THE INFLUENCE OF COMPUTER AIDED DESIGN (CAD) ON STUDENTS' CREATIVITY IN ARCHITECTURAL SCHOOLS (COVENANT UNIVERSITY AS A CASE STUDY)

Eghosa Noel Ekhaese, Patrick Francis Anweting, George Ojochogwu Abah, Chinedu Adewemisola Ademiju, Oluwatimilehin Adebayo Adereti

Department of Architecture, Covenant University (NIGERIA)

Abstract

The use of Computer Aided Design (CAD) became popularized at the end of the 20th century and there have been disagreements on the impacts of these softwares on the creativity of students of architecture around the world. The paper investigated how CAD has affected students' creativity in architectural schools using Covenant University as a case study. The research employed the use of quantitative method by classifying the population into two groups. This includes the undergraduate and post graduate students. Questionnaires were used to elucidate information from the groups. The findings of this study revealed that CAD in one way or another has greatly influenced the productive, speed as well as accuracy of students' performance. The outcome of the research would help students, lecturers, and professionals alike to plan and structure the use of CAD in architecture on a local and global scale.

Keywords: Computer Aided Design (CAD), Architecture, Design, Creativity.

1 INTRODUCTION

Computer Aided Design (CAD) simply refers to the process whereby computers and specialist software are used to produce virtual three-dimensional models and two dimensional drawings of products [1]. There are several types of CAD software which have been developed for use over a range of applications and industries.

As a result of conflicting views on the use of CAD in architectural schools, this paper aims to examine the objectives of existing literature together with the response and observation of students give a remedial on the use of CAD if it should be encouraged or discontinued.

Computer Aided Design (CAD) has been in existence for some time, we could say a quarter of a century. With the recent advent of Information Technology (IT), CAD has gained momentum and ground in both the architectural profession and architectural education. Andia [2] stated that the architectural school has served as the lively spring board for transforming the scope of the profession. He saw architectural schools as the experimental laboratory for the vitality of fresh experimental architectural imagination and also as a medium of expanding architectural realms to the cyberspace.

The question is "do computers aid the design process after all?" as asked by Brown [3] who saw the relationship between the interface and its user as not one-sided. He stated that many have unjustly believed that technology stormed and forced its way into our lives and society, rather society has welcomed it and allowed it grow for a reason. With the world having a global economy, there is an increasing need for innovative solutions and products to be made and established. This can be traced to an increase in time and cost constraints. A major skill which has continuously been seen as integral for dealing with these issues is the ability to be creative in the quest to get solutions to design problems [4].

Walther, Robertson and Radcliffe [5] in looking at the educational context on the use of CAD noticed the student's inability to use suitable forms of communication such as sketches or verbal explanations to convey his design ideas. This was as a result of a combination of the enhanced visualization capabilities of CAD and the significance that design education puts on the value of CAD models. The assessment of student work showed this. They recommended that educators should avoid confined thinking and promote good design in their students by making sure the students become aware of the realities of continual and repetitive design, rather than controlled in their thinking by the capabilities of CAD.

Olukoya and Kuti [1] carried out a study and stated that the use of CAD has comparatively more advantages than the traditional design construct. These advantages include; enhanced level of productivity, enhanced quality of design, reduced design development costs and significant time efficiency in meeting up deadlines. CAD was simply seen as a tool that aided the drafting procedure. There is no place in the thinking process for CAD and as it has minimal influence on the initial stages of design. It is merely just a physical tool that transforms the thoughts of the user into reality on the paperless board similar to the archaic traditional method of drafting. As a result, there simply is no significant reason to oppose the use of CAD in architectural practice and education in this period of technological ease and advancements.

