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AWARENESS, COMPETENCY AND ADOPTION OF APPAREL COMPUTER-AIDED DESIGN TECHNOLOGY AMONG CLOTHING AND TEXTILE LECTURERS IN TERTIARY INSTITUTIONS IN ENUGU STATE

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Abstract
This study evaluated the level of awareness, competency, and adoption of apparel CAD technology among Clothing and Textile lecturers in tertiary institutions in Enugu State. Five research questions guided the study. The research employed a descriptive survey design, collecting data from 24 clothing and textile lecturers across five public tertiary institutions in Enugu State. The instrument for data collection was a structured questionnaire titled 'Awareness, Competency and Adoption of Apparel Computer-Aided Design Technology'. The questionnaire was validated by three experts from the Department of Home Science and Management. A good internal consistency of 0.83 was obtained for the instrument using Cronbach's alpha reliability test. Data were analyzed using frequencies, percentages, means and standard deviation. Findings showed the respondents were aware of the meaning of apparel CAD technology but were not aware of CAD software and their uses. The result also indicated that they were not were not competent in apparel CAD skills such as file management and technical drawing among others. The respondents did not adopt apparel CAD technology for fabric and apparel design, pattern making and cutting operations. The lecturers agreed on the barriers to the adoption of apparel CAD technology such as lack of training and support, high initial costs and incompatibility with existing infrastructure. It was therefore recommended that training programs should be organized by University administrators for clothing and textile lecturers in order to enhance their competencies in the use of apparel CAD technology.

Keywords: Awareness, Technology, Competency, Computer-aided Design

Introduction

Textile, clothing and their production methods are as old as human history. In Nigeria, for instance, cloth weaving dates back to the pre-historic periods (Hammed, 2022) when people made weaved textiles by hand. Mechanized textile manufacturing started in the 1950s with the establishment of textile mills in different parts of the country such as Kaduna, Lagos, Aba and Asaba (Uyai, 2022). Over the years, the clothing and textile industry has seen a marked change owing to the technological advancements and computerization of the various stages of the clothing and textile production process (Benson, 2015). Technological advancements in all facets of life have transformed the way people conduct business and perform their daily tasks. They have led to the development of new technology for which fashion has not been left out. With computers one can now draw, paint, make dress patterns and do a lot more. Currently, most of the fashion and textiles illustration processes in the advanced countries, have been computerized which makes work fast, convenient, cost effective and increases productivity. Many software are available to fashion designers to perform various tasks such as fashion research, fashion design and illustration, patternmaking and design, textile design, garment construction and product management (Onyeka, 2020). The technology is referred to as computer-aided design.

Computer-aided design (CAD) is a software application that allows apparel designers to create a virtual version of the outfits they are making. It is a tool that precisely plans, designs, and assesses a product before it is manufactured (Ugwu, Ezeaku, Attah, Emeghebo & Eze, 2023). CAD software allows textile designers to fully express their ideas while designing printed and woven patterns. Textile designers encompass CAD into their apparel design

workflow, allowing them to experiment virtually and make tweaks and alterations to the garment before going into production (Browzwear, 2024). Computer Aided Design (CAD) technology allows users to develop both two-dimensional and three-dimensional designs in order to better visualize construction. It allows for the development, adjustment, and optimization of the design process (Bernstein, 2024). This technology can be used to create the desired design from scratch, complete with colors and textures, if the right software is employed. CAD is therefore, very useful to fashion designers for designing clothing, grading and creating patterns, creating fashion illustrations, and designing accessories (Kaystha & Sharan, 2017).

The apparel industry has benefited greatly from CAD, which has resulted in increased efficiency in good design precision, color selection, and, most crucially, memory storage for future use. Globally, the textile industry has seen not only extraordinary technological improvement, but also the widespread use of CAD in textile production. The innovation has significantly accelerated the production process, reducing lead time and product completion (Shi, Wang & Zhu, 2020). Countries such as the United States, the United Kingdom, China, Italy, France, Japan, and Germany have long accepted the use of CAD in textile manufacture. CAD impact is also fast extending to other advancing African countries, creating additional growth opportunities in the textile industry (Gausa, Wanduara & Kisato, 2021). Many industrialized nations have recognized the economic benefits of computer aided design (Oppong, Biney-Aidoo & Antiaye (2013), and as a result, they have encouraged the adoption of this technology by publicly and privately owned enterprises.

