Competencies Required by Technical Drawing Teachers in Senior Secondary Schools in Ondo East and West Local Government Areas of Ondo State, Nigeria

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DOI: 10.56201/ijee.v9.no9.2023.pg1.11

Abstract

The study on competencies required by technical drawing teachers in senior secondary schools in Ondo East and West Local Government Areas of Ondo State was motivated by a great concern about the future and continuity of Technical drawing in all tiers of society and most especially at secondary school level. Four research questions guided the study. Descriptive survey research design was adopted and the population was forty three technical drawing teachers. A self-structured questionnaire consisting of sixty four items was developed and used for data collection while the reliability coefficient obtained was 0.71 using Cronbach Alpha formular. Mean and standard deviation were used to answer research questions. The findings revealed that the teachers need re-training in some aspects of technical drawing. It was recommended that teachers should regularly be sent on in-service training programme to update and improve their professional competencies.

Keywords: *Competencies, Technical drawing, Teachers, senior secondary schools*

Introduction

Technical drawing is the practice of graphically representing structures and objects. Engineers, technicians, craftspeople, and manufacturers all around the world use it as a graphic language to communicate (Ogundola, 2017;Tornincasa,2021 & Oviawe, Azman,Kiong & Abilmazhinova, 2022). It serves to illustrate technical concepts for the industrial production of goods in large quantities (Jiménez-rabiela, Vázquez-gonzález, Ramírez-cruz & Bravo-acosta, 2021). Secondary schools, technical colleges, polytechnics, colleges of education, and universities all teach it. The two categories are engineering drawings and building drawings. According to Goetsh, Chalk, Nelson, and Rickman (2010) and Oviawe etal, (2022), technical drawings are a good way to quickly and visibly convey all of the information required to turn an idea into actual objects. Technical drawings contain more information about their objects than just a graphic representation, including dimensions, notes, specifications, and enough accuracy for the product to be mass-

produced with easy interchangeable parts (Chedi, 2015). It is a representation of all types of items made practically in a way that clearly and completely defines their shapes, dimensions, materials, and surfaces. In engineering learning and practices, technical drawing played a strategic role (Oke & Olakotan, 2019). It is a field of study focused on providing understanding and clarification so that one can have an intellectual understanding of the concept that other people perceived (Uddin, 2016; Oviawe etal, 2022). The use of symbols, perspectives, measurements, a notation system, visual styles, and page layout simplifies the drawings.

Colleges of education (Technical), universities, and probably polytechnics all have trained or experienced teachers who teach technical drawing (Okoro, 2006; Oviawe etal, 2022). These educators received training in order to instruct technical drawing to students effectively. Graduate teachers are those who have graduated from universities, while non-graduate teachers are those who have graduated from colleges of education and polytechnics. Given this, any teacher who completes educational training (the art of teaching) at the university level is known as a competent teacher, while those who do not complete educational training but who are technically trained are referred to as incompetent teachers.

The Federal Government of Nigeria (2014) made technical drawing an elective subject available at the secondary level. This will assist in supplying the fundamental knowledge and skills required for students to successfully complete engineering and construction programs at the higher level of education. It is the mother of all other technical-related subjects (Oke & Olakotan, 2019), and understanding it helps students better understand other technical fields like metalworking, woodworking, electrical/electronic technology, building technology, and automobile technology (Nwoke & Ogwo, 2002; Kaydonna & Abede ,2023). Technical drawing serves the important function of helping designers and planners communicate effectively, which is one of its main goals (Abdulwahab & Usman, 2014). Due to all of these, teachers will assist with tryouts the technical drawing curriculum's documented lessons.

A teacher is someone who imparts knowledge, skills, and attitudes to students in a classroom setting (Olaitan, Amusa & Nwobu, 2009). In order to impart knowledge, skills, and attitudes to students in a setting, a technical teacher must be skilled in both the pedagogy and technical aspects of the subject (Miller, Bakare, and Ikatule, 2010 in Patiko, Abudlahi Yassar, Nana, and Izom, 2020).Technical drawing teachers are a group of people who must be construed for effective purposes, so it is imperative that they have the necessary skills because they are thought of as a supervisor of knowledge that enables them to meet the requirements of the teaching profession. The training and expertise of teachers must be considered in the teaching and learning processes as this may improve their capacity.

