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The Need for New Media Technologies in the Teaching of Computer Aided Design Courses in the Digital Design Studio: a Case in the Architecture Department, Covenant University

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Abstract

Students of architecture have as a part of their training, the acquisition of Computer Aided Design proficiency in AutoCAD and Revit and other software, in order to be relevant in the global terrain. Currently, in the curriculum of the study of

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Architecture in Covenant University, the students are assembled in the Digital Design Studio with the advanced computer graphics suite on each system. As in the case of learning technologies, the use of new media is grounded in its value to support sound pedagogical approaches. This paper investigates the current study methods adopted in Architecture by administering questionnaires to undergraduate and postgraduate students of the 2016/2017 batch. The data collected showed a marked learning gap as a result of the adopted method of teaching. It is expected that the introduction of new media technologies and websites for hands-on training will lead to marked improvement in the knowledge dissemination and acquisition.

Keywords: New media technologies, Teaching of Computer, Digital Design;

1. Introduction

The decision to adopt online technology (defined here as predominantly Internet-based delivery, with provision for interaction throughout the process), even on a limited basis, is always complex and can be risky, especially if the adopting organisation lacks structural, cultural or financial prerequisites (Welsch, 2002). A discussion of some attributes of media and of the modes of teaching presentation and learning performance they support, in relation to some influential learning models, might help to clarify some of the implications in the choice of any specific delivery or presentation medium. By definition, media technologies refer to the support systems and mediums that enhance human communication over distance in time and space. These systems help individuals acquire, store and spread knowledge in smart and portable ways. This medium could take the form of audio, visual, kinesthetic or print format. The genius in using media technology in teaching is that it is an inclusive teaching strategy. That is, the learning needs of every student will be met, because the teacher can lucidly communicate information through a medium that the student understands.

CAD/CAM technology refers to digital design and manufacture. CAD software recognises the geometry of an object while CAM software is used for the manufacture. The CAD/CAM manufacturing process can either include additive rapid prototyping (RP) or subtractive manufacturing (computer numerical control machining; milling). RP has been used for industrial purposes and was developed from CAD/CAM technology. It is used to create automatically physical models from computerised three-dimensional (3D) data (Di Giacomo et al., 2014; Sarment, Sukovic & Clinthorne, 2003). RP, also known as solid freeform fabrication or layered manufacturing, has been used for creating 3D complex models in the field of medicine since the 1990s and has recently become popular for the fabrication of removable dental prostheses (Sun & Zhang, 2012; Webb 2000). The most basic role of CAD is to define the geometry of design, a mechanical part, architectural structure, electronic circuit, building layout and so on, because the geometry of the design is essential to all the subsequent activities in the product cycle. Computer-aided drafting and geometric modelling are typically used for this purpose. Therefore, these systems are considered as CAD software. Furthermore, the geometry created by these systems can be used as a basis for performing other functions in CAB and CAM.

2. Literature Review

2.1. The Use of Media Technologies in Teaching

Education is to be treated as a national emergency second only to war (Anyanwu, 2006), hence, the need for teachers and institutions (schools). Although these schools are a node where different individuals with learning abilities meet to acquire knowledge (Eni, 2017), it has been observed that learning is no longer restricted to the classroom or the school timetable (Heitor, 2005). A research conducted by Eni (2017) revealed that though the medium currently adopted by the schools of architecture in Nigeria is the traditional media, which relies heavily on print, there is a great need for teachers to engage in media technologies because the old method is ineffective. This has led to a shorter attention span, learning loss, poor academic performance, and decline in retention capacity,

and low motivation among students. Utilising media technologies in teaching simply means that the teacher adopts lateral thinking strategies contrary to the rigid, one-size-fits-all traditional teaching method, with the aim of enhancing the learning experience of students and bringing out the best in them. To achieve this, the teacher has to first understand the needs of the students. This will provide information on the appropriate media necessary for learning to occur. Another important aspect of using media technology in teaching is integrating and involving students in creating media. This encourages collaboration, accountability, creativity and mastery of ideas and concepts. Importantly, one does not need a large budget, fancy studio or advanced degrees to create original media that is informative, entertaining and educational (Kim, 2013). In Willingham's research (2009), he asks a simple question to make his point, 'Why do students remember everything that's on television and forget what we lecture?' – Because visual media helps students retain concepts and ideas. Haruna (2008) postulated that a sustainable architectural education would be one that attains the highest possible competitive state. This reiterates the need for media technology in teaching, as they are an effective way to attain the highest possible competitive state.

