Augmented Reality Imagineering Model for Learning Management with Cloud Learning Environment to Encourage the Innovative Skills of Undergraduates

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Abstract. The development of an imagineering learning management model with augmented reality (AR) technology in cloud learning environment to encourage innovation skills of undergraduate students is the research and development that aims to develop the learning management in the subject of innovation and information technology (IT) for Education. The concept of imagineering model for learning development and AR technology are brought to use in class, together with the arranging for the cloud learning environment. It requires for the modern learning environment where diverse educational technologies are applied to encourage students' innovation skills. The objectives of study are: (1) develop imagineering model with AR technology in cloud learning environment; (2) develop imagineering learning system with AR technology in cloud learning environment and; (3) study results of implementation of imagineering model with AR technology. The sample group comprises of 30 cases, selected from registration with multi-stage sampling. Meantime, the research tools include evaluation form and questionnaire. The results of research found that: (1) imagineering learning management model with AR technology in cloud learning environment consists of brainstorming, imagine, designing, implementing and presenting and evaluation; (2) imagineering model with AR technology enables to enhance innovation skills of learners at high level; (3) learners using imagineering model with AR technology in cloud learning environment are satisfied with the model at highest level.

Keywords: Imagineering · Cloud learning environment · Augmented reality · Innovative skills

1 Introduction

Nowadays, technology is playing crucial role in our daily lives. It is inevitable that human needs technology for living, especially technology in transportation, communication and medicine. Likewise, technology application in instruction enables learning development of learners satisfactory and responds information recognition of learners rapidly.

Learning with augmented reality (AR) is educational technology combining reality and virtual reality, subsequently present results through software, hardware and other

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interfaces, that building interaction with learners or users constantly. It starts from creating interest point and encouraging learners to be enthusiastic with concealed learning information. The special characteristics of virtual technology enable learners to see objects in three-dimension above real surface. The object moves dynamical and stimulating. The contents are displayed outside computer screen making it more interesting. Besides, the virtual technology helps building interaction between learners and cloud learning environment. Cloud learning is indefinite learning sourcing because it stores data unlimited. When it has been applied with virtual technology, connection and application of computer technology. Educational technology will create utmost benefits.

Applying technology in instruction is not only a decent tool for instruction in classroom, but also encourages learners to do self-learning after class. The imagineering model is bringing imagination into practice. The imagineering model clearly presents engineering contents and trains learners creating things from imagination systematically. As a result, learners are able to design and build works by themselves. Thus, the author has an idea to utilize special characteristics of augmented reality technology, cloud and imagineering model for developing instruction media for displaying complicated engineering contents explicitly.

2 Research Objectives

1. To develop imagineering learning model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students.
2. To develop imagineering learning management system with augmented reality technology in cloud learning environment.
3. To study results of application of imagineering learning model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students.

3 Populations and Samples

Populations are seventy-nine undergraduate students from the Faculty of Technical Education, King Mongkut's University of Technology North Bangkok, who registered for the educational innovation and information technology class in the second semester of academic year 2017.

The sample group consists of thirty cases of second-year undergraduate students majoring electrical engineering in the Faculty of Technical Education, King Mongkut's University of Technology North Bangkok, who registered for the educational innovation and information technology class during the first section of the second semester in the academic year of 2017.

4 Research Instrument

The research has been divided into three phases in which each phase has conformed to the research objectives as can be seen in Table 1.

Table 1. The research instrument used in each phase of the research and research objectives.

Research methodologies	Research objectives	Research tools
Phase 1 1. Step 1: the study on the learning management by an Imagineering learning model and the relevant researches 2. Step 2: the study on the implementing condition and the aim of teaching development in the subject of educational innovation and information technology 3. Step 3: the development of learning management by an Imagineering learning model	1. Develop Imagineering learning model with AR technology in cloud learning environment to encourage innovation skills of undergraduate students	1. Description of each improved subject 2. The process of Imagineering learning model
Phase 2 1. Step 1: to study on the environment and tools to be used in the learning management system 2. Step 2: to study on the student readiness for cloud learning environment. 3. Step 3: to develop the learning management system	2. Develop Imagineering learning management system with AR technology in cloud learning environment	3. Cloud learning environment promoting application such as Google for Education 4. Studio.hp-reveal program and HP Reveal application
Phase 3 1. Step 1: the development of performance assessment model and the assessment on the undergraduate students' performance by the model of learning management 2. Step 2: the development of Innovation skills assessment model and the assessment on the undergraduate students' skills 3. Step 3: the development of the satisfaction assessment model for the undergraduate students in the use of Imagineering learning model for learning management	3. Study results of application of Imagineering learning model with AR technology in cloud learning environment to encourage innovation skills of undergraduate students	5. Performance assessment model according to the process of Imagineering learning model 6. Innovation skills assessment model 7. Satisfaction assessment model for the use of Imagineering learning model in learning management

