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Mobile technology and CAD technology integration in teaching architectural design process for producing creative product

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The purpose of this research is to examine the effect of integrating the mobile and CAD technology on teaching architectural design process for Malaysian polytechnic architectural students in producing a creative product. The website is set up based on Caroll's minimal theory, while mobile and CAD technology integration is based on Brown and Campione's technology of learning theory. This study utilized a quasi-experimental method. Final semester students from four (4) polytechnics being used as research samples where sixty (60) students are in the treatment group and another sixty (60) students are in the control group. The final products being evaluated by the experts in architectural field using an instrument based on Creative Product Analysis Model (CPAM). The inferential statistics namely T-Test and Pearson Correlation Analysis with a significant level p = 0.01 were utilized. Research outcome shows that there is a significant difference between the treatment group product (M=79.1) and control group product (M=70.5). This research contributes to the use of real case in the development of an architectural website, in the use of mobile technology as media information sources, the use of CAD technology integration in designing process and in the construction of validated instrument which is used to evaluate creative architectural products.

Keyword: real case, mobile technology, CAD technology, design, creative product

1.0 Introduction

Architectural design is a complex and open process. Designing process starts from abstract which had a problem to be developed stage by stage until a level where it can be produced as a product. Lawson (2007) states that architectural design is a process where an architect produces space, place and building which has a big amount of effects on human life quality. This research concentrates on schematic stage of design process which involves sketching and schematic design. As a conclusion, the beginning stage of design process involves collecting the information needs in the design process and producing new ideas. Technological development nowadays, has given chances for mobile and CAD technology to be integrated in design process. Mobile technology gives chances for students to have access to the information without time and place limits. Websites referring to real cases provide opportunity to gather quick information for design process purpose. CAD technological development in three dimensional digital model and computer simulation can provide new methods for designers to find more solution in schematic design process.

1.1 The purpose of the research

The purposes of the research are to identify the interest of the student in finding informations need in the design process through web mobile or conventional method, to study the effect of integrating mobile technology at the analysis stage in the design process , to study the effect of integrating CAD technology at the synthesis stage in the design process , to study the effect of integrating CAD technology at the simulation stage in the design process, to study the effect of integrating mobile and CAD technology in producing the final product of architectural design and to see the relationship between the integration of mobile and CAD technology in the design process with the creative product of architectural design

1.2 Conceptual framework

The conceptual framework for this research was built based on Carroll's minimal theory (1995), Brown's and Campione's learning with technology theory (1996) and creative product analysis matrix model (CPAM), Besemer dan Treffingger (1981). This conceptual frame consists of two independent variables and one independent variable. Two independent variables are the use of web mobile in obtaining design's information and the use of CAD technology in creating new ideas activities whereas the independent variable is the creative product from the design process. For this research the design project programme prepared by the researcher. The web mobile for gathering information activity had been developed by the researcher based on Carroll's minimal theory (1995). The intergration of CAD technology in the design process occurred at the synthesis stage, the simulation stage and before producing final creative product. Evaluation instruments created by the researcher being used to evaluate product from analysis stage, synthesis stage and simulation stage. The final products had been evaluated using the instrument that built by researcher based on CPAM model. The products from each stage compared by researcher to study the effect of integrating mobile technology and CAD technology in design process.

2.0 Research methodology

This research consists of two main activities in the design process which is designs' information development activity and creating new ideas activity. Information searching for design purposes on web site based on real case is provided by researcher using mobile device while for creating new ideas activity, CAD technology is used. The web site used in this research developed by the researcher using Caroll's minimal theory. In applying Carroll's Minimalist theory when developing the web site the researcher follows the recommendations by Kearsley (1994) which are to allow learners to start immediately on meaningful tasks to minimize the amount of reading and other passive forms of training by allowing users to fill in the gaps themselves and to make all learning activities self-contained and independent of sequence. The web site that had been developed for this research can be referred at http://www.kajian_senireka.param.mobi. The integration of the web mobile and CAD technology in the design process for this research is based on Brown and Campione (1996) learning with technology theory. With this theory the integration should be done with the latest equipments required to get the accurate results. Through this study, researcher wants to see the differences in final product designed using mobile and CAD technology integration with the final product build using conventional method. Researcher also wants to see upon how is the effect of integrating web site based on mobile device in the design information

development activity. This is a quantitative research to study the effects of mobile and CAD technology integration in the design process to produce architectural creative product. Quasi experimental method is used to study mobile and CAD technology integration effects in design process.