2.2. The Use of CAD in Schools of Architecture

During ECAADE 18 and 19, held respectively at Weimar in 2000 and Helsinki in 2001, there was a series of discussions about the digital design curriculum in architecture schools. Although most of the attendees' concerns were restricted to the representational and analytical roles of CAD, many educators defended the introduction of algorithmic design in the architectural curriculum. The course sequence proposed by Mark, Martens, and Oxman (2001), for example, included a topic called 'Computables of Design', which explored 'the quantitative basis and invisible geometrical order of shapes found in nature and architecture as explored through writing computer programs'. Seebohm's (2001) position went even further, suggesting tool building courses, which he acknowledged, were 'perhaps the most difficult technically, because they involved computer programming'. However, according to him, these courses could be 'potentially very rewarding because they exploited one of the greatest underused strengths of using computers in design'.

Architectural schools have over time provided the kernel for experimenting with various architectural imaginations (Olukoya & Kuti, 2015). Hence, according to Salama and Wilkinson (2007), the advancements of digital technology and design have grotesque bearings on the approaches of architectural education in recent times. The evolution of information technology, however, is known to be redefining the ethos of the construct of architectural education. Moreover, there were argumentative responses that the use of CAD in architectural drawing is robbing the traditional method of hand drafting and craft modelling of its very significance in the development of rationalisation of design ethics (Reffat, 2007). Also, the influx of CAD into architectural education has overridden the traditional methods of drafting by emasculating the advantages of the relationships that should exist between student to student and student to instructor, which is a canonical interaction in architectural education (Brown, 2009). The Dutch architect Herman Hertzberger stated that CAD is not a creative design tool as it is the real depiction of real creativity rather a fake one as the software suggests how the outcome of the design would be. He greatly criticised the use of CAD as a drafting tool in his book, 'Lessons for Students of Architecture'. As regards the negative impacts of the use of the CAD software, Lawson (2005) claimed that 'before computers, the student architect had to learn to draw in order to design and also in order to see and record. It was of course possible that very poor architecture could be presented so beautifully that one was deceived… We are in danger of creating a generation of young architects who are highly skilled with computer software and yet have little visual sensibility'. Robertson and Radcliffe (2009) also claim that the most vital aspect of design education is the student to student or face to face social interaction, which CAD has taken away. Ekhaese, Anweting, Abah, Ademiju & Adereti (2017) stated that the use of CAD simply brings out a

student's creativity and also ensured efficiency in design in terms of time and the final products. They also stated that designing with CAD can lead to the derivation of motivation and satisfaction.

3. Methodology

This study made use of the quantitative method to obtain data, whereby questionnaires were given to both undergraduate and post-graduate students in the Department of Architecture. A total sample size of 177 students was chosen for this survey, which included 118 undergraduate students and 59 post-graduate students. Journals, books, conferences, schools' libraries and databases served as sources for secondary data.

4. Findings

Students were asked how long they had been using CAD (Table 1) and they gave the following responses: 64.9% stated 1–3 years, 28% stated 4–7 years, 3.6% stated 8–10 years, and another 3.6% stated over 10 years.

Table 1. How long have you been using CAD?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	1–3 years	109	61.6	64.9	64.9
	4–7 years	47	26.6	28.0	92.9
	8–10 years	6	3.4	3.6	96.4
	Over 10 years	6	3.4	3.6	100.0
	Total	168	94.9	100.0	
Missing	System	9	5.1		
Total		177	100.0		

Looking at the period when the students started using CAD, 19.2% stated before their undergraduate programme, 78.4% stated during their undergraduate programme and 2.4% stated during their master's programme. When asked who taught them how to use CAD effectively, the students gave the following responses: 49.7% stated a friend, 29.8% stated a lecturer, 14.3% stated they taught themselves and 6.2% stated a relative. As shown in Table 2, students were asked how long it took them to master the use of any CAD software, and they gave the following responses: 71.9% stated less than a year, 26.1% stated 1–3 years and 2% stated 4–7 years.

Table 2. How long did it take you to master any CAD software?

		Frequency	Per cent	Valid Per cent	Cumulative per cent
Valid	less than a year	110	62.1	71.9	71.9
	1–3 years	40	22.6	26.1	98.0
	4–7 years	3	1.7	2.0	100.0
	Total	153	86.4	100.0	
Missing	system	24	13.6		
Total		177	100.0		

When asked about the number of successful designs they had done since they started using CAD, the students gave the following responses: 19.5% stated none, 31.4% stated 1–3 designs, 20.1% stated 4–6 designs and 28.9% stated above 6 designs. The students were asked how long they intended to

use CAD and they gave the following responses as shown in Table 3: 3% stated 1–3 years, another 3% stated 4–10 years, 72.6% stated as long as they were in practice and 21.3% stated forever.

Table 3. How long do you intend to continue using CAD?