5 Data Analysis

The data analysis method in this imagineering model with AR technology in cloud learning environment for learning management is conducted to encourage for the innovation skills of the undergraduate students. This consists of the general statistics such as Percentage: %, Mean: $\bar{x}$, and Standard Deviation: S.D.

For the results analysis including the innovative skills assessment model and undergraduate students performance assessment model, the Rubric Score analysis method is brought to use for the Authentic Assessment of student performance. Also, the Rating Scale is adopted in the assessment of satisfaction toward the use of Imagineering model with augmented reality technology in cloud learning environment for the learning management to encourage for the innovative skills of the undergraduate students. The result interpretation is shown in form of 5 levels of rating scale.

6 Research Results

6.1 Phase 1: The Performance Results on Development of an Imagineering Learning Management Model with Augmented Reality Technology in Cloud Learning Environment to Encourage Innovation Skills of Undergraduate Students Can Be Shown in Three Following Phases

Step 1 is the study on the Imagineering learning management model and the relevant researches on an imagineering learning management model with augmented reality technology in cloud learning environment to encourage for the innovation skills of undergraduate students. From the study on any information from the relevant theories and researches, it is found that the Imagineering learning procedure can encourage the learner in the creativity from their ideas in systematic way in which it gives well answers required by the leaners in the 21st century; either creative thinking, innovation caring and judgment [1]. These promote the teachers to have process and methodology to set for the questions to lead to the results that the learner will be able to show the potential from their ideas without limit. That is the learner can think, design and create their works from their own imagination. This would also promote for the learner to work well with the other and to present their work in any forms according to the creative imagination. Thus, an imagineering learning procedure is the guideline for the learner development in the 21st century; besides, emphasizing on self-learning, it can be developed toward the creativity and innovation forming too. From the literature review, it is also found that bringing an Imagineering learning procedure to use in instruction management can truly encourage for more learner's skill on creativity and innovation.

Step 2 is the study on the implementing condition and the aim toward Innovation and Information Technology for Education subject development especially, in the teaching process and the content to be used in the teaching and learning arrangement. From the course description, it is stated that "The theories of technology and educational innovation that promotes for the quality learning development, computer

application to help in education management, information technology for teachers, the analysis on the problems arising from the use of innovation and information technology, information technology management for the teaching and learning as well as the management on the sources of learning and learning networks, innovation design for creation, application, assessment and improvement," it is found that from the previous teaching the emphasis is on theories and lecture in class or questions and Q&A. Then, testing the knowledge from all lessons via the exercises at the end of each chapter, while in some week, the learner may be assigned to form the work piece from the studied theories, usually the single and individual task. From the review, it is found that if the educational innovations and information technology can be brought to use in learning management and class management in reality [2], the learner then can clearer foresee on the benefits and methods of adoption in class. In addition, the learners will be able to see more characteristic of education innovations and information technology used in each form and they will better understand on the reason to adopt innovations and information technology in education. Moreover, in the improvement of the teaching procedures and weekly activities arrangement, or the content itself can allow for more practices among the learners, but to emphasize on the self-creating work to fully conform to the course description as well as to be able to increase the innovative skills in the learner more or less.

Step 3 the development of an Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students. From the study and analysis on the condition of learning arrangement, it allows for the development of an imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students through the applying of an imagineering learning procedure [3] together with the system management approach [4]. For setting the learning management process, that will be adapted into the former learning context by arranging the activities. That suited and conformed to the learning objectives for the learner. To receive in each subject in which consisting of five phases. see in Fig. 1.