Adoption is the act of deciding to take up and utilize something. Technology adoption therefore, means the process by which people and organizations accept integrate, and make use of new technologies (Gururajan, 2010). It entails learning and adjusting to new technology like apparel CAD, and is influenced by the society, environmental conditions, performance expectancy, and effort expectancy (Batti, 2025). The implication is that organizations need to make every efforts to train their personnel in the use of CAD technology. The development of required training and education for this technology has been left to the CAD vendors, universities, technical institutes, and trade schools with little or no assistance from government (Kassah, Bruce-Amartey & Acquaye, 2022). The goal of utilizing technology in schools is to enhance and increase the standard, cost-effectiveness, and accessibility of instruction provided to students (Umennuihe, Shu'ara, Okechukwu, Alutu, & Umennuihe, 2023). Consequently, some tertiary institutions in Africa are presently offering a variety of high technology oriented courses. In most cases, this training is offered as a part of drafting technology, engineering, or similar program (Akah, Bassey & Ukpong, 2021). Unfortunately, these efforts have not been effectively implemented in the Nigerian context. For instance, research by Kassah et al. (2022) showed little adoption of computer aided design technology in textile and apparel industries in Nigeria. This is because the existing education system in Nigeria is too theoretical and not specific enough for the particular needs of the industry and this might have had an impact in apparel CAD in training programs. Although there is considerable demand for offerings of computer aided drafting as an upgrade course for engineers, architects, designers, draftsmen and other professional, there appears to be little or no demand for CAD in clothing and fashion programs (Akah et al., 2021). This could be attributed to lack of awareness about this technology.

Technology awareness is more than just recognizing the existence of specific technology. It is a state wherein an individual is cognizant of some information about a particular technology (Webb, 2024). Being aware of apparel CAD technologies involves knowing their intended uses, benefits, limitations, and potential hazards. It goes beyond knowing how to adopt CAD software but also involves recognizing the implications that they have on our lives and society (Anderson, 2024). In Africa, nations like South Africa, Tunisia, Mauritius, and Madagascar are ranked as the leading countries in apparel CAD usage (Fukunishi, 2014); yet, a good percentage of textile and fashion industries in Africa are still

unable to apply CAD technologies mainly due to lack of awareness. The appropriate CAD requisite software packages for textile production is very limited in most African countries. In addition, there is also the challenge of inadequate skilled labour and expertise in the application of the software (Omondi, Imo & AndOtina, 2016). According to Kamau (2012), few lecturers in the apparel sector are aware of the technology and even fewer number of them can efficiently use them. Since the clothing and textile industry is also impacted by global changes, it have to adopt new technology in the market in order to remain competitive. Apparel computer aided design technology is the driving force to industrialization in the apparel and textile sectors (Sun et al., 2024); therefore, awareness and training is the first and crucial step to increasing people's competencies in its use.

One's ability to carry out a given task successfully and efficiently is termed competency. Competencies are those direct and indirect skills and behaviors that allow individuals to perform given tasks effectively (Draganidis & Mentza, 2006). Technological competency is the capacity to select and utilize modern forms of technology to overcome difficulties or produce results. The curriculum of virtually all the institutions in Nigeria have been drawn up before the introduction of computer, therefore the element of CAD application may be lacking. In addition, majority of the lecturers trained before the era of information technology and hence, may not be computer literate. As a result, the competency needed to apply the use of computer in the training of the students may be grossly lacking (Abdullahi, 2017). For lecturers to embrace CAD in the teaching of apparel and textiles, they must acquire important competencies that will enable them to develop wide technological knowledge, practices, and attitudes. To develop the competencies of lecturers in the application of apparel CAD, it is necessary for them to go through the process of training, on-the-job learning, and career management. The resultant effect is that students will be able to maintain competitiveness in the apparel industry and their performance in today's work environment will be improved (Wong, 2020). According to Umennuihe et al. (2023), without the support and guidance of lecturers who are able to take advantage of the potential benefits of technology in the teaching and learning process, the implementation of this technology alone will not improve student outcomes. Hence the need to evaluate lecturers' competency skills in using these technologies. A lecturer is an academic expert who teaches and conducts research at a university or college. They are responsible for imparting knowledge to students with which they can function properly in the wider society. Lecturers are therefore required to keep abreast of all technological advancements in their respective fields. Previous studies over the years has continued to record low adoption of CAD technology in the instruction of clothing and textile in Nigerian universities and colleges of education. This has been attributed to factors such as high cost of the technology, poor infrastructural development, resistance to change, lack of training and support, lack of awareness and poor technical competencies among others. This study therefore determined the awareness, competency and adoption of apparel computer aided design technology by clothing and textile lecturers in Enugu state. The findings of this study will assist relevant agencies in developing awareness and training programs in the usage of apparel CAD technology.

Research Questions

The following research questions guided the study.

1. What is the level of awareness of apparel CAD technology among clothing and textile lecturers in tertiary institutions in Enugu state?
2. What is the level of clothing and textile lecturers' competencies in using CAD?
3. What is the adoption level of apparel CAD technology by the respondents?
4. What are the barriers to the adoption of apparel computer-aided design technology?
5. What are the solutions to the barriers of using apparel CAD technology?

