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Digital Studio vs. Conventional in Teaching Architectural Design Process

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Abstract

The main objective of this paper is to present an action research conducted in a polytechnic in determining the effect of using digital studio on architectural diploma students for teaching the design process compared to the use of conventional studio. For the past three years part of the semester six students had been exposed to the use of digital studio for the design process in helping students to produce creative design and more alternative ideas. The semester six students were selected for this study because all of these students already had basic skills to produce three-dimensional digital model using AutoCAD which they learn in semester five. The creativity of the design products for this study had been evaluated using an instrument developed based on the Creative Product Analysis Matrix (CPAM) (Besemer and Treffinger 1981). The strength of the design products was not affected by the quality of students' drawing, but depended a lot on the characteristics of creative products that were based on CPAM model. Students were involved with the use of a digital studio in the design process using AutoCAD, SketchUp, 3D Studio Viz and Lumions. This study involved architectural students with 12 different design projects in the period of three years. For the research purposes students were divided into two groups, one group involved in design activities using digital studio and the other group involved in design activities using conventional method. In this study no new digital studio was built physically, but every student was involved with the use of a digital studio in the design process required to carry out design activities in CAD lab, or students were asked to use their laptop in the studio. This study shows that students from groups that used digital studio in the design process produce more alternative ideas. Study also shows the digital design method can produce more complex and dynamic design ideas.

Keywords: digital studio, architectural design process, design activities, computer simulation

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1. Problems in Teaching Architectural Design Module

Architectural design is a complex and dynamic process. Designers start from something that is abstract and has progressively developed a problem that can be produced in the form of products. According to Lawson (1997), the architectural design is a process in which architects create spaces, places and buildings that have a major impact on the quality of human life. For this study the design process is a systematic process that has several levels to produce new products that can be evaluated physically and has many benefits. According to Kalisperis and Pehlivanidou (1998), the main problems faced by students in the design process is the limited ability of conventional media to produce a good visual presentation of more complex space. The conventional media also does not have the capability to evaluate the performance of any design space in a real situation. The past experiences of the researchers showed the lack of sensitivity of the students to manipulate the elements such as light, scale, finish and proportion in the design process. The students gave high priority to the production of accurate drawing and to the selection of graphic techniques suitable for use in producing interesting drawings. More time spent and effort had been given in producing presentation drawing rather than producing creative design products. Another problem of the conventional method is that the design activity relied heavily on a static graphic image without taking into account the effect of movement in a space, the effect of light in a space and the effect of finishing material in a space. The visual effects by moving images can facilitate designers to create the effective and creative interior design. Computer animation can help the designer to study the interior space based on the effect of light, color, texture and scale. One of the greatest advantages of AutoCAD is its capability to understand the weaknesses of the design of buildings and spaces before the building is constructed (Kalisperis & Pehlivanidou, 1998).

2. CAD Technology Built in Design

According to Husain (2007), CAD now known as computer-aided design is a technology that can actually do more than just a sketch. CAD technology has also been able to produce a digital model of three dimensional objects. This digital model has a good visual impact and gives freedom to the architect to think about objects, space and form on the same screen.

The fast development of CAD technology today has created a lot of software that can be used for drawing of two dimensional and three dimensional models. The digital model can be used easily for simulation activity. The development of CAD technology today has opened up new opportunities to assist the development of architectural education, especially in learning the design process.

3. Computer Simulation

Simulation is a method to bring the actual situation in a process or activity during the learning process (Humphreys, 1990). Computer simulation can be described as a method involving the use of a computer to replicate events, processes or situations into learning activities (Michael, 2000). The integration of computer simulation in the architectural design process can help students to study the physical impact of building finishes and colors in the actual situation on the building designed using CAD software. Two methods based on CAD technology can be used to help students in simulation activities. Three dimensional digital models can help students to carry out static simulation to study the effects such as texture and finishes of finishing materials on the architectural design. The computer animation can be used in performing a dynamic computer simulation. Computer animation being integrated in the design

process can also help students to assess the quality of space in terms of movement. The main advantage of using computer simulation in the design process is that it can help students to quickly assess the quality of the designed shape and space. If computer simulation is integrated into the design process the polytechnic students are expected to produce a creative design product. Integration of CAD technology in the design process can improve the quality of polytechnic education in architecture, especially for learning architectural design process through design module. Integration of CAD technology can help students create new ideas in architectural design process.

4. Research Methodology

For the last eight semesters part of the students who attended design module class in semester six were required to use CAD technology in the design process. This study session was held from January 2007 to June 2010. This study was conducted at a Polytechnic in one of the states in Malaysia involving 240 students. This study was quantitative in nature and examined the effect of the digital studio in the design process for producing creative design product. Quasi-experimental method was used to study the effect of integrating CAD technology in the design process. For each module in a three week periods all students involved in the retrieval of designs' information and analysis in respect of the project given. For 14 weeks remaining students were asked to participate in design activities. To see the effect of integration of CAD technology in the design process the students were divided into two groups in each semester.