2 CONCEPTUAL THEORETICAL DISCOURSE

2.1 The concept of student creativity

Creativity can simply be seen as the development of ideas or work that is usually useful and original [6], [7], [8], [9], [10]. Runco [11] adds that creativity plays a significant role in the process of cultural reproduction, technological advancement, innovation and intervention. Creativity can be seen as a key element of design which is a very important for innovation and change [12]. Design entails the imagination and development of new realities meaning central to a designer's work is the quest for a cutting edge and unusual solutions to problems which is in contrast other sciences which focus on the analysis and description of existing realities. Also in contrast to the arts, design is basically directed by human purposes towards the actualization of the intended functions, thus emphasizing the significance of meeting requirements and generating proper solutions [12], [13]. Brockling [14] and Barrett and Donnelly [15] give an enlightening four-dimensional philosophical view on creativity which is: *"firstly, something everyone has – an anthropological capacity; second, something one ought to have – a binding norm; third, something one can never have enough of – a telos without closure; fourth, something that can be intensified through methodological instruction and exercise – a learnable competence."* Kane [16] relates who we are to what we do, meaning a student is himself/herself to the extent that he/she is creative. Four major elements were given by Robinson [17] for creativity and these are; the medium, expertise in or mastery of the medium, the need to play and take risks and the need for critical judgement. It should be noted that each of these elements is important to learning and teaching. Amabile [18] stated that creativity arises from the combination of three components namely; knowledge, creative thinking and motivation. Knowledge encompasses all the needed understanding an individual brings to be used on a creative effort. Creative thinking is associated with how people handle problems and is dependent on an individual's personality and thinking/working style. Motivation is usually as important for creative production and the main motivators are inborn passion and interest in the work itself. In relation to architecture, Sidawi [19] reviewed some literature by Lawson [20], Seidel [21], Salamah [22], Sachs [23], Davis, Kogan & Soliman [24], AIAS [25], Salamah [26]: Schon [27], Coffield et al [28], Ostwald and Williams [29], [30], Salamah [31], Williams et al [12] and found out from a creativity perspective as seen in many cases that students were able to develop new architectural solutions but not creative ones.

2.2 The concept of cad in schools of architecture

With the arrival of Information Technology a few decades ago, there has been massive improvement in various professional fields given new software development tools, programming languages and methodologies. Today, the work of architectural students has become a lot easier when compared to decades ago as a result of development of personal computers and software [32]. The major CAD software for architecture includes; Auto CAD by Autodesk, Revit Architecture also by Autodesk, DataCAD by DATACAD LLC, Free CAD by Juergen Riegel, Chief Architect Software and ArchiCAD by Graphisoft [1]. SketchUp by Trimble is also a CAD software. Mârşanu and Rusu [32] noted that the architect or student isn't just concerned with the look of a building and how it fits into the environment, but also with the bearing capacity of walls, the existence of efficient systems to ensure heating, ventilation, supply electricity and water. The book "Computer Aided Design and Drafting in Architecture" noted that architectural designers continue to make sketches while the computer waits for input. The original method of creating bubble drawings to figure the arrangement of a basic room arrangement continues to be a general practice. Sketches are still produced by designers in a bid to establish design ideas. The computer can assist in the design process but individual creativity takes place even before the computer is turned on. CAD has enhanced creativity and there is a more effective management of the repetitive areas of design. An example is seen in the design of apartment

complex or a block of flats whereby an initial unit is designed and then a number of the same units are attached together as desired in a swift manner. Some units can be increased or reduced in size, or a quick implementation of alternatives for bedrooms and baths. The book also noted that today, architecture both in business and education uses a wide range of design and drafting applications from the traditional manual drafting to the major modern form of CAD. Botchway, Abanyie and Afram [33] stated that students of architecture in Kwame Nkrumah University of Science and Technology, Kumasi, Ghana however did not enjoy the full benefits of using CAD tools in the design process as a result of several problems like: lack of adequate logistics for teaching and practicing CAD, the absence of CAD training experts, complexities in the user interface of CAD tools and the weak creativity of the development work in CAD. They stated that the current concept of architectural design education is a combination of the traditional methods of manual drafting using the drawing board and T-square and the use of CAD tools in the design process. It should be noted that this situation of a combination of the traditional method of manual drafting and the use of CAD tools in the design process is similar to that in the Department of Architecture in Covenant University, Ota, Nigeria

3 METHODOLOGY

To fully achieve the aim of this study, the use of quantitative method was employed to obtain data. This quantitative method classified the population into two groups namely; the undergraduate and post graduate students. Questionnaires were used to obtain data from the groups. A sample size of 45 was chosen from the undergraduate students and another 49 from the post graduate students making a total sample size of 94 students. Secondary data was gotten from other professionals via journals, books, conferences, schools' libraries and data bases.

