THE USE OF INSTRUCTIONAL MODELS IN TEACHING ENGINEERING DRAWING: ACADEMIC ACHIEVEMENT AND ABILITY LEVEL REFLECTION

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Abstract

This study investigated the effect of Instructional models on Secondary School learners' academic achievement and ability in Engineering drawing (ED). Two research questions and two hypotheses guided the study. All ED learners in public senior secondary schools participated in the study. Eighty-nine ED learners of two intact classes drawn from participating schools were randomly assigned to experimental and control groups respectively. Engineering Drawing Achievement Test (EDAT) was used for data collection. The instrument and lesson plan used for the study were validated by 5 experts. Pearson Product correlation coefficient formula was used to determine the reliability of the instrument after subjecting it to pilot testing in a similar school with the participating schools. The learners were grouped into low and high achievers using their sessional results from various schools. The study adopted a 2 x 2 factorial design. Mean was used to answer the research questions while hypotheses were tested with ANCOVA at .05 probability level The findings of the study revealed a significant difference in students' academic achievement in favour of the experimental group. The high and low ability learners in the experimental group also achieved more when compared with high and low ability learners in the control group. Models as instructional material, when used properly, can have positive and significant effects on learners' learning outcomes, especially the low achieving learners. The study recommended among others that ED teachers should develop the habit of using models in teaching ED to enhance the academic achievement of learners and bridge the gap between high and low ability learners.

Keywords: *Instructional models, academic achievement, ability level and engineering drawing*

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Introduction

Engineering Drawing (ED) is a form of language for engineers, drafters, designers, machinists, and technical teachers. According to Speranza *et al*. (2017), ED is a form of technical language usually applied to tackle not only other engineering programmes but also for employment in future. Thus the main purpose of ED courses is to standardize the level of knowledge of ED focusing on different drawing tools such as sectional views, dimensioning rules and practices, orthogonal and isometric projections and the introduction of related drawing and international technical standards. ED is one of the most important courses for engineering students during their undergraduates study. Farzeeha *et al* (2017) argued that students see engineering drawing as difficult and complex course and often shy away from it. The students also assumed that the subject is difficult to practice thereby affecting their performance in both internal and external Examinations such as National Business and Technical Examination Board (NABTEB), West African National Examination Council (WAEC) and National Examination Council (NECO).

Furthermore, Agbonghale and Iserameiya (2018) asserted that there is dearth in the quantity and quality of teachers teaching technical drawing in Nigerian schools and colleges and this may also affect the performance of students in the subject. They further stressed that in terms of quantity, the number of teachers required to teach this course is in short supply and in quality, and most of the teachers are not qualified. There was no adequate plan by government to develop the capacity of these teachers or send them for further training in higher institutions.

Teaching is a deliberate demonstration made by a full grown or experienced individual to impact knowledge, information, skills, and so on to a youth or less experienced individual through a system that is perfect. A successful teaching of ED can then be regarded as the ability of a competent ED instructor to make use of the right and proper teaching strategies or techniques, tools and resources in assisting learners to obtain and use technical skills and knowledge with a view to achieve the goal of the lesson and at the same time lay a concrete foundation for the learners continued interest in the subject. The process of educating and fostering experience should be student-centred, and one way to shift the focus in teaching from a teacher-centred is by modifying Instructional method. Such Instructional interventions are effective if they produce the desired learning outcome in the students. Academic achievement and ability level are end products of learning and they are commonly measured by examination. This is why individual’s fulfillment after a course of study is normally determined by test scores.

Models are representations of an idea, object, event, process or system. A model is an important teaching aid for engineering education teaching. Models belong to the group of three dimensional instructional media such as puppets, mock-ups, dioramas, and so on. Models have a three-dimensional effect on the mind of the students. They are the replica of the real subject matter. Models in ED are commonly produced with the use of wood, metal and cardboard papers. Sometimes clay, paper, plaster of Paris and varieties of colour can be added to make suitable models of different objects. This group of models is referred to as expressed models which are commonly used in engineering communication and teaching (Akpeli, 2019). Models and modelling play a crucial role in education practice. One justification for their inclusion in teaching is that they contribute to an 'authentic' engineering education, where teaching reflects the nature of engineering as much as possible. Models help in simplification of complex ideas by clarifying the structure of a complex phenomenon by reducing it to simpler and more familiar terms (Akpeli, 2019). Models allow learners to ask questions and help learners to interpret the representation observed through questions.

