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Creation of Educational Innovations through Cloud-based Constructivism and Connectivism Learning for Undergraduates

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Abstract

This research examined the process of creating educational innovations through cloud-based constructivism and connectivism learning for undergraduates. The objectives were as follows: (1) To examine the cloud-based constructivism and connectivism learning model's roles in helping undergraduates create educational innovations; and (2) To evaluate the learning and innovation skills of students participating in cloud-based constructivism. The population in the study consisted of 60 undergraduates of Phetchaburi Rajabhat University, acquired using simple random sampling. The undergraduates were enrolled in a course for designing and developing games for education and computer-assisted mathematics instruction. The independent variable was the format of the constructivism and connectivism learning model for undergraduates involving cloud technology to promote innovative education. The dependent variable was the result of innovative education. The research findings were as follows: (1) Participants' overall satisfaction with the model was at the highest level ($\bar{x}$ = 4.53, S.D. = 0.60). (2) Out of the 60 students, 21 created innovative educational workpieces. Four workpieces were accepted for academic publication, showing that this model allowed learners to analyze media, promote innovative education, and apply educational innovations.

Keywords: constructivism, connectivism, cloud technology, educational innovation

1. Introduction

Changes in society and the global economy, from the industrial revolution era to Industry 4.0, have always occurred with the intention of improving the quality of life of the population (The Secretariat of The House of Representatives, 2016). This is particularly true in Europe (Schmidt et al., 2015). For Thailand to compete with others in the world arena, its industrial sector had to evolve toward Industry 4.0. The Thailand 4.0 policy was the outcome of this evolution (Office of Academic Affairs, Secretariat of the House of Representatives, 2016). Thailand 4.0 is intended to accelerate the reformation of the Thai economy through innovation to achieve 21st-century wealth. In this transition, education will be a key factor (Lonkaew, 2016).

Initially, the model of education consisted of "Education 1.0," in which learners just followed the teachers' instructions; the focus was solely on lectures. Then, "Education 2.0" emphasized giving knowledge rather than promoting creativity. "Education 3.0," an educational model for the information technology age, placed emphasis on creating bodies of knowledge. Currently, "Education 4.0" focuses on equipping learners with the ability to create their own works or innovations. "Education 4.0" is also recognized as a model for the age of innovation and the creation of bodies of knowledge based on individuals' interests or on the shared interests of groups of people. The roles of technology change based on the learner; they are deemed sources of technological evolution for the creation of innovation (Sinlarat, 2015). It is believed that "Education 4.0" will help Thai learners develop at all levels and create their own innovations (Jones & Pimdee, 2017). In summary, it is highly essential to equip learners at all levels with the competencies and skills needed to create innovations.

Constructivism is widely accepted as an instructional management concept that can help promote and develop innovation skills. This concept enables learners to construct bodies of knowledge through the arrangement of

learning environments based on real-life contexts.

Learning occurs not only from learners themselves (Jeerungsuwan, 2015) but also from outside factors. (Sangpum, 2011). This perspective forms the origin of connectivism, which is a learning theory for the digital age (Siemens, 2004). Thunhikorn (2012) stated that learning is presently related to the connection of learners' knowledge with outside knowledge or information via internet network systems such as Google, Wikipedia, Blogger, Wordpress, Facebook, Twitter, and Youtube (Sitti et al., 2013). Learners create new knowledge by connecting themselves to desired knowledge sources and then managing the relationship among these different sources. Therefore, learning takes place when learners connect to the data and the input (Kop & Hill, 2008).

Cloud computing is becoming increasingly popular today. Thanks to it, users do not need to install any programs to process data on their personal computers. In cloud computing, a large amount of data can be sent to and processed on the cloud server. Conclusions can be obtained from the data's analysis in a rapid manner. This can help many organizations save on the cost of information technology investments. Additionally, cloud computing allows users to use and access shared resources, making data storage and access more efficient.

The challenge of creating educational innovation today is the provision of learning media that can be easily accessed without requiring learners and instructors to be in the same place. Additionally, learners must be able to quickly search for information online through the learning management system, which contains a variety of learning media and can be linked to various sources of knowledge. The system should also process information in such a manner that learners can obtain the desired information accurately and quickly. Cloud technology and the internet, in conjunction with open-source software, can enable the aforementioned learning innovations. To promote innovation skills and the ability to apply knowledge to real-life situations, which can pave the way for learners' future careers, the researcher studied the cloud-based constructivism and connectivism learning model's roles in helping undergraduates create educational innovations. Based on the results, learners are encouraged to examine problems and use their knowledge to create works and innovations that have practical use and that can eventually enhance education.

