Mobile Apps Development on Higher-Order Thinking Approach

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This research aimed to develop HOTS Flash application and evaluate the effectiveness usability of HOTS Flash applications in MPPP 1223 Authoring System course. Respondents involved in this study were 16 students, specifically from the Master of Education (Educational Technology) programme. All respondents enrolled in MPPP 1223 Authoring System course where they learnt basic skills in Adobe Flash Professional software. A set of questionnaire was used as a research instrument. Data collected were processed and analysed by using Statistical Package for Social Science (SPSS) version 20. The data obtained are shown in descriptive statistics such mean, percentage, and standard deviation. Overall, this app was very useful and most respondents were satisfied with the content in this app with the mean value 4.19. This research shown that users' perception of effectiveness usability of the HOTS Flash application to incresase Higher-Order Thinking Skills can help student in constructing knowledge in learning skills subject.

I. Introduction

Thinking skills involve the manipulation of knowledge rather than memorize is defined as High order thinking skills (HOTS).[17] This thinking skills require comprehension, analysis, synthesis, application, and evaluation. After that, HOTS involves the assignments more forward in cognitive so that students will achieve deeper understanding on the learning material, create new knowledge, solve the problems that require more than one possible answer, create the original material, or make decision.[16]

The formal lecturing faced many problems in teaching and learning such as not promote the Higher-Order Thinking Skills, too depend on teachers, lack of students engagement, and bored. The purpose of the research is to develop the mobile app concern on Higher-Order Thinking Skills which focusing on course of MPPP 1223 Authoring System among master students in Faculty of Education students. The research is also aimed to develop mobile app based on of Higher-Order Thinking Skills concept among students, study its acceptance, and evaluate the students' perception to this app. In this development, several objectives have been identified as follow:

1. To develop a mobile app based on Higher-Order Thinking Skills concept
2. To study students' acceptance when using the mobile app regarding to Higher-Order Thinking Skills.
3. To evaluate students' perception when using the mobile app regarding to Higher-Order Thinking Skills.

The formal lecturing is conventional learning method that only offer the formal learning environment. This formal learning shows the weakness when it not promote the higher-order thinking skills, too depend on teachers, lack of students engagement, and bored. Therefore, the researcher developed mobile app to change the formal learning environment into informal learning environment.

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II. Literature Review

Currently, there is no fixed definition of term of m-learning. However, mobile learning is defined as the learning by using electronic devices that across the context through the interaction of content and social.[11] Other definition of m-learning is, portable electronic devices included tablet computers and smart phones is used to access the learning.[9] The next definition is all activities in education involving technology as mediation devices between learners and mobile devices, where learners access data and communicate via wireless technology.[25]

The advantage of using mobile learning is that it is flexible where students can learn anytime and anywhere. M-learning encourage self-paced learning environment where students could learn anytime and anywhere according to their own preference.[19] In addition, most students prefer to use mobile devices more as a new technology of learning because the devices are portable and can be accessed anywhere.[22] After that, viewed mobile devices provide learning on the go and independent to time and space.[21] Furthermore, mobile learning is flexible and can be accessed instantly anytime user want.[7]

Many researches that was done by scholars have shown the positive result of using mobile learning that offers flexibility in learning. The research that was done shows that, 90.1% of 374 lecturers in Universiti Kebangsaan Malaysia agree that mobile learning offers more flexibility to students and teachers.[2] Another proof that mobile learning give flexibility is 86.26 % of the students in Universiti Malaysia Sabah respond to agree and very agree because mobile learning provides freedom to manage their learning time.[24] From the output of the interviewed students in the public university in the Black Sea region of turkey statet that they can learn in leisure time such as before sleeping and travelling on the bus.[5]

As skills learning need a lot of practicing to master the skills, basic knowledge of the function of the skills are needed and the understanding of the step by step process to learn the skills are much important. Thus how learners are able to master the skills are by understanding the step by step process which student actually construct their knowledge through the understanding of the step by step process that bring to the expected output. However if the step by step process is being unfollowed or learners done even a mistake then the expected output become improper. Thus it is very important for learners to be able to follow the step by step process in able to construct the concept of skills which constructivism theory should become the basis to the skills learning process.