In engineering field today, a noticeable variety of educational resources have advanced and have had vital impact on the advancement of the nation's educational practices; all these are directed at improving the quality of instruction, teachers performance in classroom and the learning provided for the students. One of the ways of achieving the identified aim is through the proper utilization of model, real objects wherever available and a large variety of audio-visual resources. Studies have revealed that the use of models in teaching have positive impacts on students' achievement (Sarac, 2018). The best way to bring about a change in methods of teaching a subject is to demonstrate through experimentation and empirical evidences that such approach can produce positive learning outcomes more than the conventional approach.

Statement of the problem

Studies have revealed that low enrollment and poor academic achievement of ED students in SSSCE examination is attributed to lack of tools, instructional resources, lateness to class, lack of drawing equipment and material, students not doing homework, lack of sufficient motivation, and inadequate experienced teachers (Ndashiru, 2023). WAEC, on the other hand, attributed the problem to the use of outdated strategies and techniques in teaching the subject (WAEC Examiners Report, 2016). All efforts to shift away from these antiquated and practices, the Educational sector has been prompted to advocate for stimulating, issue-based, innovative approaches and techniques such as the integration of models, field trips and real objects into ED teaching. However, a significant number of ED teachers still adhere to conventional methods. This is an indication that these innovative strategies and techniques have not been accepted by vocational and technical teachers as a better method of teaching compared to the traditional method, both for attaining better achievement in ED and for bridging ability level of the students. Therefore, the problem of this study posed as a question is: How would the use of instructional models in teaching affect learners' achievement and their ability in ED?

Aim and objective of the study

The aim of this study is to investigate the effect of instructional Model on learners' academic achievement and their ability level in ED. Specifically, the study:
1. Determined the mean academic achievement scores of students taught using the model and those learners taught with the conventional method (without models).
2. Determined the mean academic achievement scores of high and low ability learners taught with instructional model and conventional method (without models).

Research questions

1. What is the effect of using instructional models and conventional method in teaching ED on learners' mean academic achievement scores in the subject?
2. What is effect of using Instructional models and conventional method in teaching ED on the mean academic achievement scores of the high low ability learners?

Hypotheses

The following hypotheses were tested .at .05 level of significance.
1. There is no significant difference between the mean academic achievement scores of learners taught ED with instructional models and those taught with conventional method.
2. There is no significant mean difference between the mean academic achievement scores of high level ability learners and low level ability learners taught ED with instructional models.

Theoretical framework

The theoretical framework for this study is based on the Piaget, Bandura and Experimental learning theories. These theories review the manner in which learners react to the stimuli from his external environment and see learning as a matter of establishing or changing an association between the learner’s responses and the stimuli that is impeded on him.

The Piaget Theory of 1962 stated that imitative behaviour is related to the cognitive structure of the organism. The theory asserts that a child will be able to imitate behaviour, which can be assimilated to the existing structure or schemes. Thus imitation will take place to the extent that the behaviour display by a model falls within the range of the observer’s level of operative knowledge (Oyenuga, 2010). According to Piaget, two conditions are necessary for imitation to occur namely-the model behaviour must be assimilated to the currently available schemes and the scheme must be capable of differentiation (accommodation) when confronted with the experimental data. The superiority of modeling over other techniques of improving on intelligence was supported by Piaget’s (1969) assertions that imitative learning is very crucial process in mental development. The theory believed that one of the methods of learning a prescribed behaviour is imitative learning or model. Instructional model is a process of observational learning in which the behaviour of an individual or group (model), act as stimulus for the thought or attitude of another individual who is the observer, who observes the model performances (Kanfer and Goldstein 1975 cited in Oyenuga, 2010). Kenry (2021) Stated that Observational learning describes the process of learning by watching others or objects, retaining the information, and then later replicating the behaviors that were observed. It plays an important role in the socialization process. Children learn how to behave and respond to others by observing how their parent(s) and/or caregivers interact with other people. Thus, the behaviour exhibited by students in observing the performances of the instructional model is primarily controlled by external stimuli in the classroom behaviour. This is often shaped by the different stimuli or events that occur in the classroom and those stimuli act as reinforcement. According to Obeka (1998), if real life operations and situations are practiced through group work simulation experience, the learners can operate and comprehend the situations and concepts easily, if confronted with such similar situations in future.