Methods

A descriptive cross-sectional survey design was adopted for the study. Descriptive cross-sectional design is a study in which the sample size is measured at a specific point in time for a defined population (Thomas, 2023). It was considered appropriate for this study because it has ability to examine the current situation in a given place and to check the extent to which current practices meet required standard. The population of this study comprised of 26 lecturers of clothing and textile unit of Home Economics and Home Science departments in the two universities and three colleges of education that offers the programs in Enugu state (Nigerian Education Consult, 2023). This included 10 lecturers from the University of Nigeria, Nsukka; four from Enugu state University of Science and Technology; five from Federal College of Education Eha-Amufu; four from Enugu State College of Education (technical); and three from OSISATECH College of Education, Enugu. There was no sampling due to the small population of the respondents.

A structured questionnaire titled 'Awareness, Competency and Adoption of Computer-Aided Design Technology (ACACADT)' was developed by the researchers after extensive literature review. The questions were structured on the basis of answering the research questions. The responses were on a four-point scale of Very Competent (VC)/Strongly Agree (SA) = 4, Competent (C)/Agree (A) = 3, Fairly Competent (FC)/Disagree (D) = 2, Not Competent (NC)/Strongly Disagree (SD) = 1. The instrument was subjected to face validation by three experts who are lecturers from the Department of Home Science and Management. The experts' suggestions and observations were used to improve the questionnaire items. To ensure that the instrument is consistent in measuring what it was designed to measure, it was administered to respondents in a tertiary institution in Imo state with similar characteristics as the study population. Cronbach Alpha was used to obtain a reliability index of 0.83 and the instrument was thus adjudged to have good internal consistency.

The structured questionnaires were distributed to the respondents by the researchers and their assistants who were postgraduate students. The questionnaires were distributed by hand to the lecturers, and researchers with assistants came back on a later date to collect the questionnaires. Twenty-four questionnaires were retrieved out of 26 that was distributed, giving 92% return rate. Descriptive results were presented in frequencies, percentages, means and standard deviation. Responses of 50% and above in the affirmative indicated awareness and adoption of apparel CAD, whereas responses below 50% in the affirmative signified not aware and not adopted. For lecturers' level of competency, barriers to the use of apparel CAD and solutions; means of 2.5 and above were regarded as competent and agreed while less than 2.5 was viewed as not competent and disagreed. Tables were used for data presentation

Results

Research Question One: What is the level of awareness of apparel CAD technology among clothing and textile lecturers in tertiary institutions in Enugu state?

Table 1: Frequency and percentage responses on the level of awareness of apparel CAD

Indicators	Aware	Not aware	Decision
	F (%)	F (%)	
Meaning of apparel CAD			
CAD is a software tool that gives apparel designers a virtual representation of the garments they are designing	21 (87.5)	3 (12.5)	
CAD is a form of software used to develop, modify, and optimize the process of clothing or textile pattern design	20 (83.3)	4 (16.7)	
Average	**20 (83.3)**	**4 (16.7)**	**Aware**
Apparel CAD Software			
AccuMark pattern design software by Gerber technology	5 (20.8)	19 (79.2)	
CAD.Assyst by Human Solution Assyst AVM	5(20.8)	19(79.2)	
Modrais by Lectra Systems	7 (29.2)	17 (70.8)	
Cosma Technology	8 (33.3)	16 (66.7)	
Optitex Pattern Design software by Optitex	9 (37.5)	15 (62.5)	
TUKAcad by Tukateck Inc.	7 (29.2)	17 (70.8)	

Fashion Cad by Cad Cam Solutions Australia Pty. Ltd	10 (41.7)	14 (58.3)	
SDS-ONE APEX3 from Shima Seiki	10 (41.7)	14 (58.3)	
PAD System	10(41.7)	14(58.3)	
GT CAD by Genuine Technology and Research Limited	11 (45.8)	13 (54.2)	
StyleCAD	10 (41.7)	14 (58.3)	
Average	**2 (8.3)**	**22 (91.7)**	**Not aware**
Uses of apparel CAD			
Design making and modification	17 (70.8)	7 (29.2)	
Pattern development and management	17 (70.8)	7 (29.2)	
Pattern grading	17(70.8)	7(29.2)	
3D body scanning	15 (62.5)	9 (37.5)	
Virtual garment styling	16 (66.7)	8 (33.3)	
2D simulation	15 (62.5)	9 (37.5)	
Pattern marking	15 (62.5)	9 (37.5)	
Fashion illustrations	16 (66.7)	8 (33.3)	
Textile and knitting design	18 (75.0)	6 (25.0)	
Pattern digitizing	19 (79.2)	5 (20.8)	
Pattern flattening	14 (58.3)	10 (41.7)	
3D sample visualization	14 (58.3)	10 (41.7)	
Made-to-measure	13 (54.2)	11 (45.8)	
Pattern design by draping	17 (70.8)	7 (29.2)	
Full-scale drafting	16 (66.7)	8(33.3)	
Average	**9 (37.5)**	**15 (62.5)**	**Not aware**