Technical drawing instruction carries a lot of weight, so it is crucial to evaluate the teachers' level of expertise. Competency is the ability to agree to possess the knowledge, skills, and attitudes necessary to perform a specific duty (Honby, 2015). According to Olaitan (2003) in Patiko et al. (2020), competence is the combination of knowledge, abilities, and attitudes that must be present for a person to perform successfully at a given level in any given job. According to Patiko et al. (2020), competency is the capacity to maintain the skills, knowledge, and know-how necessary to perform a specific job. According to Nussel, Inglis, and Wiersman in Abdulwahab et al. (2014),

competency is an ability that is useful in real-world situations the fundamental principles and practices of a specific field, and in cases where these elements are lacking, the teacher's ability to teach is crucial. Competency can also refer to the requirement that a person consistently perform a particular task accurately (Villanueva, 2018; Holmes, Polman Tuin & Turner, 2021).This implies that competence is the quality of having the skills and abilities necessary to carry out a particular task, as well as the state of being sufficiently or well-qualified. A person possesses a competency if the knowledge, skills, and abilities necessary to Hakio ,support that competency are a part of them and allow them to carry out practical tasks in a particular work environment.

In related meaning, Villanueva (2018) and Jaakkola, Karvinen, Wolff L-A, Mattelmäki and Friman (2022) discussed in his article that competency is the individual's capacity to use, relate, and validate a group of related awareness, knowledge, skills, and assertiveness in order to successfully carry out jobs and responsibilities. This capacity can be measured against widely-accepted standards required in engagement as well as assessed against evidence that is provided at the workplace. Wahha (2018) cited Villanueva (2018) in this regard. The competency affects a person's job responsibilities as well as how they present themselves at work. This study defines competence as the technical drawing teachers' ability to demonstrate the knowledge, skills, and attitudes necessary to teach the subject. On the other hand, if one could not adequately demonstrate the knowledge, skills, and attitudes necessary for teaching, then that person has a competency gap.

Statement of the Problem

The heart of any engineering program is technical drawing. The competency of the teachers determines the caliber of the knowledge that students in traditional secondary schools learn. Technical drawing in secondary schools serves as the foundation for the development of technological skill. It is crucial for equipping students studying technical drawing with the knowledge and abilities that will enable them to advance in their academic careers and become more qualified to work in the workforce or as teachers in traditional secondary schools and technical colleges. Additionally, the performance level of Nigerian technicians as a whole is currently very low. Regrettably, despite government efforts to ensure high-quality secondary education and produce highly competent products in both academics and employability, there have been persistent reports of a high failure rate among students studying technical drawing at secondary school final examinations by WAEC Chief Examiners Report. The lack of required teaching competencies in recent years may be partially to blame for the high failure rate. It is therefore, necessary to examine whether teachers have the required competency skills to teach technical drawing in senior secondary schools. Similarly, the purpose of this study is to evaluate the skills needed by technical drawing teachers in senior secondary schools in Ondo State's Ondo East and Ondo West Local Government Areas of Ondo State.

Purpose of the Study

The purpose of the study was to assess the competencies required by technical drawing teachers in senior secondary schools in Ondo East and Ondo West Local Government Areas of Ondo State. Specifically, the study intends to assess the competencies required by technical drawing teachers to teach:

(i) Basic and construction drawing
(ii) Geometrical shapes
(iii) Drawing presentations
(iv) Assembly drawing.

Research Questions

The following research questions were formulated to guide this study.