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	1–3 years	5	2.8	3.0	3.0
	4–10 years	5	2.8	3.0	6.1
	As long as I'm in practice	119	67.2	72.6	78.7
	Forever	35	19.8	21.3	100.0
	Total	164	92.7	100.0	
Missing	system	13	7.3		
Total		177	100.0		

Five CAD software applications (Sketch-Up, AutoCAD, ArchiCAD, 3D-Max and Revit Architecture) were chosen and the students were asked which they used and they gave the following responses: 35.6% stated they use Sketch-Up, 75.7% stated they use AutoCAD, 11.9% stated they use ArchiCAD, 14.7% stated they use 3D-Max and 78.5% stated they use Revit Architecture. The students mentioned other software applications they use: Lumion, Rhinoceros, Chief Architect and Artlantis. The same five CAD software applications (Sketch-Up, AutoCAD, ArchiCAD, 3D-Max and Revit Architecture) were chosen and the students were asked which they intend to use and they gave the following responses: 50.3% stated Sketch-Up, 42.4% stated AutoCAD, 31.6% stated ArchiCAD, 66.7% stated 3D-Max and 58.8% stated Revit Architecture. The students mentioned other software applications they intended to use and these were Lumion, Rhinoceros, Grasshopper and Maya.

Four media (Classroom teaching, Digital design studio application, Digital design studio website, and simulations) were chosen and students were asked about which was going to enhance their learning or use of CAD software and they gave the following responses as shown in Tables 4–7: for classroom teaching, 79.8% agreed to this, 9.8% were uncertain and 10.4% disagreed to this. For the Digital design studio application, 86.9% agreed to this, 8.9% were uncertain and 4.2% disagreed to this. For the Digital design studio website, 76.4% agreed to this, 15.5% were uncertain and 8.1% disagreed to this. For simulations, 82.4% agreed to this, 13.9% were uncertain and 3.6% disagreed to this.

Table 4. Classroom teaching

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Strongly agree	58	32.8	35.6	35.6
	Agree	72	40.7	44.2	79.8
	Uncertain	16	9.0	9.8	89.6
	Disagree	11	6.2	6.7	96.3
	Strongly disagree	6	3.4	3.7	100.0
	Total	163	92.1	100.0	
Missing	System	14	7.9		
Total		177	100.0		

Table 5. Digital design studio application

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Strongly agree	69	39.0	41.1	41.1
	Agree	77	43.5	45.8	86.9
	Uncertain	15	8.5	8.9	95.8
	Disagree	6	3.4	3.6	99.4
	Strongly disagree	1	0.6	0.6	100.0
	Total	168	94.9	100.0	
Missing	System	9	5.1		
Total		177	100.0		

Table 6. Digital design studio website

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Strongly agree	49	27.7	30.4	30.4
	Agree	74	41.8	46.0	76.4
	Uncertain	25	14.1	15.5	91.9
	Disagree	12	6.8	7.5	99.4
	Strongly disagree	1	0.6	0.6	100.0
	Total	161	91.0	100.0	
Missing	System	16	9.0		
Total		177	100.0		

Table 7. Simulations

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Strongly agree	87	49.2	52.7	52.7
	Agree	49	27.7	29.7	82.4
	Uncertain	23	13.0	13.9	96.4
	Disagree	6	3.4	3.6	100.0
	Total	165	93.2	100.0	
Missing	System	12	6.8		
Total		177	100.0		

Students were finally asked about any other media that enhanced their learning or use of CAD Software, and they mentioned the use of video tutorials on the particular CAD software application.

5. Conclusion

This study shows that most students have been using CAD for the past 1–3 years as a result of the fact that most of them started using CAD during their undergraduate programme. It was also found that most students learn CAD from a friend or colleague with others learning from a lecturer. The majority of students learning CAD are able to do so in less than a year, showing the short time needed for learning any CAD software. Given that most students started using CAD 1–3 years ago, most of them have successfully done just 1–3 designs with any CAD software. Most students intend to use CAD as long as they are in practice and others forever stating the significance of CAD to the architecture profession. The commonly used CAD software applications by students are Revit Architecture and

AutoCAD, others include Sketch-Up, ArchiCAD, 3D-Max, Lumion, Rhinoceros, Chief Architect and Artlantis. The most common CAD software applications students would like to learn are 3D-Max, Revit Architecture and Sketch-Up, while others include AutoCAD, ArchiCAD, Lumion, Rhinoceros, Grasshopper and Maya. Comparison of the media technologies shows that for students' preference to enhance their learning or use of CAD, the Digital design studio application came out top, then simulations and videos. Others include classroom teaching and digital design studio website.

6. Recommendations

To enhance students' learning and use of CAD, lecturers should provide more of student to student interaction during CAD classes to better the knowledge of students who understand more from interacting with fellow students. The Department of Architecture could work with the Department of Computer Science to set up a Digital design studio application that can be installed on the students' laptops or even tabs. This application would have detailed explanations on the use of the different CAD software applications with diagrams. The application would also have explanatory videos and simulations that could be downloaded alongside detailed explanations. A website for this purpose could also be set up. All of this would aid the Institution (Covenant University) in attaining its vision of '1 of 10 in 10', whereby the institution should be among the ten best universities in the world by 2022.

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