Table 1 shows the frequency and percentage responses on the level of awareness of apparel CAD technology among clothing and textile lecturers in Enugu state. From the analysis, the average awareness about the meaning of apparel CAD was 83.3% indicating awareness of what apparel CAD is all about. The average awareness of apparel CAD software was 8.3%. This was well below the 50% cut-off mark, signifying that the respondents were uninformed about the different CAD software such as Cosma technology, Modaris, and TUKAcad. From the table, the respondents were equally not aware of the uses of apparel CAD. This is shown by the average awareness of 37.5% being less than the 50% cut-off.

Research Question Two: What is the level of clothing and textile lecturers' competencies in using CAD?

Table 2: Mean and standard deviation responses on the level of clothing and textile lecturers' competencies in using apparel CAD

Skills	Mean	Standard deviation	Decision
File management	2.33	0.92	Not competent
Keyboard shortcuts	2.63	0.82	Competent
Basic computer troubleshooting	2.50	0.88	Competent
Geometric and surface modeling	2.13	0.99	Not competent
Parametric design	2.00	0.88	Not competent
Engineering design	2.13	0.99	Not competent
Design creation using 2-D and 3-D design concepts	1.83	0.87	Not competent
Visualization skills	1.83	0.87	Not competent
Creating and manipulating garment patterns	1.79	0.83	Not competent
Digital sketching and design development	1.79	0.83	Not competent
Grading and resizing of patterns	1.79	0.83	Not competent
Fabric simulation	1.67	0.82	Not competent
Technical drawing	1.88	0.79	Not competent
Exporting and sharing files in various format	1.79	0.78	Not competent
Grand mean	**2.00**	**0.73**	**Not competent**

Table 2 shows the mean and standard deviation responses on the level of clothing and textile lecturers' competencies in using apparel CAD. From the table, the grand mean of 2.00 was below the 2.5 cut-off point, indicating that the lecturers were not competent in apparel

CAD skills such as parametric and engineering design, file management, fabric simulation, technical drawing, file sharing and visualization skills among others.

Research Question Three: What is the adoption level of apparel CAD by the respondents?

Table 3: Frequency and percentage responses on the adoption of apparel CAD

CAD Software	Adopted F (%)	Not adopted F (%)	Decision
CAD for fabric design			
Design Dobby	1(4.2)	23(95.8)	
Design Jacquard from Textronic	0 (0.00)	24(100.0)	
Pro Weave from Pointcarre	2 (8.3)	22 (91.7)	
TUKAstudio for TUKATECH	2(8.3)	22(91.7)	
Weave It	7(29.2)	17(70.8)	
Adobe Illustrator	11(45.8)	13 (54.2)	
Average	**0 (0.0)**	**24 (100.0)**	**Not adopted**
CAD for apparel design			
Adobe Photoshop	10 (41.7)	14 (58.3)	
Adobe Illustrator	11 (45.8)	13 (54.2)	
Corel Draw	12 (50.0)	12 (50.0)	
AutoCAD	12(50.0)	12(50.0)	
Smart Designer Modern High Tech	4 (16.7)	20 (83.3)	
Telestia Creator	2 (8.3)	22 (91.7)	
Average	**1 (4.2)**	**23 (95.8)**	**Not adopted**
CAD for pattern making			
Lectra	3 (12.5)	21 (87.5)	
O/DEV by Optitex	3 (12.5)	21 (87.5)	
TUKAcad by Tukatech	3 (12.5)	21 (87.5)	
Richpeace	3 (12.5)	21 (87.5)	
Gemini CAD systems Wild Ginger	3 (12.5)	21 (87.5)	
Average	**0 (0.0)**	**24 (100.0)**	**Not adopted**
CAD for cutting operations			
Integrated CAD by Gerber technology	4 (16.7)	20(83.3)	
Modaris by Lectra	5(20.8)	19(79.2)	
GT CAD Software	6(25.0)	18(75.0)	
O/PRO by Optitex	6(25.0)	18(75.0)	
SMARTmark	6(25.0)	18(75.0)	
Tukatech	4(16.7)	20(83.3)	
Richpeace	4(16.7)	20(83.3)	
Average	**1 (4.2)**	**23 (95.8)**	**Not adopted**

Table 3 shows the frequency and percentage responses on the adoption of apparel CAD by clothing and textile lecturers. From the table, average adoption value of CAD for fabric design (0.0%), apparel design (4.2%), pattern making (0.0%) and cutting operations (4.2%) by the lecturers were all below 50.0% in the affirmative. This signifies that apparel CAD were not being utilized by the respondents in the teaching of clothing construction.