1. What skills must technical drawing instructors possess in order to instruct basic and construction drawing?

2. What skills must instructors of technical drawing possess in order to instruct students in geometric shapes?

3. What skills must instructors of technical drawing possess in order to instruct drawing presentations?

4. What skills must technical drawing instructors possess in order to instruct assembly drawing?

Methodology

The research project used a descriptive survey methodology. Ondo East and Ondo West Local Government Areas in Nigeria's Ondo State were the locations of the study. 43 technical drawing instructors from eight schools that offer technical drawing made up the study's population. The relative size of the population is the cause of the lack of sampling. A self-structured questionnaire with 62 items, created by the researcher was adopted from Ubelle and Okwelle (2020), to suit technical drawing served as the data collection tool. The competencies necessary for technical drawing teachers were determined using a four-point Likert scale. The options are Highly Possessed (HP), Possessed (P), Possessed (P), Moderately Possessed (MP), and Not Possessed (NP), with a value of 4, 3, and 2, respectively. Two technical drawing experts from Saint Don Bosco Technical Institute in Ondo and two measurement and evaluation experts from Ekiti State University in Ado-Ekiti validated the instrument. The instrument that was modified and used to collect the data was updated with suggestions and corrections. Using the Cronbach Alpha (α) coefficient method, the instrument's internal consistency was assessed. The validated instrument was administered to five teachers who are not part of the study. The reliability coefficient of 0.71 was obtained, the instrument was considered valid for the study. The questionnaires were administered on the respondents by the researcher through personal contact and with the help of two research assistants trained by the researcher. A return visit was made by the researcher and the research assistants to collect the completed questionnaires after few days of the administration. The completed copies of the questionnaires were collected from the respondents for further analysis. Data collected from respondents was analyzed using mean and standard deviation. Items with mean of 2.5 and above were considered as having high means which indicates that the teachers possessed competencies in the areas. Any items with a mean rating of less than 2.50 were considered to be subpar, indicating that the teachers lacked the necessary expertise and required additional training.

Results

Research Question 1: What skills must technical drawing instructors possess in order to instruct basic and construction drawing?

The data for answering research question one were presented in table one.

Table1: Responses of respondents on the area of skills required for basic and construction drawing.

S/N	Skills in basic and construction drawings	Mean	S.D	Remarks
1	Drawing of border lines	3.32	0.71	Possessed
2	Drawing, placement of title block	3.30	0.73	Possessed
3	Arrangement of drawing on the drawing sheet	3.11	0.89	Possessed
4	Forms of lettering	3.42	0.64	Possessed
5	Different types of symbols and conventions	3.15	0.69	Possessed
6	Identification and sketching of geometrical shapes	3.21	0.66	Possessed
7	Properties of plane shapes	3.15	0.71	Possessed
8	Point, line, segment and diameter	2.48	0.83	Possessed
9	Construction of various angles	2.14	0.81	Not Possessed
10	Division of lines into any number of equal parts and ratio	2.28	0.88	Not Possessed
11	Reduction and enlargement of plane figures	2.29	0.84	Not Possessed
12	Methods of drawing lines, circles, arcs, angles using freehand	2.51	0.83	Possessed
13	Orthographic Projection	2.54	0.83	Possessed
14	Meaning and description of first and third angle projections	3.13	0.74	Possessed
15	Planes of projection	3.23	0.73	Possessed
16	Converting pictorial drawings to first and third angles projection	3.21	0.71	Possessed
17	Converting orthographic projection to pictorial drawing	2.53	0.85	Possessed
18	Projection of views in orthographic	2.24	0.86	Not Possessed
19	Leader, dimension line and extension line	3.64	0.75	Possessed
20	Sectioning	3.14	0.74	Possessed
21	Types of sectioning	2.41	0.81	Not Possessed
22	Loci	2.51	0.83	Possessed
23	Link mechanisms	2.44	0.85	Not Possessed

Source: Field work 2022

Data in Table 1 revealed that 6 out of 23 items, the teachers had not possessed competency in those skills while 17 skills was possessed by the teachers of technical drawing. Generally, teachers of technical drawing needed to possess all the 23 competencies in basic and construction drawings.

Research Question 2: What skills must instructors of technical drawing possess in order to instruct students in geometric shapes?

The data for answering research question two were presented in table two.

Table 2: Responses of respondents on the area of skills required for geometrical shapes.