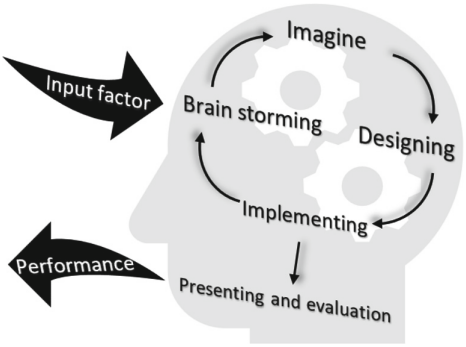

Fig. 1. Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students

Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students detailed as follows:

1. Brain storming phase is the first phase that the learners will join together to review the content and information to present or to respond to the assigned questions by reviewing the previous knowledge and the basic knowledge on any theories to be used in work creation with the guidance from the teacher.
2. Imagine phase is when the task has been assigned and leaner shall capable to reflect how to present it, in which form that would be interesting and create the best understanding in that content.
3. Designing is to set the order, plan and set for things to create from the imagination with the attempt to make it real. This could originate from the draft or storyboard as a plan before implementation.
4. Implementing is to process in order, The imagination as planned by it is important to define things, to be used to form the work as planned. They are tools, technology and equipment to help creating work.
5. Presenting and evaluation is to display the created work beginning from the presentation in class with teachers and classmates then, bringing the teacher suggestion and ideas exchanging with peers, to improve and revise before making the co-assessment. The learner will conduct self-assessment whether the final work is alike to their primary imagination or plan. The teacher will assess on the work piece, presentation as well as the attempt to improve the work in combination.

6.2 Phase 2: The Development of an Imagineering Learning Management Model with Augmented Reality Technology in Cloud Learning Environment to Encourage Innovation Skills of Undergraduate Students Can Present the Performance Result in Three Following Phases

Step 1 is the study on the environment and tools to be used within the Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students. From the study on the tools to be used in the learning management and review the methodology for the past learning management implementation. It is found that in many classes, educational technologies have been adopted more in the learning management. These technologies can facilitate for either teacher or student by becoming the channel to hand on the works, collecting the works as well as a communication channel between teachers and students. Together with learning with augmented reality [5] is educational technology combining reality and virtual reality and subsequently present results through software, hardware and other interfaces that building interaction with learners or users constantly. It starts from creating interest point and encouraging learners to be enthusiastic with concealed learning information. The special characteristics of virtual

technology enable learners to see objects in three-dimension above real surface. The object moves dynamical and stimulating. The contents are displayed outside computer screen making it more interesting.

Step 2 is the study in the learners prompt preparation by considering on their readiness to smoothly use an Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students. From the observation on students in the readiness to use online applications and skills of communication devices or mobile phone usage, it allows the researcher to recognize that students in IT generation have no problem in the use of communication and mobile phone devices. Everyone has their own mobile phone and understands how to use it well. Mostly they have new models of mobile phone with touchscreen and updated to the latest version. From the asking about the amount of those who have personal notebook, everyone has it thus, it can be confident that the learners are prompted to use the cloud learning system [6]. For the internet signal service, from the survey, the faculty has installed the internet signal for students at all spots in the building with the good signal quality, stable and speed without obstruction in use.

Step 3 the development of an Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students. From the study and testing to use many existing applications for learning management, it is found that students will be more convenient if using Google service because an email account used in the class registration (@kmutnb.ac.th) can adopt free Google service throughout the years of study. In order to enhance the students to conveniently use Google for Education service and quick as well as be able to bring any files to keep in Google and share them with those who need with co-revision plus, be able to use the data storage space without limit, etc. By this reason, the class management system by Google is selected for Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students. That means the classroom is the tool to facilitate for the convenience in learning management in which designed to form and store the teaching and learning information. It can be used together with other services in supporting to the classroom activity by the teacher can check the learning information at all time and prompt to give advice the students as well. This can add more channels for communication between teachers and students, to provide advice for the students at all-time though not at school. Importantly, Google classroom can categorize the individual student data folders and each student can always see and revise their own data through the full service of classroom management. Thus, it is adopted in supporting to an Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students in which there are steps in system accessing as Fig. 2.

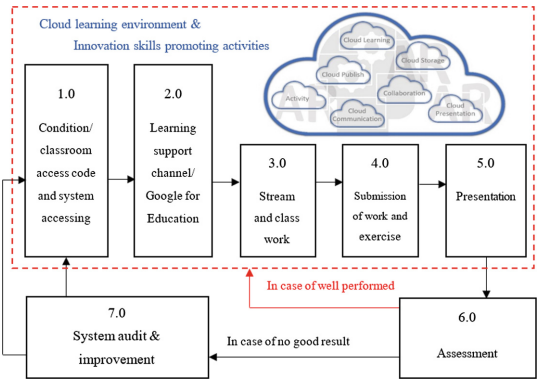

Fig. 2. Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students

An Imagineering learning management system with augmented reality technology in cloud learning environment to encourage the innovation skills of undergraduate students is detailed as followed.