4 RESULTS

It was noted that most students have been using CAD for about 1-3 years and others for about 4-7 years with only a few using CAD for more than 8 years as shown in table 1. Most students started using CAD at the BSc level while a few before the undergraduate level and at the MSc level. Many students mastered the use of some CAD tools in less than a year and others between 1 and 3 years. Most students actually intend to use CAD for as long as they are practicing Architecture.

Table 1. *Showing how long students have been using CAD.*

	Period of usage (yrs)	Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	1-3yrs	50	53.2	53.2	53.2
	4-7yrs	40	42.6	42.6	95.7
	8-10yrs	2	2.1	2.1	97.9
	over 10yrs	2	2.1	2.1	100.0
	Total	94	100.0	100.0	

On the students perspective on the use of CAD, most stated that CAD brings out a student's creativity as shown in table 2. Many also disagreed with the supposing theory that CAD makes students lazy, although a few agreed with this. In comparing manual drafting and the use of CAD for designs, most students stated that CAD is better than manual drafting as seen in table 3. Many students also disagreed that CAD slows down the thinking process of a student. Many students would love that the use of CAD be taught at all levels in the university, as lectures on CAD begin at 300 level at the undergraduate level, although a few disagreed with this.

Table 2. *Showing students' view on CAD enhancing creativity.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	strongly agree	26	27.7	27.7	27.7
	agree	47	50.0	50.0	77.7
	uncertain	11	11.7	11.7	89.4
	disagree	7	7.4	7.4	96.8
	strongly disagree	3	3.2	3.2	100.0
	Total	94	100.0	100.0	

Table 3. *Showing students' view on manual drafting being better than the use of CAD.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	strongly agree	1	1.1	1.1	1.1
	agree	11	11.7	11.7	12.8
	uncertain	15	16.0	16.0	28.7
	disagree	31	33.0	33.0	61.7
	strongly disagree	36	38.3	38.3	100.0
	Total	94	100.0	100.0	

Students were asked on the methods they used to present immature ideas to their colleagues and lecturers. It was found out as shown in tables 4, 5, 6, 7 and 8 that many students use freehand sketching and verbal discussions while others work directly with CAD tools and even CAD outputs such as printouts while a few use the traditional drawing board and T-square. Students were also asked the methods they used to present immature ideas to themselves for personal purposes. It was found out that many students use freehand sketching while others work directly with CAD tools and CAD outputs and a few use the traditional drawing board and T-square.

Table 4. *Showing how frequently students work directly with CAD to present immature ideas to their colleagues and lecturers.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	very often	22	23.4	23.4	23.4
	often	24	25.5	25.5	48.9
	occasionally	35	37.2	37.2	86.2
	rarely	11	11.7	11.7	97.9
	never	2	2.1	2.1	100.0
	Total	94	100.0	100.0	

Table 5. *Showing how frequently students use CAD outputs to present immature ideas to their colleagues and lecturers.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	very often	23	24.5	25.3	25.3
	often	30	31.9	33.0	58.2
	occasionally	23	24.5	25.3	83.5
	rarely	9	9.6	9.9	93.4
	never	6	6.4	6.6	100.0
	Total	91	96.8	100.0	
Missing	System	3	3.2		
Total		94	100.0		

Table 6. *Showing how frequently students use freehand sketching to present immature ideas to their colleagues and lecturers.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	very often	30	31.9	32.6	32.6
	often	32	34.0	34.8	67.4
	occasionally	21	22.3	22.8	90.2
	rarely	9	9.6	9.8	100.0
	Total	92	97.9	100.0	
Missing	System	2	2.1		
Total		94	100.0		