The requirement for learning with instructional model is by observing such instructional model. The observer acquired the response of a model through what Bandura (1977) called cognitive coding of the observed event. The performance of a learned response may depend on response consequences or incentives associated with that response. Bandura highlighted some processes of the use of instructional models. (i) Attention process: - This is dependent upon the use of models stimuli and the characteristics of the observer to regulate the sensory registration of the actions modeled. (ii) Retention processes:- This process govern how well the use of models actions are converted and stored cognitively by the client for use as future guides for behaviour. Akinade and Adedipe (1994), cited in Oyenuga (2010), pointed out that learning take place when using instructional models in the two phases-acquisition and performance. Acquisition is the first stage in which action of the instructional model is initially acquired by the observer. The observer acquires images and representations of the instructional model behaviour, which is then stored in the memory. Bandura reported that acquisition phase is dependent on three conditions: (a) Model's characteristics which involve similarity between the model and the observer for learning to occur. (b) Observers characteristics which include crucial degree of anxiety, uncertainty, personality attributes, cognitive abilities as well as his/her perceptual capacities and (c) Models presentation characteristics which are the newness or uniqueness, whether desirable or not, whether hostile or aggressive or likeable are factors in the models' presentation. Other factor is the frequency of the presentation, which psychologist has said that the more frequent, the better are the chances of learning to take place. The performance phase is when the observers now re-enact the observed behaviour in a similar way like that of the model. In the case of Engineering Drawing, the students have to perform the operation as done by the teacher/instructor in a similar way. However, the use of model may be one of the most effective strategies for teaching and learning in Engineering. This will involve the teacher to first demonstrate the activities and then rewarding the students for their good responses. This is one of the ways of bringing learning closer to the students and eventually learning may take place successfully. This behaviour would attract the students to the activity and as well arouse their interest in Engineering Drawing.

Experiential learning introduced by David Kolb (Kolb, 1984) is a constructivist learning theory defined as 'learning by doing' that allows learners to learn through direct experience. The learner is an active participant in the educational process, and learning is achieved through a continuous cycle of inquiry, reflection, analysis and synthesis (Bartle, 2015). It involves four stages: concrete experience, observational reflection, abstract conceptualization, and active experimentation. The Experiential Learning method is relevant as it allows learners to learn to be more focused on practice (Morris, 2020). This approach improves learners' technical skills and helps them develop a more holistic understanding of the overall process of mechanical design and production. This approach allows students to develop practical skills through hands-on experience, deepening their understanding of the material being taught (Butler, 2022; Murakami & Lehrer, 2022; O'Brien et al., 2021). In the ED course, the use of Experiential Learning methods can have significant impact on learners. Learners can learn to draw objects through authentic projects that require the application of theoretical concepts, assisting them to develop technical skills and analytical abilities more effectively (Benavente et al., 2020; Mc Pherson-Geyser et al., 2020).