Constructivism is a theory of learning which student not only receive and store knowledge given by the teacher but they are constructing the new knowledge.[4] The HOTS Flash application was developed based on constructivism theory where students will construct their own knowledge after a series of learning. This theory will linking the facts with the students understanding. Inductive method of reasoning is a process of transformation particular to general. In a guided inductive discovery lesson, hereafter called the inductive approach, the students, not the teacher, state the generalization following their examination of specifics.[18] In this research, researcher has implement higher order thinking levels into the learning process through the mobile application software. Interactive multimedia program will develop students with high order thinking. Substantial levels of higher-order thinking can be supported and maintained by approach of multimedia program based on a situated learning in learning environment.[14] In the application software, the learning design is construct based on problem solving skills approach where users have been asking question related to the course content but using Higher-Order Thinking question levels. Critical thinking process and utilizes learner collaboration among students can be developed through problem-solving technique.[23] In the

process, students construct new knowledge and understanding where they are able to make decisions through the deep understanding of the topic area.[10]

III. Methodology

The mobile app is the one of technology that can create learning variation. This variation is important because it can create a change of learning style according to technology changes that based on the currect curriculum. From this point, researcher takes the appropriate instructional design so that the growth process of mobile app will be more systematic and structured. In addition, the mobile app design, should be planned carefully so that the mobile app become interactive and interesting application. The instructional design such as ASSURE, ADDIE, and waterfall models will guide researcher or developer to create the mobile app effectively and efficiently.[15] In this research, researcher choose ADDIE model in creating the mobile app. This is because, the procedure is simple, more systematic and user friendly. Employment of ADDIE model in the development of a program or course can assist developers in instituting a learner-centered approached as it make program more applicable and meaningful to learners.[13] This ADDIE model is not only used in education but used in almost field.

The research design used in this research is descriptive observation form to evaluate the usefulness HOTS Flash app in the learning. This research is suitable by using the quantitative methods in the same populations. A questionnaire is used as the instrument to collect the respond according to research objectives. The questionnaire was distribute to the respondents by online medium which is Google Docs form. The questionnaire, contains 38 items that covers all the construct in research onjectives. The sums of 16 sets of questionnaire will be distributed to postgraduate students in the Faculty of Education. All items were divided into two sections according to the study objectives. The following sections were asked in questionnaire namely:

a) Section A: Background of Respondent
b) Section B: Survey items

The items in Section A related to students background. The aspects of students' background including gender, age, programme of study, semester, working experience, and phone model. Items in Section B contain 30 items that consists of ten constructs. The ten constructs are; 1) user friendly, 2) interactivity, 3) design, 4) question instructions, 5) note explanation, and 6) overall app.

Researcher has analysed the data using SPSS software (Statistical Package for Social Science) version 20. The statistics data that used in this research were in form of percentage, average, and standard deviation. The scale is supposed to be used is ordinal scales where the degree of agree is ranked by ordering into five-point Likert's Scale. The highest rating scale for "Strongly Agree" is five point and the lowest rating scale for "Strongly Disagree" is one point. Assumed that the distance between each point of scale cannot be same. While the interval scale is used to the data that equal interval to each data point. Example of interval data is the distance. The distance between KM 14 and KM 16 is same as distance between KM 25 and KM 27 (Cohen et al., 2007). However, that the distance points between scale is equal to each other.[12] Thus, this five-point Likert's scale treat as interval scale. This is become common practice among social science scholar in treating the point in Likert's scale. The use interval scale enable researcher to mean the level of agree to the usefulness of mobile app among MPPP 1223 (Authoring System) students.

IV. Application Design

Design phase is conducted after the researcher finish the process in the analysis phase. In general, the design of mobile app is divided into 1) information design, 2) interaction design, and 3) interface design. Researcher organize content by using the flowcharts. Flowchart is usually to describe algorithms or processes in form of graphical symbols. Graphical symbol is represented in form of circles and arrows. The aims of use flowchart are to represent the control flow and provided detail by using text.[3] By applying flowchart, the researcher can visualize the flow knowledge process clearly. This mobile app is initially created for the mobile phone with the screen size 480 × 320 pixels with the landscape orientation and full screen.[6] However, this mobile app is suitable for all mobile app with the variety of size since this mobile app stretch the display. That is mean that, when the smartphone with the 800 × 600 pixels, the mobile app will displayed at 800 × 600 pixels according to the mobile phone size.

The application software screens will display a main menu, about, questions, and notes once the application software is completely loading in to the mobile phone. There are two menus in the Main Menu. The first one is "Challenge Yourself!" where this is the most important part of HOTS Flash app. This menu shows questions regarding the Adobe Flash Professional topics. The second menu is "About Us" where this menu will direct us to the general information about the mobile app.

V. Data Analysis

The type of statistics used in quantitative analysis are descriptive statistics and inferential statistics. The descriptive statistics is used to analyse the mean, and mode, to identify the level of agree to the acceptance of HOTS app among Authoring System students. In section A of questionnaire, the information regarding to students' demographic was analysed quantitatively to view the relationship between the level of agree to the usefulness of mobile app to the students' phone model, status such as full-time and part-time student and skill level of Adobe Flash Professional. In Universiti Teknologi Malaysia (UTM), there are two categories of postgraduate students: full time students and part time students. In the course of MPT 1223 (Authoring System), there has 31.25 % of full time students and 68.75 % part time students.