2. Objectives of the Research

1) To examine the cloud-based constructivism and connectivism learning model's role in helping undergraduates create educational innovations

2) To evaluate the learning and innovation skills of students participating in cloud-based constructivism

3. Literature Review

3.1 Constructivism

Constructivism argues that learners' conceptions of knowledge are derived from a pursuit of meaning-making in which learners construct individual interpretations of their experiences. Constructivist learning is the process of constructing meaning and making sense of this experience (Amineh & Asl, 2015). The essential features of constructivism in practice are as follows: Cognitively active learners characterize learning and learning should happen in context and be structured around related themes or primary concepts. New knowledge constructs are built on prior knowledge. New knowledge should be applied and feedback provided. Learner self-reflection on the learning process is a key learning activity (Yoders, 2014). The central premise of constructivism is that learners create new understanding by actively building on prior knowledge and experiences (Jonassen, 1991). In constructivism, learning is represented as a constructive process in which the learner is building an internal illustration of knowledge and a personal interpretation of experience. This representation is always open to modification, with its structure and linkages forming the foundation to which other knowledge structures are attached. Learning is then an active process in which experience plays an important role in understanding and grasping meaning (Amineh & Asl, 2015).

3.2 Connectivism

Connectivism is a theoretical framework for understanding learning. In connectivism, the starting point for learning occurs when knowledge is actuated through the process of a learner connecting to and feeding information into a learning community (Kop & Hill, 2008). The learning process is cyclical in that learners will connect to a network to share and find new information; they will modify their beliefs on the basis of this new information; and then they will connect to a network to share this information and find new information again. The connectivist concept is particularly timely because the navigation of the internet and the means by which information is dispersed on the internet now provide a reference point for Siemens's assertions (Siemens, 2004). Network connections contain streams of information constantly flowing with substantiated data, including empirical findings from peer-reviewed journals and subjective information from personal websites or blogs

(Kropf, 2013). Connectivism generates new ways of learning by leveraging technology so there is an evolution in learning systems. Most of Siemens's papers address the limitations of previous learning theories, which he sees as inadequate because they are based on learning occurring within a person. He argues that technology and data systems allow learning to occur outside the brain, in computers and databases. Connectivism, a learning theory that posits new learning in the internet environment, has become a popular academic topic at the forefront of online learning and creative thinking in educational work (Chen & Xu, 2022). Connectivism-based area learning models are effective for increasing students' creativity and social skills (Wati & Mariono, 2022).

3.3 Cloud Technology

Internet thinking is a new way of thinking in the network environment. It meets the real-time interaction needs of students, teachers, and students through large data, cloud computing, and multidirectional interaction. The three core natures of internet thought are the link, noncentralization, and socialization. "Socialization" in internet thought directly corresponds to the construction of the learning community in the theory of connectivism, both of which emphasize the important role of the user community (Zhang et al., 2017). The components of information technology in Industry 4.0, which spans the development of the digital age, are cyber systems with computer connectivity and worldwide internet network infrastructure that support human activities in managing information. The latter involves automation between digital devices and data exchanges conducted using various digital technology services such as cloud computing, internet of things, and cognitive computing (Sulianta et al., 2020). Computer-supported collaborative activities offer functionalities desired by teachers, students, and pedagogy experts participating in the collaborative learning process. Computer-supported collaborative platforms deliver self-regulated learning capabilities. In self-regulated learning, individuals can freely choose their goals and develop their own strategies for monitoring, regulating, and controlling various aspects that influence the learning process and for evaluating or analyzing their cloud technology activities (Sharma & Kumar, 2017). Therefore, mobile digital devices connected to cloud-based platforms can create opportunities for collaboration. Creative innovation is also being used to help young people prepare to enter the real world and deal with real-world problems (Srikan et al., 2021). Cloud technologies allow flexible and cost-effective access to technology. The use of cloud technologies by educational institutions to manage their resources effectively is considered a good solution (Tugrul & Karakoca, 2020).