S/N	Skills in drawing geometrical shapes	Mean	S.D	Remarks
24	Meaning of triangles and their types	4.42	0.78	Possessed
25	Construction of triangles	3.10	0.76	Possessed
26	Quadrilaterals(Definition and examples)	3.35	0.77	Possessed
27	Construction of quadrilaterals	3.61	0.81	Possessed
28	Polygons (Meaning and types)	3.55	0.74	Possessed
29	Polygon constructions	2.31	0.64	Not Possessed
30	Circles (Meaning and properties)	3.14	0.72	Possessed
31	Circle constructions	2.43	0.68	Not Possessed
32	Area of plane shapes	2.44	0.69	Not Possessed
33	Scales (Meaning and constructions)	2.54	0.76	Possessed
34	Inclined Solids	2.52	0.75	Possessed
35	Principles of tangency	2.55	0.73	Possessed
36	Isometric drawing	3.15	0.79	Possessed
37	Oblique drawing	3.37	0.80	Possessed
38	Isometric circles	3.24	0.76	Possessed
39	Line in space	2.15	0.62	Not Possessed
40	True shapes	2.24	0.66	Not Possessed

Source: Field work 2022

Data in Table 2 revealed that 5 out of 17 items, the teachers had not possessed competency in those skills while 12 skills was possessed by the teachers of technical drawing. Generally, teachers of technical drawing needed to possess all the 17 competencies in geometrical shapes.

Research Question 3: What skills must instructors of technical drawing possess in order to instruct drawing presentations?

The data for answering research question three were presented in table three.

Table 3: Responses of respondents on the area of skills required for drawing presentation.

S/N	Skills in drawings presentation	Mean	S.D	Remarks
41	Common graphical symbols, building presentation, mechanical and electrical drawings	3.12	0.73	Possessed
42	Range of standard scales for site plans, floor plans and elevation.	3.24	0.76	Possessed
43	Working principles of typical plan printing machine.	3.44	0.77	Possessed
44	Basic principles of design	2.41	0.64	Not Possessed
45	Form, function and beauty in design.	2.44	0.67	Not Possessed
46	Parts of residential bungalow living room, kitchen and their relationships.	2.41	0.61	Not Possessed

47	Identification of sanitary and water services and soak away.	3.14	0.75	Possessed
48	Purpose of town planning authority regulations.	3.24	0.74	Possessed
49	Preliminary sketch design	3.22	0.73	Possessed
50	Characteristics of survey plan	3.14	0.72	Possessed
51	Drawing of preliminary sketch design of a modern 3-bed room bungalow for a teacher.	2.15	0.61	Not Possessed
52	Preparation of working drawings to suitable scale.	2.14	0.63	Not Possessed

Source: Field work 2022

Data in Table 3 revealed that 5 out of 12 items, the teachers had not possessed competency in those skills while 7 skills was possessed by the teachers of technical drawing. Generally, teachers of technical drawing needed to possess all the 12 competencies in basic and construction drawings.

Research Question 4: What skills must technical drawing instructors possess in order to instruct assembly drawing?

The data for answering research question four were presented in table four.

Table 4: Responses of respondents on the area of skills required for teaching of assembly drawing.

S/N	Skills in assembly drawings	Mean	S.D	Remarks
53	Bolt and nut (Meaning and construction)	2.42	0.65	Not Possessed
54	Conventional representation of stud, screw, nut, bolt and thread.	2.45	0.67	Not Possessed
55	Locking devices	3.43	0.81	Possessed
56	Fasteners (Meaning and types)	3.41	0.80	Possessed
57	Preparation of part list of simple mechanical device	3.48	0.84	Possessed
58	Orthographic of simple assembled parts	3.36	0.81	Possessed
59	True and foreshortened lines and surfaces in projected views.	3.43	0.83	Possessed
60	Sectioning of assembled parts.	3.36	0.86	Possessed
61	Drawing and interpretation of simple electrical and electronics circuits.	3.32	0.82	Possessed
62	Cam and gear motion	2.32	0.63	Not Possessed
63	Types of gear	2.24	0.61	Not Possessed
64	Drawing of meshing gear profiles.	2.25	0.62	Not Possessed

Source: Field work 2022

Data in Table 4 revealed that 5 out of 12 items, the teachers had not possessed competency in those skills while 7 skills was possessed by the teachers of technical drawing. Generally, teachers of technical drawing needed to possess all the 12 competencies in assembly drawing.