Phase 1.0 is the step to conditions and agreement, to access into the system or access into the classroom, including the use of could in other forms to support for the arranging of classroom activities. The pre-accessing process is explained as follows:

1. Informing about the access into system, using objectives, and basic example of use.
2. Assigning the classroom access code and authentication to access the system.
3. Explaining the basic use and testing on the using channel.

Phase 2.0 is the channel to support for the learning in cloud learning environment, where it sets the environment for the students to adopt the Google for Education as the main tool, by testing on the use of any tool using as follows:

1. Cloud Learning, Collaboration – Classroom, Form
2. Cloud Storage – Drive
3. Cloud Publish – Studio HP
4. Cloud Communication, Activity – Social, HP Reveal
5. Cloud Presentation – Site

Phase 3.0 is to assign the tasks with details of task through the stream which is the main window for Classroom usage where all assigned tasks will be shown on the stream page. The steps to access to see the assignment are as follows:

1. System access.
2. Selecting the command and stream to see the announcement and assignment.
3. It allows students to see and download the ordering file or the image immediately.

Phase 4.0 is the channel of work and exercise submission. The assignment will be set with deadline for submission to the system both date and time. If it has exceeded the deadline, system will automatically notify and show as missing deadline. The submission processes are as follows:

1. System access.
2. Selecting the command and class tasks to see the details of assignment, date and time of deadline.
3. Students are allowed to see and revise the work until the submission deadline, within the notification will be the on-time submission no matter how many times of revision.

Phase 5.0 is the result presentation, it is the process to present the creation project by all will be displayed in the system where it can be accessed and presented right through the classroom. The accessing steps are as follows:

1. System access.
2. Selecting the command and class tasks to see the details of assignment.
3. Students are allowed to see and present the work immediately right through the system.

Phase 6.0 is to rate for the score and assessment, rating can be done through classroom system immediately right after the deadline is completed. If there is any revision on the work, it is allowed to set for the new date and time of deadline and the new score rating criteria. The assessment processes are as follows:

1. Teachers and classmates can access to see the works of everyone on the system.
2. Teachers can give the score through the system immediately and the scores will be immediately displayed to the students as well.
3. If any pieces of work have not received the score, there will always be the notification to the teachers.

Phase 7.0 is about the system auditing and improvement, it is the process to audit for the system development from the results of system used.

6.3 Phase 3: Studies on the Result of an Imagineering Learning Management Model with Augmented Reality Technology in Cloud Learning Environment Adoption to Encourage Innovation Skills of Undergraduate Students

Step 1 is to develop the performance assessment form and assess on the performance of the students who use an Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students according to the Imagineering learning procedure.

An imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students consists of phase 1 brainstorming, phase 2 imagine, phase 3 designing, phase 4 implementing and phase 5 presentation and result assessment. In each phase, there will be the assessment on the ability of the learner in reality with the following assessment criteria.

1. Brainstorming
   - Planning for the solution of the assigned tasks (assessing from the implementation plan to process)
   - Reviewing of the presenting information (evaluating from the answer to question)
   - Presenting the selected information content as planned (presentation assessment)
2. Imagine
   - Explaining for the other to understand in the imagination
   - New and interesting creative ideas
   - Using media to assist in the imagination explaining
3. Designing
   - Simulating the situation, drafting the model from the imagination in details
   - The delicate in event ordering in the storyboard of imagination
4. Implementation
   - Selecting the media to help creating the imagination to reality
   - Following the plan and design
5. Presentation and assessment
   - Work presentation
   - Testing
   - Self-assessment of work by the student
   - Work assessment by teacher and classmates

The result from the use of performance assessment form of the students according to the Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students. From the observation, it is found that the learners are confident since in all steps of the assessment, the teachers will help advice and adjust for the students. Therefore, they can revise and improve for the new ideas from the co-evaluation in all steps in class and the final work comes out as expected and imagined.

Step 2 is to develop the skills assessment form and to assess on the innovation skills of the undergraduate students who have used the Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students.