Research Question Four: What are the barriers to the adoption of apparel computer-aided design technology?

Table 4: Mean and standard deviation responses on the barriers to the adoption of apparel CAD technology for clothing construction

Barriers	Mean	SD	Decision
CAD technology is difficult to learn and use	1.96	1.04	Disagree
Lack of awareness of apparel CAD among lecturers and students	2.67	0.87	Agree
Lack of training and support for CAD technology in my institution	2.83	0.76	Agree
High initial cost of implementing CAD technology	3.17	0.70	Agree

CAD requirements are not compatible with available infrastructure	2.88	0.89	Agree
Traditional method of design and pattern- making are deeply ingrained in my school	2.67	0.87	Agree
Lack of awareness and understanding about the benefits of CAD	2.83	0.82	Agree
Lack of the necessary resources to support CAD technology adoption	2.13	0.79	Disagree
The integration of CAD into the curriculum would require significant changes to existing courses	2.33	0.76	Disagree
The textile and clothing industry still heavily relies on manual methods, making CAD technology less relevant	3.04	0.75	Agree
Resistance to change and a lack of openness to adopting new technologies	2.92	0.78	Agree
Limited availability of skilled CAD professionals, making it difficult to implement CAD technology effectively	3.00	0.72	Agree
Lack of a clear strategy for incorporating CAD technology	3.17	0.70	Agree
Perception that CAD technology reduces creativity and artistic expression is prevalent	2.58	0.97	Agree
Lack of standardization in CAD file formats poses challenges in collaboration with other institutions or industry partners	2.46	0.98	Disagree
Lack of time and resources to train staff and faculty on CAD technology	2.96	0.75	Agree
Grand mean	**2.72**	**0.48**	**Agree**

SD = Standard deviation

Table 4 shows the mean and standard deviation responses on the barriers to the adoption of apparel CAD technology. From the table, the grand mean of 2.72 was above the cut-off mark, indicating that the lecturers agreed on the barriers to the adoption of apparel CAD technology.

Research Question Five: What are the solutions to the barriers of using apparel CAD?

Table 5: Mean and standard deviation responses on the solutions to the barriers of using apparel CAD technology

Solutions	Mean	Standard deviation	Decision
Designers should ensure that accurate measurements are obtained in order to ensure the accuracy of the designs	3.13	0.79	Agree
Mastering the software and using it to create designs that push the boundaries of what is possible	3.17	0.82	Agree
Investment in secure cloud storage solutions (e.g. use of password and encryption to protect data and files)	3.17	0.82	Agree
Use of file conversion software to ensure compatibility when sharing information	3.21	0.66	Agree
Use of free and open-source CAD software or less expensive alternatives in order to mitigate cost	3.21	0.66	Agree
Participation in training and education programs that teach how to use the software effectively	3.04	0.81	Agree
Provision of resources that supports the use of CAD technology by the school and government	3.08	0.72	Agree
Integration of apparel CAD technology into the curriculum of institutions offering clothing and textile courses	3.04	0.62	Agree
Grand mean	**3.13**	**0.65**	**Agree**

Table 5 shows the mean and standard deviation responses on the solutions to the barriers of using apparel CAD. From the analysis, all the items of research question five show a mean response of above 2.5. The grand mean of 3.13 was well above the cut-off mark, indicating that the lecturers are in agreement on the solutions to the barriers of adopting apparel CAD technology for clothing construction.

Discussions

This study showed the awareness, competency and adoption of apparel CAD among clothing and textile lecturers in tertiary institutions in Enugu state. Findings showed that the respondents were aware of the meaning of apparel CAD technology but were not aware of apparel CAD software and their uses. This implies that clothing and textile lecturers in Enugu state understood that apparel CAD involves using software tools to virtually design and modify garments. Similarly, research by Kamau (2012) recognized CAD as a tool in the clothing industry. His research supports the idea that CAD has become a recognized and integral technology in the field. According to Sayem et al. (2010) CAD software facilitates apparel designers to create, develop and manipulate designs with greater ease and speed, reducing the time required for manual processes. Findings also showed that the lecturers did not have information about the different CAD software such as AccuMark, CAD.Assyst, Modrais, Cosma Tech and TUKAcad and their uses in apparel design, pattern development, grading and body scanning. Supporting this finding, Gausa et al. (2021) opined that a good percentage of textile and fashion industries in Africa are not able to apply CAD technologies due to several factors such as lack of knowledge about the software and of its application. Similarly, Onuoha (2013) reported that in Nigeria, the use of CAD-CAM in textile production is at a very slow pace due to a lack of awareness and knowledge about the application of the software.