Research methods

The study is a 2 x 2 factorial design which involved establishing the effect of using instructional model as a strategy for teaching ED, on students' academic achievement in ED at the Senior Secondary School (SSS) level. The study assigned 89 students (45 males and 44 females) in their intact classes to experimental and control groups. There were 45 participants in the experimental group while there were 44 participants in control group, in which models were utilized in teaching the experimental group while conventional method was used in teaching control group. The sample size of 89 was obtained because the students offering ED at SSS are few in number. The moderating variable is ability level (high and low), the dependent variable is academic achievement while the independent variables are instructional model and traditional methods of teaching. The students 2018/2019 sessional results in their various schools were used to group students into high and low ability levels and the students that scored 50% and above were grouped as high ability (achiever) students, while those that scored less than 50% were grouped as low ability (achiever) students. The two treatment groups as defined by the two different modes of teaching are Experimental (use of instructional

model) and Control (use of traditional method) groups. The design is symbolically represented as follows:
O_1 x O_2
O_1 – O_2
Where O_1 = the pretest, x = the treatment, O_2 = the posttest and **--** = conventional method.

The study was carried out using only public SSS that prepare students for Senior Secondary School Certificate Examination (SSSCE). The participants included all the SSS II students in public secondary schools. The sample was made up of two intact classes of all SSS II ED students. Eighty-nine students were drawn from the overall population using simple random sampling technique. The two intact classes were assigned to treatment and control groups through balloting. The lesson plan on instructional model prepared by the researchers assisted the experimental group for ease of understanding during the teaching and learning session. The 3D model shapes were developed using local materials such as special adhesive, straw board and modeling paper of different colors. The objects formed using the materials include square, rectangle, trapezium, pyramid, tetrahedron, cone, cylinder, prism, screw and polygon that were used in teaching the experimental group. Instructional model and traditional lesson plans were prepared by researchers from SS II ED curriculum and they covered the topics and instruction objectives. Engineering Drawing Achievement Test (EDAT) (See Appendix) was the instrument used for data collection and the topics on which the test items were based were derived from the SSSCE ED curriculum. The pretest and posttest items of EDAT were developed based on the test blue print table.
The choice of multiple choice questions as measuring instrument is based on the fact that the test can be used to assess various levels of learning outcomes, from basic recall to application, analysis, and evaluation. The items are less susceptible to guessing and typically focused on a relatively general representation of course material, thus increasing the validity of the assessment (Brame, 2013). Most importantly, multiple choice tests are the strongest predictors of overall student performance compared with other forms of assessment instruments and it is easy to produce, score and analyse (Bontis, Hardie, & Serenko, 2009).

Despite these advantages, multiple choice questions create room for guessing and usually a 25 percent chance of getting it correct on a four-answer choice question, it allows the examinees (students) to make an argument for their viewpoint and potentially receive credit for it. There is possible ambiguity in the examinee's interpretation of the item which can result in an "incorrect" response, even if the taker's response is potentially valid. The test is usually not adaptable to measure certain learning outcome such ability to articulate explanation, display thought, furnish information, organize personal thought perform a specific task and provide example, such learning outcomes are better measured by short answer or essay questions or by performance tests. Multiple choice questions are best adapted for testing well-defined or lower-order skills.

The test items and lesson plans were validated by five experts, three from Industrial and Technology Education, one from Educational Technology and one from measurement and evaluation. Based on experts' suggestions, the test items were screened and revised by the researchers. These items then served as temporary ED achievement test used for the pilot testing on a sample of 12 students during 2018/2019 academic session. The pilot tryout of EDAT was conducted in schools and area that has similar characteristics with the study schools. A psychometric test analysis was carried out to determine the Difficulty and Discrimination Index of each item in the test. An item is good if it has Difficulty Index ranging from 20 to 80; Discrimination of 0.20 and above and its entire distractor index a negative decimal (Okoro, 1999). The result of the analysis showed that 25 out of 30 items representing a greater percentage of the test items were appropriate in terms of difficulty and discrimination index because their indices were within the range of 0.30 to 0.70. Therefore, 25 items satisfied the difficulty and discrimination indices rules (See Appendix).

The reliability of the instrument was carried out by re-administering it on the same group of students from the pilot school. Data collected were analyzed using Pearson product moment correlation, and Pearson r of 0.67 was obtained, an indication that the instrument is reliable. The regular ED teachers were employed in teaching both experimental group with instructional model lesson plan and the control group with traditional lesson plan (without model) respectively for a period of six weeks. The control group was taught using traditional method of teaching ED. The traditional method involved the use of lecture and demonstration teaching methods.