Fifteen students received the highest grade in the AutoCAD class were asked to perform design process with the integration of CAD technology and the remaining 15 students were asked to carry the design process in conventional method. This strategy was used by researcher to ensure that time is not spent to retrain students using AutoCAD and 3D Studio Viz during the study. To facilitate integrating CAD technology in the design process students were asked to use CAD laboratory for design module. The rest of the students who followed the design process in conventional method, the design module was implemented in the third year design studio. Throughout the research was carried out, the type of project made by students was a public utility buildings with less than four levels such as child care centers, automotive centers, museums, craft centers, sports centers and recreational sea centers. The students' final design products for each semester were evaluated by two lecturers. To create the scenario of using digital studio in the design process CAD laboratory being used as design studio for those students that integrate CAD technology in the design process. CAD laboratory brought the feeling of digital design environment in the digital studio to the students. There were four activities in the design process for this research which were design information analysis, synthesis, simulation and determination of the final product. Analysis of design information was an activity to analyze the information derived from information search activities to provide design information to be used in the design process. Next, was the synthesis activity, and during this activity the ideas being triggered in the preparation of preliminary alternative ideas before decisions were made in the preparation of the final design ideas. Simulation activities were activities to produce final design ideas from the selected alternatives. A simulated activity was to provide a real situation in the design process. For this study building simulation were made using 3D Studio Viz and Lumions.

5. Findings

In assessing students' skills on the synthesis stage in the design process with the integration of CAD, this study was conducted to determine whether students who used CAD technology in the synthesis activity make more changes from two dimensions to three dimensions compared to conventional methods in the synthesis stage. The findings are shown in Table 1. Thus, the students involved in digital design methods scored a higher mean to change from the initial idea of two-dimensional to three-dimensional compared to the conventional method

Table 1 Mean for changing initial idea from 2D to 3D

Session	No of Students	Mean for Treatment Group	Mean for Control Group
Jan 2007	30	1.95	4.10
Jun 2007	30	2.05	3.85
Jan 2008	30	2.15	4.05
Jun 2008	30	2.10	3.45
Jan 2009	30	1.95	3.65
Jun 2009	30	2.20	3.85
Jan 2010	30	2.10	4.05
Jun 2010	30	2.05	3.75
Average		2.07	3.84

In assessing students' skills on the simulation activity during the design process with the integration of CAD, analysis had been made to determine whether students who used CAD technology did more simulations than students using conventional methods. The findings are shown in Table 2. Thus, the students involved in digital design methods scoreda higher mean in simulation activity compared to conventional methods.

Table 2 Mean for simulation activity

Session	No of Students	Mean for Treatment Group	Mean for Control Group
Jan 2007	30	2.00	3.95
Jun 2007	30	2.15	3.65
Jan 2008	30	1.95	4.15
Jun 2008	30	1.50	4.05
Jan 2009	30	1.65	3.90
Jun 2009	30	2.15	3.85
Jan 2010	30	1.95	3.75
Jun 2010	30	1.85	4.15
Average		1.90	3.93

This finding shows that students who undergo a digital design process made more simulations than students who undergo conventional design process. In conclusion, the descriptive analysis showed that the integration of CAD technology in the design process helped students at the synthesis and simulation activities. Inferential data was derived from the assessment of student outputs in the synthesis, simulation and final products in the design process. This data was used to determine the impact of CAD technology integration on student products in the design process, determining the effect of integrating CAD technology in the synthesis activity, and whether there were differences between initial ideas generated during the synthesis stage integrated with CAD technology compared with the initial ideas generated in the conventional synthesis activity. Inferential data show a significant difference between the initial ideas generated at the synthesis activity integrated with CAD technology (M = 82.3) compared with the initial ideas generated during the synthesis stage in the conventional method (M = 71.2), t (238) = 13 410 significant.

In determining the effect of CAD integration in simulation activity in terms whether there were differences between the ideas generated at the end of simulation technology integrated with CAD ompared with the ideas generated at the end of a conventional simulation, inferential analysis shows a significant difference between the ideas generated at the end of the simulation with CAD technology integration (M = 81.8) compared with the ideas in the conventional simulation (M = 71.63), t (238) = 9992 significant. In looking at the impact on the integration of CAD technology into the design process in producing creative product researchers looked at the effect of this integration based on the CPAM model. The results showed significant differences between the final product produced by the integration of CAD (M = 80.3) compared with the final product produced by the conventional design process (M = 71.3) in terms of creativity, t (238) = 9198 significant. Inferential analysis also showed a significant difference between the design process integrated with CAD technology (M = 82.3) compared with a conventional design process (M = 74.1) in producing unique product, t (238) = 11,090 significant. The

findings also showed significant differences between the design process integrated with CAD technology (M = 78.0) compared with a conventional design process (M = 71.3) in producing practical product, t (238) = 6901 significantly.