Developing a well-rounded skill set is crucial for effective CAD integration into the curriculum and teaching process. From this study, findings indicated that the lecturers were not competent in apparel CAD technological skills. This suggests a need for targeted training programs to enhance lecturers' proficiency in areas such as parametric and engineering design, file management, fabric simulation, technical drawing, file sharing and visualization skills. The lack of competence recorded in this study agrees with the findings of Kassah et al. (2022) which showed that fashion design professionals were incompetent in CAD applications for apparel development. Similarly, a study by Kamau (2021) showed that less than one-third of apparel design lecturers had obtained competency training in the use of CAD technology. Aduwa-Ogiegbean and Iyamu (2015) opined that these lecturers encounter various limitations which may indirectly impact their competency. Therefore, by enhancing their CAD skills, lecturers can better prepare their students for careers in the fashion and textile industry, where CAD technology is increasingly important (Biney-Aidoo & Antiaye, 2013).

CAD has considerably improved the fashion industry by improving productivity in product designs, color decisions, and above all, memory storage for later use (Kassah et al., 2022). Findings of this study indicated that apparel CAD were not being utilized by the respondents in the teaching of clothing construction. This suggests that lecturers in Enugu state continue to rely on traditional methods for fabric and apparel design, pattern making and cutting operations. These traditional method is known to consume a lot of time and students often experience fear about the complex processes it involves (Ugwu et al., 2023). The non-utilization of apparel CAD recorded in this study agrees with the findings of Kamau (2022) which showed that the adoption of apparel CAD technology at the public universities in Kenya was low. Additionally, Ugwu et al. (2023) reported that the application of apparel CAD is not effective among clothing and textile lecturers in Public universities in South-east, Nigeria due to diverse challenges they face.

This study also showed the barriers to the use of CAD in the clothing construction process. The grand mean of 2.72 indicated that the lecturers agreed on the barriers to the adoption of apparel CAD technology such as awareness gaps, lack of training and support, high cost of the technology, poor technical skills, stifling of creativity, resistance to change and weak infrastructure. Supporting this finding, the study by Ugwu et al. (2023) showed that some of the obstacles to the use of CAD were teachers' lack of expertise, a shortage of computers, and a lack of technical assistance for academics. Consequently, current students' training in CAD technology falls short of meeting labor requirements in the clothing sector (Omondi et al., 2016). Kamau (2022), in his study reported that appropriate CAD hardware and software

resources were limited and hence could not be effectively utilized in the teaching/learning process. Uoshima, Akiba and Nagasawa (2021) further stated that many fashion designers may not have the required technical skills or may need additional training to effectively use the software. They may also be hesitant to learn new skills or may feel that the software takes away from their creative process (Sayem et al., 2010). In addition lecturers may not have the time or resources to devote to the initial learning curve or may feel that the time investment is not worth the potential benefits (Liborius et al., 2019).

This study also identified different strategies that could be used to overcome these barriers and effectively integrate CAD into fashion and apparel education. The grand mean of 3.13 was an indication that the lecturers were in agreement on the solutions to the barriers of adopting apparel CAD technology for clothing construction. These solutions included investing in training, enhancing awareness, providing safe storage for data, ensuring infrastructural compatibility, and fostering a culture of openness to technological advancements. Supporting this, Imayanti and Yahya (2018), stated that training programs are essential for building the technical skills needed to effectively use CAD software. Study by Ugwu et al. (2023), equally suggested orientation of teachers on the importance of CAD technology as one of strategies to overcoming the challenges facing the adoption of CAD for clothing construction. Similarly, Kamau (2022) also emphasized need for lectures to be trained in the use of apparel CAD. Additionally, Williams (2017) also suggested some strategies to the barriers of using CAD such as investment in secure cloud storage solutions, including password protection and encryption. This will help protect sensitive design data and files from unauthorized access or loss.

Conclusion

The study provided valuable insights into the current state of awareness, competency and adoption of apparel CAD technology among clothing and textile lecturers in Enugu state. The study concludes that the lecturers were aware of the meaning of apparel CAD technology but were not aware of apparel CAD software and their uses. The lecturers lacked competency in using CAD skills in the clothing construction process. As a result, they did not adopt the technology for fabric and apparel design, pattern making and cutting operations. Their lack of competency and adoption was attributed to many challenges such as lack of awareness and training, high cost, infrastructural limitations and compatibility challenges. To mitigate these barriers, participation in training and provision of needed infrastructure were some identified solutions.