Discussion of Result

Analysis revealed that the technical competency requirements of technical drawing teachers in senior secondary schools were pertinent. These results show that those competencies are necessary for any worker's effective job motivation, performance, and satisfaction. According to

Abdulwahab and Usman (2014), personality development can be characterized as a result of both a press and a need. The aforementioned needs concepts have implications for teachers in general and technical drawing teachers in particular, among other things.

According to research question number one as analyzed in table 1, the results of this study showed that out of 23 items on competencies required by technical drawing teachers with respect to skills in basic and construction drawings, six items were decided to require by technical drawing teachers in SSS in Ondo East and Ondo West, Ondo State, and they are basic, construction of various angles, division of lines into any number of equal parts and ratios, reduction and enlargement of objects, and basic. These results support Ogwo and Oranu's (2006) assertion that teachers must participate in improvement or training programmes on a continuous basis.

The results of research question two, as shown in table 2, also showed that teachers needed to improve on five of the 17 competencies related to technical drawing teachers' abilities to draw geometrical shapes. These five competencies included polygon and circle constructions, area of plane shapes, line in space, and true shapes. The results are consistent with Abdulwahab and Usman's (2014) assertion that technical drawing teachers must possess a thorough understanding of the competencies for skills in drawing geometrical shapes. However, all respondents agreed that a practical training program would be the best way to acquire the desired competencies.

In the analysis of research question 3 shown in table 3, it was discovered that teachers needed development in 5 of the 12 competencies needed for drawing presentations, including fundamental design principles, form, function, and beauty in design, the components of a residential bungalow's living room and kitchen, and their relationships, and drawing of a preliminary sketch design of a modern 3-bedroom bungalow for a teacher. However, seven items identified key competencies that are necessary for technical drawing instructors to be capable of imparting the proper, effective skills to students in the area of drawing presentation. This is related to Umar's (2014) discoveries, according to which technical drawing teachers need to have certain abilities to improve SSS students. When students receive the necessary skills, according to Bakare and Fadairo (2010), they will be competent to work effectively with little to no control. Therefore, during the process of training and reequipping teachers to update their knowledge and skills in the deteriorating areas of technical drawing, the items found to be required should be taken very seriously.

The study's findings regarding research question4 in table 4 indicated that practical training programs should be organized to provide technical drawing teachers with the competencies they need in order to teach assembly drawings. This is because it was discovered that 5 out of 12 items, including bolt and nut (meaning and construction), conventional representation of stud, screw, nut, bolt and thread, cam and gear motion, types of gear, and drawing of meshing gear profiles, were not possessed by the participants in the study. Audu (2008) provides evidence in support of the idea that the development of psychomotor abilities and knowledge should be carefully planned to identify all teachable items that a person can possess. Additionally, it agreed with Abdulwahab and Usman's (2014) contention that teaching effectiveness depends on what to teach, how to teach it, to whom it will be taught, and the circumstances in which it will be taught. In addition, Abdulwahab and Usman's (2014) emphasis was on the personal and professional qualities of the teacher for effective teaching and learning. Apagu (1997) adds credence to this by stating that

quality teaching is a prerequisite for quality education and that it is only possible to achieve this through mastery of the various skills in the training components.

Implication of the Study

This study found that basic and construction drawing, geometrical shapes, drawing presentation, and assembly drawings all require skill enhancement. Likewise, methodical training and re-training will raise the bar of how those skills are taught by teachers. In general, the benefits of retraining teachers in those skills acquisition at high level competency cannot be overstated. These findings will allow government agencies to better allocate resources.

Conclusion

According to the study's findings, technical drawing teachers need to improve their technical drawing skills to a higher level in all areas of the subject in order to fill the gap left by their lack of proficiency in various areas and inspire technical drawing students in a way that will improve the effectiveness of their performance in their future careers in engineering.

Recommendations

Based on the findings of this study, the following recommendations were made since there were inadequate competencies of some skills in technical drawing by the teachers:

(1) In-service training programs for technical teachers should be sent out on a regular basis to update and advance their professional competence in skills for support in teaching activities in schools. Such an in-service technical training programme should take the form of seminars, conferences, postgraduate programmes, workshops, and any other training that will benefit the teachers.

(2) In order to plan and modify the curriculum for the in-service training programme, curriculum planners can make use of the acknowledged needs for improving competencies.

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