3.4 Educational Innovation

Educational innovations try to improve the competitiveness of the teaching process itself (García-Peñalvo et al., 2015). Innovative processes in systems of education provide variation and follow personality-oriented trends in the educational process so that the knowledge, skills and abilities of students are transformed into a means of developing their cognitive and personal qualities and competence (Mykhailyshyn et al., 2019). Educational innovations can emerge in various areas and in many forms. Innovation can be directed toward progress in one, several, or all aspects of the educational system: theory and practice, curriculum, teaching and learning, policy, technology, institutions and administrations, institutional culture, and teacher education. It can be applied to any aspect of education that can have a positive impact on learning and learners (Serdyukov, 2017). Therefore, developing innovation skills of students is extremely important.

4. Methodology

4.1 Scope of Research

This research encompassed the following:

4.1.1 Population and Sample Group

The population in this research consisted of undergraduates of Phetchaburi Rajabhat University. The sample group was derived using simple random sampling. Sixty undergraduates enrolled in the Educational Game Design and Development Program and Computer-Assisted Instruction for Mathematics Program were recruited.

4.1.2 Variables

The independent variable was the cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations. The dependent variables were educational innovations and satisfaction with instruction management.

4.1.3 Experiment Duration

The duration was 10 weeks.

4.2 Research Objective

Research objective 1: To create educational innovations through the cloud-based constructivism and connectivism learning model for undergraduates.

Research objective 2: To evaluate learning and innovation skills of students participating in cloud-based constructivism and connectivism learning for undergraduates to promote the creation of educational innovations.

4.3 Research Design

A one-shot case study design was adopted (Campbell & Stanley, 2015). The format was as follows:

X O

X referred to the treatment (cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations).

O referred to dependent variables (the results of the creation of educational innovations).

5. Results

Cloud-based constructivism and connectivism learning consist of three main elements: input factors, instruction process, and output factors.

Input factors consist of 21st-century learning skills, including innovation skills, constructivism theories, connectivism theories, cloud technology, and contents of programs used in learning management (Educational Game Design and Development Program and Computer-Assisted Instruction for Mathematics Program in this research).

The instruction process in this study refers to instruction management with the cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations. The process is composed of analysis and planning, development of workpieces, tests, presentation, improvement after presentation, and publication of workpieces.

The output factors consist of media analysis, educational innovations, and application.

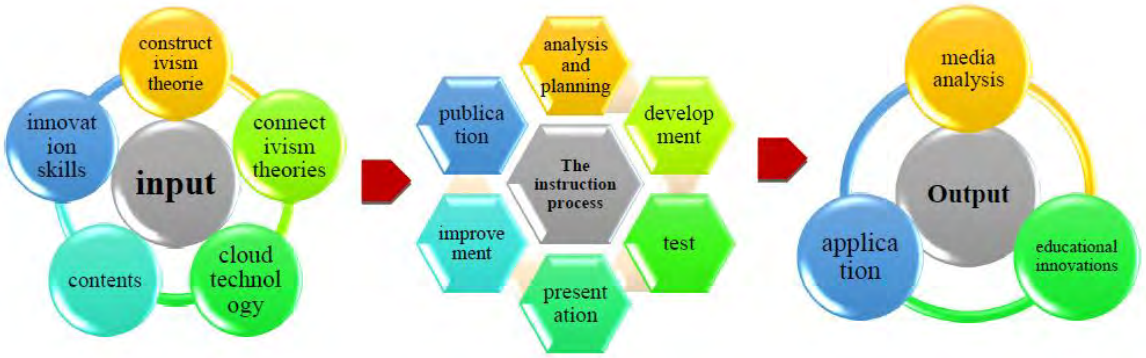

Figure 1. Conceptual framework of the cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations

The results can be divided into two parts: (1) educational innovations and (2) satisfaction with instruction management in the cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations.

The educational innovations of the sample group, which was enrolled in the Educational Game Design and Development Program, were derived from storyboards.

Figure 2. Samples of storyboards used for the creation of educational innovations

Figure 2 illustrates the storyboards employed to create educational innovations. These storyboards were created during the analysis and planning stages; after that, they were used to further develop the innovations, which were categorized as game-based educational innovation media (Figure 3).

Figure 3. Samples of educational innovations

Table 1 shows the results of the evaluation of the satisfaction of the sample group with instruction management in the cloud-based constructivism and connectivism learning model.