Innovation skill is the skill that reflect the idea and imagination that would result on the selection of innovation to use, innovation creation or, to use the innovation for the utmost benefit. Thus, it can be considered that in the innovation skills assessment, it can be evaluated from the behaviors or the students' performance. The assessment is designed in form of score rating using the Rubric Score. The criteria for the assessment has synthesized the data from the learning skill and innovation that shall exist in the 21st century [7] and the compositions of the creative and innovation skills [8]. The behavioral assessment consists of four criteria as follows:

Level 3 means the level (80–100%)
Level 2 refers to the medium level (50–79%)
Level 1 means the level for less (less than 50%)
Level 0 means no skills innovation (0%)

Behavioral or implementation assessment as follows:

1. The aspect of the planning for the innovation development in consequence of the imagination
2. The aspect of efficient innovation development implementation as planned
3. The aspect of quality assessment on the developed innovation by using the empirical data
4. The aspect of continuing deficiencies improvement for the innovation

Results from the assessment on the innovation skills among the undergraduate students who use the Imagineering learning management model with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students have shown that the scores on the aspect of innovation skills as evaluated from the reality by the setting criteria if considering from the average of score, the students have the average score at level 3. This can be calculated into 87% and it shows that the Imagineering learning management with augmented reality technology in cloud learning environment to encourage innovation skills of undergraduate students allows for more innovation skills enhancement of the students. This is in accordance with the prediction that the Imagineering learning management model with augmented reality technology in cloud learning environment can encourage for more innovation skills in undergraduate students at high level or 80% for at least.

Step 3 is the developing of the satisfactory assessment form and to assess the students' satisfaction in the use of an Imagineering learning management model with augmented reality technology in cloud learning environment to encourage for the innovation skills of undergraduate students.

In the satisfactory assessment for the use of an Imagineering learning management model with augmented reality technology in cloud learning environment to encourage for the innovation skills of undergraduate students, the researcher adopts the Rating Scale assessment in form of 5 Levels [9] in which results can be interpreted in Table 2 as follows.

The criteria in the analysis are as follows:

4.50–5.00 meant highest satisfaction
3.50–4.49 means high satisfied
2.50–3.49 means moderate satisfaction
1.50–2.49 meant less satisfied
1.00–1.49 means least satisfaction

The results of students' satisfactory assessment in the use of an Imagineering learning management model with AR technology in cloud learning environment to encourage for the innovation skills of undergraduate students have shown that the students who adopted the Imagineering learning management model with AR technology in cloud learning environment have the highest level of satisfaction. The

average score is at $\bar{x}$ = 4.87, S.D. = 0.17 in which being in accordance to the expectation for the learner to have the high level or more satisfaction in the system use.

Table 2. The results of satisfactory assessment in the use of an Imagineering learning management model with augmented reality technology in cloud learning environment to encourage for the innovation skills of undergraduate students

Student satisfactory assessment	Assessment results		
	$\bar{x}$	*S.D.*	Level
On the aspect of learning management;			Highest
1. Success in the brainstorming phase	4.67	0.48	
2. Success in an imagination phase	4.63	0.49	
3. Success in designing phase	4.50	0.50	
4. Success in the implementation phase	4.67	0.48	
5. Success in presentation and assessment phase	4.67	0.48	
6. Overall picture in the successful compliance of each phase	4.83	0.38	
The aspect of learning management system;			Highest
1. The proper amount of content in each week	5.00	0.00	
2. The lesson presentation has followed the order of simple to difficult	5.00	0.00	
3. The dividend of lessons into sub-topic allows students to understand better in the content	5.00	0.00	
4. The task assigned in each week is proper	5.00	0.00	
5. The convenience in the use of channel that supports for the cloud environment learning	5.00	0.00	
6. Selecting the proper cloud in the creation of work	4.83	0.38	
The aspect of learning management;			Highest
1. Examples and questions are partly helped create better understanding in the content	5.00	0.00	
2. Tasks assigned in each step of form can improve the innovation skills of the learner	5.00	0.00	
3. In each time of suggestion providing, it helps the learner form better work	5.00	0.00	
4. Cloud learning environment has partly helped enhance for the higher innovation skills of undergraduate students.	5.00	0.00	
5. Imagineering learning management model with AR technology in cloud learning environment can encourage for the better innovation skills of the students	5.00	0.00	
Total	4.87	0.17	Highest

7 Conclusion

Instruction in educational innovation and IT has been implementing imagineering model, AR technology, instruction and cloud learning environment, aims to modernize instruction, apply diversified educational technology and improve innovation skills of learners. The imagineering model process has been conducted in five aspects comprising brainstorm, imagine, design, implement, and presentation and result assessment. Learners implement AR technology with content design and presentation and make works more interesting in accordance with imagination and engineering principles. Results from the research found that the innovative skill of all 30 cases are increasing in high level (87%) after using AR Imagineering model for learning management with cloud learning environment.

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