2.1 Research Samples

Research has been made on final semester students of diploma architecture from four (4) polytechnics. The students have the basic skill for using ACAD 2007 and 3D Studio viz software. Research duration is for six weeks involving one hundred twenty students (120) students as research samples. In this research, research samples have been asked to design a kindergarten. Sixty (60) students from POLIPD and PMM were selected to design with the integration of mobile and CAD technology and they are used as treatment group while the other half of the students are from PUO and POLISAS perform the design process using conventional method and they are used as control group. All the four polytechnics selected are using the same curriculum for diploma in architecture which being developed by the Malaysian ministry of higher education. This research has been conducted by two lecturers from each polytechnic selected. Design process for treatment group and control group has been conducted simultaneously. Products for every activity from both of the design processes have been evaluated by selected lecturers using the research instruments provided.

3.0 Findings

The finding for this research being divided into five categories which are identifying students interest in finding design information, inferential data to compare design information created through analysis activity, inferential data to compare design product from synthesis and simulation activity and inferential data to compare final design product through conventional method compare to integrated method.

3.1 Student interest in finding information

In identifying student interest to find information needed in designing process whether it is via mobile technology based website or via conventional method, research outcomes show in Table 1.

Table 1 Descriptive statistics in finding information activity

No	Name of polytechnic	Finding information activities (Frequency)
1	POLIPD	204
2	PMM	188
	Total	392
	Mean	6.53
1	PUO	80
2	POLISAS	98
	Total	178
	Mean	2.97

This outcome clearly shows that student searching activities increased with web site integration related to real case based on mobile technology.

3.2 Comparing the product of analysis activity

This outcome comparing the quality of designs' information being created from analysis activity consists of two methods which are design information created through conventional method and design information created through integrated method. Research outcome shows in the Table 2.

Table 2 Finding on comparing design information produced in analysis activity

t-test	n	mean	s.d	t	p
Analysis Activity					
Treatment	60	81.2	5.13	18.369	0.000
Control	60	65.5	4.19		

The significant different on the product being produced in analysis activity proves that the integration of web site based on mobile technology helps the students to produce quality design information in analysis activity.

3.3 Creating new ideas in synthesis activity

In determining student skills at synthesis stage in design process with CAD integration, research has been made to decide whether students using CAD technology integration in synthesis stage has made more idea changes from two dimensional to three dimensional compared to students using conventional method in synthesis stage. The research outcomes of the synthesis activity in the design process show in Table 3.

Table 3 Finding on ideas produced in synthesis activity

No	Name of polytechnic	Conceptual diagram	Early ideas	2D to 3D
1	POLIPD	110	132	126
2	PMM	119	111	109
	Total	229	243	235
	Mean	3.82	4.05	3.92
1	PUO	69	70	61
2	POLISAS	81	80	66
	Total	150	150	127
	Mean	2.50	2.50	2.12

Research outcomes show that treatment group is actively involved in synthesis activity compared to control group.

3.4 Comparing the product of synthesis activity

The inferential finding data for synthesis activity are shown in Table 4. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the synthesis stage compare to the product being produced by control group at the synthesis stage.

Table 4 T-test finding to compare mean between treatment group and control group product for synthesis activity in design process

t-test	n	mean	s.d	t	p
Synthesis Activity					
Treatment	60	80.6	3.72	17.184	0.000
Control	60	67.1	4.80		

Research outcomes show that the initial ideas being produced from integrated method better than the initial ideas being produced from conventional method.