All smartphone and tablet model used Android operating system and version 4 (Ice Cream Sandwich) and above. Therefore, there is no compatibility issue when installing Adobe AIR into their smartphones because the minimum operating system requirement for this app is Android version 2.3 and higher.[1] The screen size is not become a major problem because researcher has developed the HOTS Flash by using a screen size of 320 × 480. About 18.8% and 31.3% were intermediate and average user of Adobe Flash Professional respectively. However no one is an advance and expert user of Adobe Flash Professional. The highest mean is the item of "the fullscreen size of this app enable you see the content easily" and "navigation menu assists you to access the app easily". Both of items shows the mean of 4.50. However, the lowest mean is the item of "save your time when use this app" with mean score 4.25. Overall for mean of user friendly is 4.39. This shows that, this app is user friendly.

The second part of acceptance test is interactivity where the respondents are communicating with the app using buttons on the screen. The researcher ensures that, the button should be fully functioning and minimizing the flaw. The third element of acceptance test is screen design. The screen design is focusing more on the visual elements such as layout, font, animation, and graphic. The item "the font size appropriate to gadget size" is the highest mean on the screen

design with value of 4.25. The lowest mean for this design item is "The background is very interesting". The findings show that the mean for overall design is 4.15. The researcher used the constructive approach where after respondents used answered every question, the notes was provided to give information about the function of selected tools and features of Adobe Flash Professional. The highest mean score for this construct are items of "Note explanation after Question 3 (Frames) is clear and easy to understand" and "Note explanation after Question 4 (Interactivity) is clear and easy to understand". The both value for these items is 4.31. Overall mean score of 4.25 for this construct shows that the explanation in all notes are excellent. The highest mean score for this construct are items of "Note explanation after Question 3 (Frames) is clear and easy to understand" and "Note explanation after Question 4 (Interactivity) is clear and easy to understand". The both value for these items is 4.31.

Overall mean score of 4.25 for this construct shows that the explanation in all notes are excellent. The highest mean for overall usage and perception of this app is 4.31. The item with the highest mean score is "App are handled easily" where respondents tend to "strongly agree" on this item. It also shows that, 68.8 percent of students responded on the "agree" while 31.3% responded into "strongly agree". This highest mean is also tie with the item of "Instructions for Question 2 (Tools) is clear and easy to understand ". In contrast, the lowest mean score is on the "Question 1 (Tools) encourage the use of high-order thinking skills"and "Question 3 (Frames) encourage the use of high-order thinking skills" with the mean score of 3.75. For overall acceptance of this app shows that the mean score is 4.19.

VI. Discussion and Summary

This research was conducted to develop HOTS Flash application and test the system functionality and usability to a group of users. The HOTS Flash application was developed based on constructivism theory where students will construct their own knowledge after a series of learning. In this research, researcher has implement higher order thinking levels into the learning process through the mobile application software. In the application software, the learning design is construct based on problem solving skills approach where users have been asking question related to the course content but using Higher-Order Thinking question levels. After the application software was completely developed, the researcher has run an acceptance test containing of six constructs: 1) user friendly, 2) interactivity, 3) design, 4) questions instruction, 5) note explanation, and 6) overall evaluation for HOTS Flash application.

The sample were consisted of 16 students, who are enrolled in MPPP 1223 (Authoring System) course. They are comprised of full time students and part time students who are in the first year of study in Master program. All of them have mobile gadgets such as mobile phone and tablet computer with Android Operating System. Their gadget has been installed with HOTS Flash application to test the acceptance part of this study. The questionnaire was given to the respondents in the classroom. The questionnaire has two sections, Section A and Section B. Section A consisted of demographic background of the respondents that asked about the gadget model, category of student, the skill level of using Adobe Flash Professional, the frequency of using application based on education, and the purpose of using a gadget.

Meanwhile, in Section B, respondents were asked to respond to six constructs of acceptance test; 1) user friendly, 2) interactivity, 3) design, 4) questions instruction, 5) note explanation, and 6) overall evaluation for HOTS Flash application.

Table 6.1: The questionnaire items categories and its mean score

Construct	Mean Score
User friendly	4.39
Interactivity	4.15
Design	4.15
Question instruction	4.05
Note explanation	4.25
Students' perception on HOTS Flash application	4.13

From this research, the category of students showed the significant difference in mean score for encouraging them to think critically when using this application. The skills of Adobe Flash Professional level is related to the mean score for the encouraging of using Higher-Order Thinking Skills.

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