Recommendations

The following recommendations were made based on the findings of the study.

1. Awareness campaigns that emphasize the use of apparel CAD technology should be mounted by educational institutions through workshops, seminars, and online resources.
2. Training programs should be designed by school administrators to enhance lecturers' competencies in apparel CAD skills.
3. Educational institutions should allocate resources to support the adoption of CAD technology. This includes investing in hardware, software licenses, and infrastructure upgrades to facilitate a seamless CAD learning experience.
4. Institutions should prioritize cyber security and secure cloud storage solutions when implementing CAD technology. Protecting sensitive design data and files is essential to maintain the integrity of design projects.

References

Abdullahi, A. (2017). Origin of clothing lice as an indicator of early clothing use by anatomically modern humans in Africa. *Journal of Molecular Biology and Evolution*, *28*(1), 29-32. https://doi.org/10.1093/molbev/meq23p

Aduwa-Ogiegbaen, I. O., & Iyamu, E. O. S. (2015). *Utilization of information and*

communication technology in education: New perspectives. Nigeria: Okoko Press.

Akah, U.E., Bassey, L.E., & Ukpong, E.E. (2021). Empirical investigation into the effect of computer-aided design (CAD) on the manual drafting skills of undergraduate architecture students. *GRASPACT Journal of Arts and Technology, 1*(4), 159-172. https://shorturl.at/zQfy3

Anderson, C. (2024). *What is technology awareness?* Retrieved 9th February, 2025 from https://focuskeeper.co/glossary/what-is-technology-awareness/

Batti, K. (2025). *Technology adoption curve: 5 stages of adoption.* Retrieved 9th February, 2025 from https://whatfix.com/blog/technology-adoption-curve/

Benson, J. (2015). *CAD system and its application in the garment and fashion industry.* Retrieved 5th December, 2024 from https://shorturl.at/XjjzR

Bernstein, L. (2024). *Computer-aided design (CAD): What it is – and why it's important*. Retrieved 28th December, 2024 from https://www.procore.com/library/computer-aided-design

Biney-Aidoo, V., & Antiaye, E. (2013). Assessing the production capacity of the garment industry in Ghana in relation to AGOA conditions. *African Journal of Interdisciplinary Studies, 6*(1), 83-93. https://shorturl.at/h62G1

Browzwear (2024). *What is the basic process of textile design using 3D CAD?* Retrieved 28th December, 2024 from https://shorturl.at/ussxm

Draganidis, F., & Mentza, S. (2006). Competency-based management: A review of systems and approaches. *Journal of Information Management and Computer Security, 14*(1), 51-64. https://doi.org/10.1108/09685220610648373

Fukunishi, T. (2014). Introduction: African farmers and firms in a changing world. In: Fukunishi, T. (Eds.) *Delivering Sustainable Growth in Africa* (pp. 1-22). IDE-JETRO Series. London: Palgrave Macmillan. https://doi.org/10.1057/9781137377821_1

Gausa, S., Wanduara, M., & Kisato, J. (2021). CAD-CAM technology and textile manufacturing in northern NIGERIA. *Tropical Built Environment Journal (TBEJ), 8*(1), 25-35. https://www.tbejournal.com/index.php/tbej/article/download/83/87

Gururajan, R. (2010). Organizational factors and technological barriers are determinants for the intention to use wireless handheld technology in healthcare environment: An Indian case study. In K. Khoumbati, Y. K. Dwivedi, A. Srivastava, & B. Lal (Eds.), *Handbook of Research on Advances in Health Informatics and Electronic Healthcare Applications: Global Adoption and Impact of Information Communication Technologies* (pp. 109-123). United States: IGI Global. https://doi.org/10.4018/978-1-60566-030-1.ch007

Hammed, O.E. (2022). Historicizing the development of textile industry (Aso-oke) and colonial impact in Iseyin town, Southwestern Nigeria. Retrieved 9th February, 2025 from https://shorturl.at/QuXvU

Imayanti, H.S., & Yahya, M. (2018). The effectiveness of clothing pattern making training with CAD-based system on fashion students. *Advances in Social Science, Education and Humanities Research (ASSEHR), 201,* 311-316. https://www.atlantis-press.com/article/25903519.pdf

Kamau, V.W. (2012). *Assessment of the adoption of apparel computer aided design technology training in selected public universities in Kenya*. [Doctoral dissertation, Kenya University]. IR-Library. https://ir-library.ku.ac.ke/items/7bd89c22-a648-4ef2-b8bf-f283ac2e0c17/full