The study also showed a significant difference between the design process integrated with CAD technology (M = 81.5) compared with a conventional design process (M = 72.0) in producing high details product, t (238) = 11 076 significant. Overall findings showed that there was a positive effect in integrating CAD technology in the design process to produce creative product. The comprehensive study at the polytechnic for eight semesters with design activities carried out by digital methods helped the students to produce more creative products compared to conventional design methods. Digital studio has the capability to help the students in producing creative during design process.

6. Product Review

The results showed significant differences between the products produced by digital method compared to the products produced by conventional methods. CAD technology assisted the students to produce designs' products with higher creativity. Some of the final design products produced by the students as a result of this study are shown in Figure 1 and Figure 2.

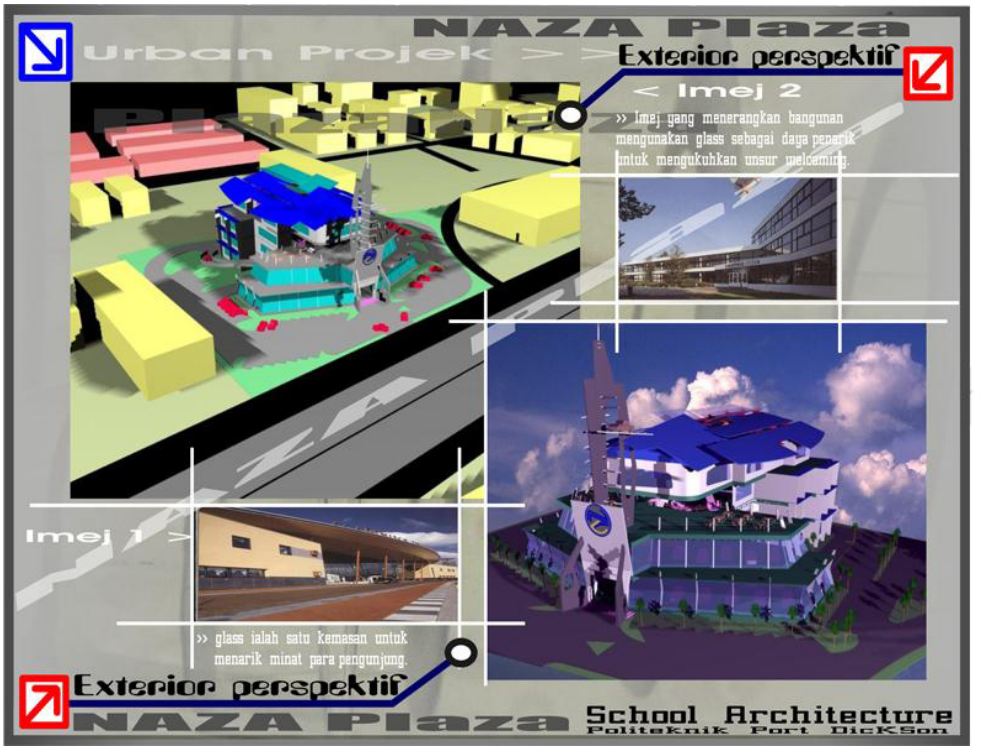

Figure 1 The Naza Plaza was designed by treatment group student in January 2007 session

Figure 2 Motor Sports Complex was designed by treatment group student Session in June 2007

7. Conclusion

This study demonstrates that the integration of CAD technology in the design process increases the number of ideas in the synthesis activity and the number of simulation in the simulation activity. This study also shows that the use of a digital studio in the design process is to build an environment to enhance students' desire to gain more knowledge and design ideas. CAD technology had been able to increase the students' abilities in producing good design ideas and rapid changes of design ideas from two dimensions to three dimensions. The integrated design process not only increases the number of solutions for design problem, but was able to improve the quality of the design solution presented by the students whether at the synthesis level or in the simulation level. The success of the product in the design process depends on the creativity of the product. To study the characteristics of creativity in determining the success of the design product based on the CPAM models consists of unique, practical and accurate details. Architectural design process is a systematic activity to produce creative products. Thus, the integration of CAD technology in the design process has been proven through this study which can help students to produce creative architectural product. CAD technology can help students in stimulating creative ideas during the design process.

Conclusions can be drawn for this study: that the use of CAD technology in learning architectural design process helps students in producing creative products, the CAD software helps the students to construct the digital model easily, especially for synthesis and simulation activities in the design process, the use of CPAM model as a basis to evaluate the creative design product enhances the quality of product evaluation and the use of a digital studio in the polytechnic provides the infrastructure that can stimulate students to produce creative design product.

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