Table 7. *Showing how frequently students use verbal discussions to present immature ideas to their colleagues and lecturers.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	very often	22	23.4	23.4	23.4
	often	38	40.4	40.4	63.8
	occasionally	19	20.2	20.2	84.0
	rarely	11	11.7	11.7	95.7
	never	4	4.3	4.3	100.0
	Total	94	100.0	100.0	

Table 8. *Showing how frequently students use the traditional board and T-square to present immature ideas to their colleagues and lecturers.*

		Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Valid	very often	7	7.4	7.4	7.4
	often	15	16.0	16.0	23.4
	occasionally	17	18.1	18.1	41.5
	rarely	35	37.2	37.2	78.7
	never	20	21.3	21.3	100.0
	Total	94	100.0	100.0	

In relation to the works done using CAD, most of the students enjoyed the use of CAD and also stated that CAD enhanced their efficiency in design in bringing about a perfect design. A good number stated that the outcomes of their designs are the same no matter the method of design used. Some students stated CAD tools usually affect the outcomes of their designs sometimes negatively, but they try to avoid this as much as possible. Other students added their designs are usually driven by the requirements and the CAD tools they are using as the CAD tools affect their designs in relation to their level of expertise in using the tools. A few students stated they have difficulties in achieving their intended designs using CAD tools as a result of the limitations of the CAD tools and the fact they are better at other methods of design.

In terms of the motivational state while using CAD tools for designs, most of the students stated they enjoy using CAD, although they have issues while using CAD but don't mind. A good number also stated they are really motivated while using CAD and they enjoy the sense of awe they create in other people while using CAD to design. Some students added that while they are motivated by CAD, they are also motivated by the type of design they are working on. For example, they are motivated if they are working on an interesting task and get frustrated from doing repetitive tasks or if the CAD tool refuses to do what it's supposed to do. This led them to state that they have good and bad days while using CAD as some tasks are interesting while others are boring and frustrating. A few stated they are discouraged by the use of CAD and the fact that they keep sitting in front of a computer all day doing endless tasks.

5 RECOMMENDATIONS

The use of CAD should as much as possible be encouraged among students mainly because of its efficiency in design coupled with the fact that time and presentation are major considerations in today's world. Students should use CAD tools more often as this would increase their level of expertise combined with researching on the use of these tools through watching tutorials or even reading books. Students should also explore various CAD tools as some functions found in some might not be found in others. Students should not be limited to using CAD since there are other methods of designing like manual drafting as the outcome of a design is of more significance than the method used in bringing about the design. Most students get bored from repetition, so should be given various types of design projects ranging from industrial designs, institutional designs, urban designs, housing designs etc. The producers of CAD tools should as much as possible make their tools user friendly to encourage the use of these tools, as Lawson [34] stated the problem when the computer uses the wrong metaphor when describing design features which could negatively affect the creative integration required by design.

6 CONCLUSION

The use of CAD simply brings out a student's creativity and doesn't increase it or decrease it as CAD in a good number of cases didn't affect the outcomes of the designs. The use of CAD also doesn't slow down a student's thinking process or even make a student lazy. If a student is lazy or hardworking, that will be displayed by the student's use of CAD to go about his/her designs. Students could combine different methods as suitable to them in presenting their ideas either fully developed or

not. These methods could be freehand sketching, verbal discussions, using CAD tools and outputs and even the use of a traditional drawing board and T-square.

There was efficiency in design when using CAD in terms of time and even the final products. The outcomes of designing with CAD are dependent on the level of expertise of the user and also the limitations of the particular CAD tools. As we are all different as individuals so there are definitely students who are better at other methods of designing like manual drafting. Motivation and satisfaction in design can be derived from the use of CAD. Students are also motivated depending on the type of design they are working on if it's interesting or boring and can also get frustrated when the CAD tools refuse to do what they are supposed to do leading to good days and bad days. Some students can get discouraged by the use of CAD by the monotony of using a computer all day.

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