3.5 Comparing the product of simulation activity

The inferential finding data for simulation activity are shown in Table 5. This inferential data will determine whether there is a significant different between the product being produced by treatment group at the simulation stage compare to the product being produced by control group at the simulation stage. The creative and quality product being produced at the simulation stage helps the students to produce a quality final design product.

Table 5 T-test finding to compare mean between treatment group and control group product for simulation activity in design process

t-test	n	mean	s.d	t	p
Simulation Activity					
Treatment	60	80.5	5.46	12.267	0.000
Control	60	66.9	6.68		

This outcome shows that the design idea that being produced from integrated method is better than the design idea being produced from conventional method.

3.6 Comparing the final product

In this research the creativity of the design product being determined based on CPAM model which are unique, practicality and detail. This inferential data will determine whether there is a significant different between the final product being produced by treatment group in the design process compare to the final product being produced by control group in the design process. The inferential finding data for comparing design product between treatment group and control group are shown in Table 6. This finding can prove positive effects on the

integration of mobile and CAD technology in the design process for producing creative product.

Table 6 T-test finding to compare mean between treatment group product and control group product based on CPAM model

t-test	n	mean	s.d	t	p
Unique Aspect					
Treatment	60	78.0	7.07	7.134	0.000
Control	60	68.5	7.63		
Practical Aspect					
Treatment	60	78.0	4.69	6.901	0.000
Control	60	73.1	5.97		
Detailing Aspect					
Treatment	60	81.5	4.57	11.076	0.000
Control	60	71.9	4.85		
Overall Creative Aspect					
Treatment	60	79.1	4.27	10.610	0.000
Control	60	70.5	4.61		

Overall, inferential outcomes show that there is a concrete effect on mobile and CAD technology integration in producing a creative architectural design. This research shows on how the integration of web site being built using the real case approach based on the mobile device help the students to get more design information at anytime and any place. The integration of mobile technology in the design process generates students' interests to be more active in searching design information during the design process. More design information being gathered by the students makes it easy to produce creative products. The integration of CAD technology makes it easy for the students to change their designs' ideas from two dimensional to three dimensional. Three dimensional models in the form of digital model make it easy for the students to get the overall view of the building they want to design at the early stage of the design process. CAD technology also allows the students simulate the real situation in their design process. This simulation activity makes it easy for the students to generate ideas in creating their final design products to solve the problem being given to them.

4.0 Conclusions and discussions

In this research, positive research results for mobile technology based website shows that learning approach using mobile technology can be a perfect replacement for computer based learning approach. Students and lecturer can gain benefits from easier and faster access of information sources. Mobile technology offers an ideal educational approach in providing a unique learning community based on technology. In the future, graphic resolution and screen size for mobile equipment is expected to be better build. From CAD technology design aspects, it is proven that CAD technology are able to give comfort for student to produce three dimensional digital model and also increases students understanding of space through good visual effect. This is because CAD technology enhances student creativity and it also encourage student to appreciate interior space when student are doing simulation using

different details and lighting into the same space. Student also get excited with produced space via simulation increment with different details and lighting towards their three dimensional digital model. Student understanding toward space is increased with the ability to run a simple interior animation. With the animation, student can look at the space from a different perspective. Student gives good response towards three dimensional digital model usage to produce good quality interior space design. Overall, CAD technology via three dimensional digital models helps student to produce a creative final product design. This research outcomes is also strengthen by Lawson (2007) research outcomes which states that architect Ian Ritchie has produced a creative gallery space in London Museum with the help of CAD technology integrated design. Lawson (2007) also says that the kindergarten design produced by kindergarten teachers with the help of CAD technology has higher esthetic value than the one produced by an architect using conventional method. From this research, it is concluded that CAD technology are able to help architectural student to produce a much more creative product design. CAD technology, specifically via three dimensional digital models can boost student understandings towards space while they are in designing process through the use of good visual impact.

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