Kassah, J.K., Bruce-Amartey, E., & Acquaye. R. (2022). Fashion design training in technical universities and performance of graduates in computer-aided apparel development in Ghana. *American Journal of Art and Design, 7*(3), 78-82. https://doi.org/10.11648/j.ajad.20220703.11

Kaystha, H., & Sharan, M. (2017). Use of computer technology in the apparel sector. *International Journal of Applied Research, 3*(5), 362-365. https://www.allresearchjournal.com/archives/2017/vol3issue5/PartF/3-5-5-829.pdf

Liborius, P., Bellhäuser, H., & Schmitz, B. (2019). What makes a good study day? An intra-individual study on University students' time investment by means of time-series analyses. *Learning and Instruction, 60*, 310-321. https://doi.org/10.1016/j.learninstruc.2017.10.006.

Nigerian Educational Consult (2023). *Universities in Enugu state.* Retrieved 28th December, 2024 from https://samphina.com.ng/list-federalstate-private-universities-enugu-state/

Omondi, E. O., Imo, B. E., & AndOtina, M. A. (2016). Importance of CAD/CAM training for fashion design students in Kenya. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *6*(2), 70–75. https://doi.org/10.9790/7388-0602027075

Onuoha, C.B. (2013). Factors Militating Against the Global Competitiveness of Manufacturing Firms in Nigeria. *American International Journal of Contemporary Research*, *3*(4), 54-63. https://www.aijcrnet.com/journals/Vol_3_No_4_April_2013/6.pdf

Onyeka, E.O. (2020). The use of Computer Program in Teaching and Learning Pattern Making: Drafting. *Nigerian Journal of Textiles (NJT), 6*, 66-69. https://tran.org.ng/NJT/files/2020/11-NJT-Vol.6-2020-Onyeka_66-69.pdf

Oppong, J.A., Biney-Aidoo, V., & Antiaye, E. (2013). Evaluating the benefits of computer aided-design (CAD) in fashion education, the case of Accra polytechnic. *Journal of Education and Practice*, *4*(21), 73-79. https://www.iiste.org/Journals/index.php/JEP/article/view/8277/8383

Sayem, A. S. M., Kennon, R., & Clarke, N. (2010). 3D CAD systems for the clothing industry. *International Journal of Fashion Design, Technology and Education*, *3*(2), 45–53. https://doi.org/10.1080/17543261003689888

Shi, Y., Wang, X., & Zhu, X. (2020). Lean manufacturing and productivity changes: The moderating role of R&D. *International Journal of Productivity and Performance Management*, *69*(1), 169-191. https://doi.org/10.1108/IJPPM-03-2018-0117

Sun, N., CaO, B., & Mu, X. (2024). The transformative role of computer-aided design technology in innovation in the apparel industry. *Applied Mathematics and Nonlinear Sciences, 9*(1), 1-17. https://doi.org/10.2478/amns-2024-2230

Thomas, L. (2023). *Cross-sectional study: Definition, uses & examples.* Retrieved 7th February, 2025 from https://www.scribbr.com/methodology/cross-sectional-study/

Ugwu, E.I., Ezeaku, M.N., Attah, B.I., Emeghebo, U.M., & Eze, E.C. (2023). Application of computer aided design (CAD) and flat techniques in teaching pattern drafting by clothing lecturers in universities in south east, Nigeria. *International Journal of Home Economics, Hospitality and Allied Research, 2*(1), 29-43. https://doi.org/10.57012/ijhhr.v2n1.003

Umennuihe, C. L., Shu'ara, J., Okechukwu, F. O., Alutu, C.E. & Umennuihe, A.E. (2023). Availability and the extent of utilization of information communication technology among senior secondary school students in Nsukka local government area, Enugu State. *Journal of Family and Society Research, 2*(1), 14-28. https://jfsr.afass.org.ng/index.php/JFSR/article/view/42

Uoshima, K., Akiba, N., & Nagasawa, M. (2021). Technical skill training and assessment in dental education. *Japanese Dental Science Review, 57*, 160-163. https://doi.org/10.1016/j.jdsr.2021.08.004

Uyai, L. (2022). *The Nigerian textile industry.* Retrieved 9th February, 2025 from https://www.scribd.com/presentation/553162250/THE-NIGERIAN-TEXTILE-INDUSTRY

Webb, G. (2024). *Awareness.* Retrieved 28th December, 2024 from https://medium.com/@grahamwebb_7317/awareness-a7120d76c65e

Williams, C. (2017). *Understanding accuracy, precision and tolerance to improve product design.* Retrieved 28th December, 2024 from https://www.starrapid.com/blog/designing-for-manufacturing-accuracy-precision-and-tolerance/

Wong, G. (2020). *The perception of sustainability and circular economics.* https://doi.org/10.3390/su12072809