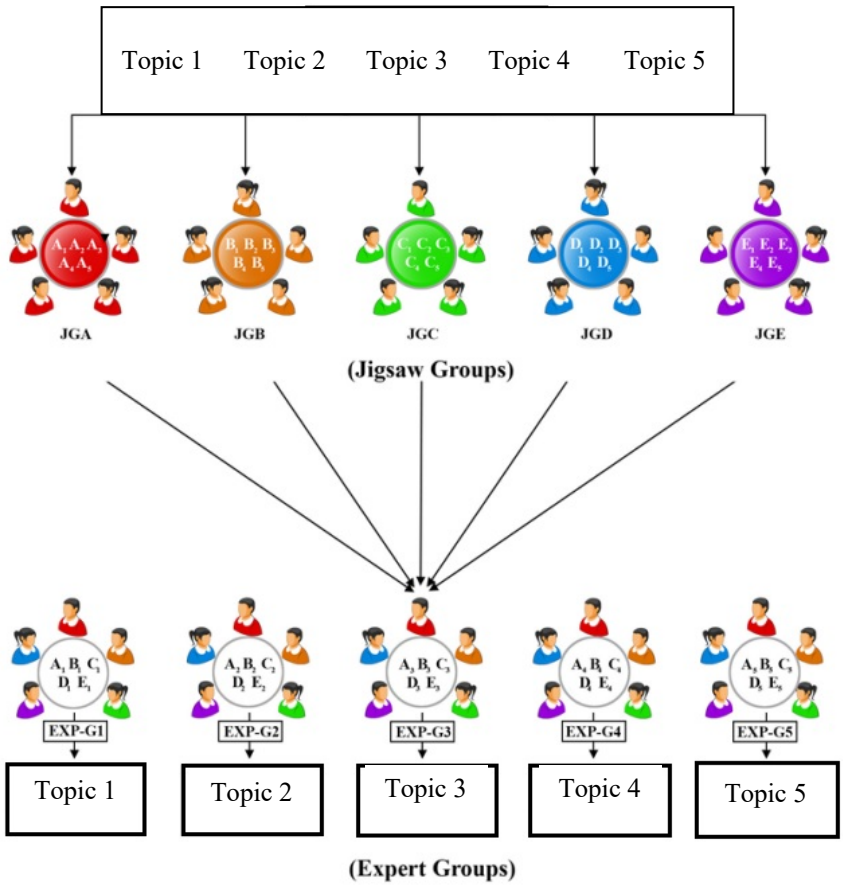

Figure 1. Work Order Formed For Jigsaw-Based Cooperative Learning

3.2 Mezirow Reflection Thinking Model

Education process is referring to transformative learning and reflection committed to professional performance [18]. In education, Mezirow model can be used for creating understanding and thinking among students. The six levels of Mezirow reflection are (1) Reflection, (2) Emotional reflection, (3) Evaluative reflection (4) Judgmental reflection, (5) Conceptual reflection and (6) Psychic reflection.

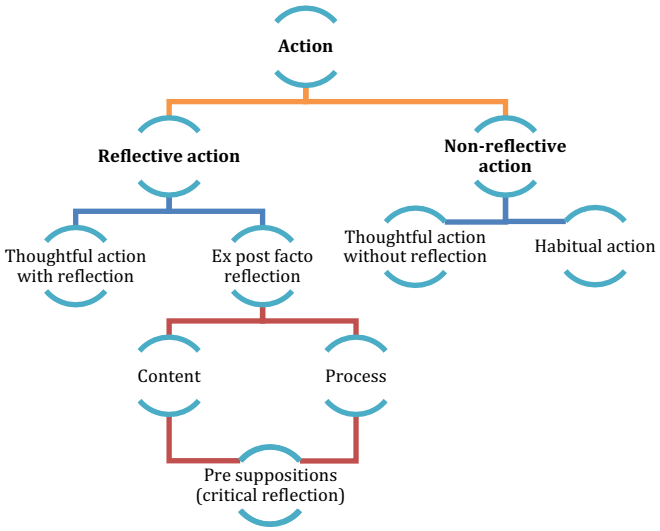

Figure 2. Mezirow's Critical Reflective Model (Mezirow, 1990)

3.2.1 The Instrumentation of Mezirow Reflection Thinking Model

To produce a usability instrument, there are four dimensions that have been clarified to identify the reflection thinking of students while using IoET content artifact [19].

Dimension 1 is measure the habitual action at the beginning, middle and end for the teaching and learning session

Dimension 2: measure students understanding by investigating the participants reflect the object such as self-reflection, artifact and circumstance.