Table 1. Results of the evaluation of the satisfaction of the sample group with instruction management in the cloud-based constructivism and connectivism learning model

Items for Evaluation	Mean	Standard Deviation	Satisfaction Level
1. The instruction process proceeds according to the steps shown in the lesson plan.	4.56	0.62	Very High
2. The instruction process provides a pleasant learning atmosphere and encourages class participation.	4.46	0.68	High
3. The instruction process contains learner-centered instructional activities.	4.60	0.53	Very High
4. The instruction process provides activities for learners to practice searching and collecting data, along with conducting analysis and synthesis thinking.	4.55	0.59	Very High
5. The measurement process is in accordance with the instruction details.	4.48	0.59	High
Total	**4.53**	**0.60**	**Very High**

The overall satisfaction was at a very high level ($\bar{x}$=4.53, S.D. = 0.60). The top three items with the highest scores of satisfaction were "The instruction process contains learner-centered instructional activities" ($\bar{x}$= 4.60, S.D. = 0.53), "The instruction process proceeds according to the steps shown in the lesson plan" ($\bar{x}$= 4.56, S.D. = 0.62), and "The instruction process provides activities for learners to practice searching and collecting data, along with conducting analysis and synthesis thinking" ($\bar{x}$=4.55, S.D. = 0.59), respectively.

The researcher organized instruction management and instruction activities and evaluated students' learning and innovation skills in terms of three aspects: creative thinking, creative collaboration with others, and implementation of innovations. Undergraduates in the Educational Game Design and Development Program created 15 educational innovations, and undergraduates in the Computer-Assisted Instruction for Mathematics Program created six educational innovations. Everybody in the sample group was able to work creatively with others in the group.

6. Summary and Discussion

The results of this research are summarized and discussed as below.

Referring to the results of the creation of educational innovations through cloud-based constructivism and connectivism learning for undergraduates to promote the creation and application of educational innovations in the instruction management in higher education at Phetchaburi Rajabhat University, it is found that the students are able to create their own educational innovations. Regarding the results of the evaluation on satisfaction toward instruction management, it shows that the overall satisfaction is at very high level ($\bar{x}$=4.53, S.D.= 0.60). The top three items with the highest scores of satisfaction are "Contain learner-centered instructional activities" ($\bar{x}$=4.60, S.D.= 0.53), "The instruction process proceeds according to the steps shown in the lesson plan"($\bar{x}$=4.56, S.D.= 0.62), and "Provide activities for learners to practice searching and collecting data, along with analysis and synthesis thinking" ($\bar{x}$=4.55, S.D.= 0.59), respectively.

According to the evaluation of the learning and innovation skills of the 60 students who participated in the cloud-based constructivism and connectivism learning for undergraduates to promote the creation of educational innovations, these students could create 21 educational innovations, and four works out of these innovations have been accepted to be showcased in an academic conference. It can be clearly seen that the learning model developed in this research enables learners to create concrete educational innovations and analyze and apply different media in an effective manner. In addition, the said learning model can foster teamwork skills, enabling learners to work creatively with others as well.

7. Conclusion

The cloud-based constructivism and connectivism learning model for undergraduates to promote the creation of educational innovations consists of constructivism learning, connectivism learning, and clod technology. It allows learners to create educational innovations in the form of online instruction media. The steps involved are as follows: (1) the teacher specifies the problem; (2) learners plan and design a response by working together with the support of cloud technology while the teacher provides advice; (3) learners create their innovations using cloud technology; (4) learners check and test their innovations; (5) learners present their innovations to

other learners to exchange knowledge and gain more creative inspiration from each other's innovations; (6) learners improve and evaluate their innovations; and (7) learners publicize their innovations. Cloud technology is used as a source of information and as a tool to carry out these activities (Jirasatjanukul et al., 2021). The instructor provides advice and encourages learners to connect bodies of knowledge based on the theories of constructivism and connectivism (Jirasatjanukul & Jeerungsuwan, 2018). These steps help promote creativity (Chujitarom, 2020). Further, an evaluation of the suitability of the model conducted by seven experts shows that this model is suitable for adoption in instruction management for creating educational innovations and promoting innovation skills (Moreno-Guerrero et al., 2020). Through educational innovations derived from instruction management conducted using this model, students have acquired creativity and collaboration skills (Kembara et al., 2019). Their innovations have also been publicized at the national level. This in turn can lead to sustainability, which is in compliance with Chareonwongsak (2020). It shows that this model provides students with opportunities to analyze media. Promote innovative education and put educational innovations into practice.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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