Dimension 3 is measure the reflective which is a part of the critical thinking process. It refers to the process of analyzing and creating judgments about what has happened. Reflection involves the critique of expectations about the content or practice of problem-solving.

Dimension 4 is called critical reflection and it is recognized as higher level of reflective thinking. Critical reflection towards an ex post facto is reflection for content and process happened. Mezirow [18] uses the term of premise reflection which explains how we becoming attentive of why we perceive, reflect, feel or act as we do.

3.3 ADDIE Model

This research is using ADDIE model for designing and developing the Internet of "Educational Things" (IoET). The ADDIE instructional model was developed by Dick and Cary in 1978 and used in designing and developing in education [20]. There are involving five stage in development such as analysis, design, development, implementation and evaluation.

1. Analysis phase is defines the problem, and possible solution. Research techniques such as analysis, goal and task need to define in this phase.

2. Design phase is the process of stipulating the objectives, plan instruction and develop item.
3. The Development phase builds to generate the lesson plans and lesson materials. During this the constructed and developed the set of IoT system and supporting documentation.
4. The Implementation phase refers to the installing the project in the real world context.
5. The Evaluation phase is measure the effectiveness and efficiency of the IoET system. The activity included record time data, interpret test results and survey and revise activities.

3.4 Usability Evaluation

A usability evaluation will be used to evaluate the usability. The usability attributes is developed by Nielsen [21]. One of the criteria in Nielsen models is "'user's satisfaction'. User satisfaction is about the user's particular assessment towards the ease-of-use of particular system as well as its usefulness [21].

The usability will be evaluated from three characteristic such as user, task and context of use [21],[23].

1. User: Students, who using IoET system
2. Task: Using artifact to enhance reflective thinking on subject matter.
3. Context: Subject such as Mathematics

3.4.1 The Instrumentation of Usability Evaluation

Usability is acceptability to the interface and content of a system. It is the criteria of 'user's satisfaction' towards IoET content based on Nielsen models such as easy to learn, efficient to use, easy to remember, few errors and subjectively pleasing.

Learnability is the users' ability to learn a particular system containing IoET content artifact. This is to measure the ease of use students can gain proficiency with the artifact. The user's satisfaction with the users' particular assessment is in regard to how useful and easy it is to use IoET content artifact.

1. Efficiency is the users' level of performance while accessing IoET content. This is to measure the speed and accuracy of the user to complete task [26]. This attribute reveals the productivity of a student while using IoET content artifact.

2. Effectiveness is the user's tasks on accuracy and completeness while accessing aIoET content. According to Harrison et al. [23], effectiveness refers to specified context to be completed by users. Indicate how many errors do users make and how can they recover the errors. In this study, the usability content is an attribute to assess and complete the specified task in IoET content artifact.

3. The satisfaction towards IoET content also is a measure to know the pleasant is it to use the artifact. Therefore usability is important for evaluation the IoET.

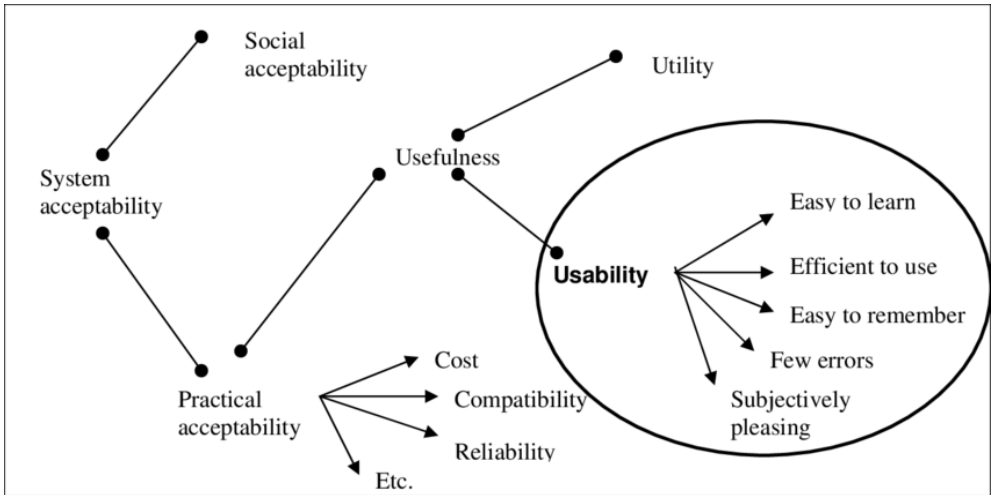

Figure 3. Usability Evaluation on IoET Content (Harrison et.al, 2013)

3.5 Evaluation on Reflective Thinking

Students reflective thinking of will be evaluate using four dimension [18].

Dimension 1: Habitual action is measure at begging, middle and end for the teaching and learning session

Dimension 2: Measure students understanding by investigating the participants reflect the object such as self-reflection, artifact and circumstance.

Dimension 3: Level of reflection towards students' thought-action with reflection

Dimension 4: Level of critical reflection towards students' ex post facto reflection for content and process happened.

3.6 Internet of "Educational Things" (IoET) Design Models in Facilitating Reflective Thinking

IoET content provides students with learning and content to create and help educators to provide personalized content. Personalized content improves students' understanding and thinking skills. Other tools used for the improvement of teaching and learning in classroom are the use of wearable devices and smart [24]. According to Hanan [5], course content needs to be improved by implementation of the system approach. Ghajargar [25] highlighted that traditional product focuses more on development of single artifact compare rather than reflection. The design model on IoT system should include reflection. Currently, active collaborative self-directed model is used in education. The importance of IoT technology includes design to support reflective thinking especially among students.

4. Proposed Conceptual Framework

In Education 4.0, properly designed IoT technology can be used to promote reflective and critical thinking which is considered as crucial skills for human capital development in the 21st century. In response to that, conceptual framework for IoET is developed. Internet of "Educational Things" (IoET) has been used to enhance teaching and learning specifically among Z generation students. Implementation of IoET will transform traditional classrooms into new styles of learning and enhance level of student's reflective thinking. IoET system will facilitate reflection thinking among students which results in increased in students' performances in learning. This conceptual framework describes five essential elements such as theoretical model, design, development, implementation, and evaluation on IoET. Figure 4 portrays the conceptual framework for IoET content which involve in this research.

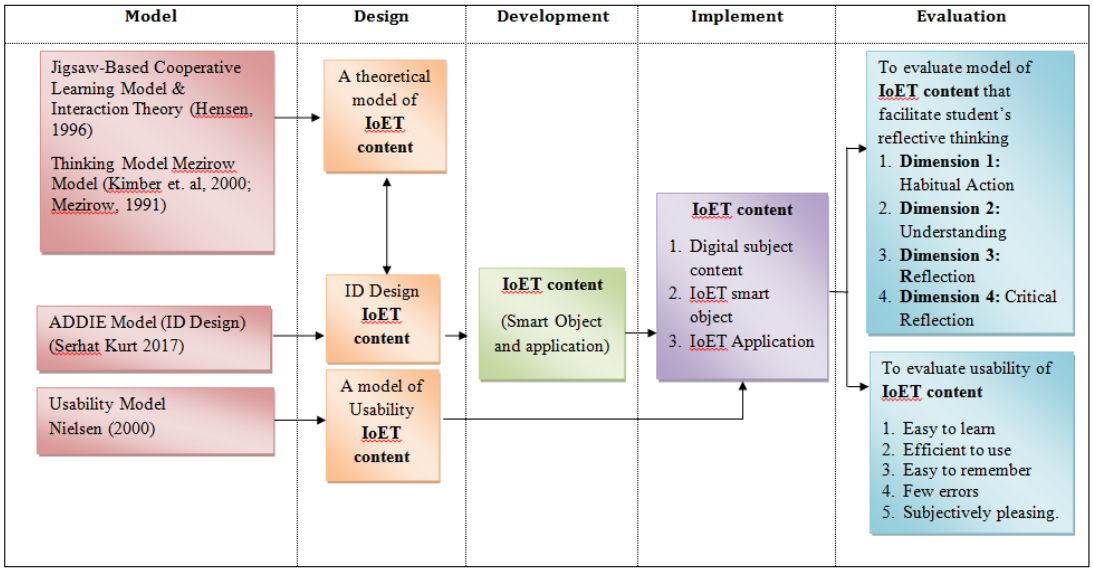

Figure 4. Conceptual Framework for IoET Content to support Reflective Thinking

5. Conclusion

In conclusion, this research through literature review carried out on IoET framework which forms the groundwork of the study. These comprise the study on the theoretical model and evaluation of IoET content. These attributes have an impact on the design of IoET model that facilitates reflective thinking and usability of IoET artifact.

Acknowledgments

The authors would like to express my gratitude towards Universiti Teknologi Malaysia (UTM) for providing access to many resources used for this research.

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