The achievement test was finally administered as pretest before the commencement of the lesson and posttest after teaching on 89 students from the two schools by the ED regular teachers. The EDAT was scored out of 50 (2 marks each). The teachers were trained on the procedure for conducting the experiment. The trained teachers carried out the teaching and administration of instruments. The experiment was carried out for a period of seven weeks. The data generated in this study was analyzed using mean and standard deviation to answer the research questions while hypotheses were tested with Analysis of Covariance at .05 probability level

Results

Research question 1

What is the effect of using instructional model on learners' academic achievement in ED?

Table I: Mean of pretest and posttest scores of experimental and control groups in the achievement test

Group	N	Pretest	Posttest	
		$\overline{X}$	$\overline{X}$	**Mean Gain**
Experimental (Model	25	22.34	43.56	21.22
Control (Conventional)	24	23.05	35.73	12.68

The data presented in Table I show that the experimental group had a mean score of 22.34 in the pretest and a mean score of 43.56 in the posttest making a pretest, posttest mean gain in experimental group to be 21.22. The control group had a mean score of 23.05 in the pretest and a posttest mean of 35.73 with a pretest, posttest mean gain of 12.68. With this result, the learners in the experimental group performed better in the achievement test than the learners in the control group. Hence, the use of instructional model is more effective than the conventional teaching method on learners' achievement in ED

Research question 2

What is effect of using Instructional models and conventional method in teaching ED on the mean academic achievement scores of the high low ability learners?

Table II: Mean of pretest and posttest scores of high and low level ability students taught ED with the Instructional model and conventional method in the achievement test

	Instructional Model				**Conventional Method**			
Ability level	N	Pretest	Posttest	***Mean Gain*** $\overline{X}$	N	Pretest	Posttest	***Mean Gain*** $\overline{X}$
High	10	28.28	46.62	18.34	09	28.78	40.24	11.46
Low	15	15.32	38.58	23.26	15	15.01	28.64	13.63

Table II shows that high achieving learners taught ED with instructional model had a mean score of 28.28 in the pretest and a mean score of 46.62 in the posttest making a pretest, posttest mean gain of 18.34. Low achieving learners taught ED with instructional model had a mean score of 15.32 in the pretest and a posttest mean of 38.58 with a pretest, posttest mean gain of 23.26. High achieving learners taught with conventional method had a mean score of 28.78 in the pretest and a mean score of 40.24 in the posttest making a pretest, posttest mean gain of low achieving students taught with conventional method to be 11.46. Meanwhile, low achieving students taught ED with conventional method had a mean score of 15.01 in the pretest and a posttest mean of 28.64 with a pretest, posttest mean gain of 13.63. With these results low achieving learners taught ED had higher mean gain scores than High achieving learners in the achievement test. Thus, there is an effect attributable to ability level on the achievement of learners taught ED.

Hypotheses

HO_1: There is no significant difference in the mean achievement scores of students taught ED with instructional mode and those taught with conventional method.

Table III: Summary of analysis of covariance (ANCOVA) for test of significance between the mean scores of experimental and control groups in the achievement test

Source	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Corrected Model	36.781[a]	2	18.328	10.349	.001
Intercept	524.643	1	524.643	300.435	.000
Pretest	22.460	1	22.460	8.340	.007
Ability Level	5.671	1	5.671	3.734	.003
Error	72.567	45	2.932		
Total	26455.352	46			
Corrected Total	108.207	48			

***Significant at sig of F< .05**

Table III shows that F-calculated value for achievement is 3.734 with a significance of F at .003 which is lower than .05. Hence, the null hypothesis is therefore rejected at .05 level of significance. With this result there is significant difference between the mean achievement scores of learners taught with instructional model and those taught conventional method.

HO_2: There is no significant mean difference in the achievement scores of high level ability students and low level ability students taught ED with instructional model.

Table IV: Summary of analysis of covariance (ANCOVA) for test of significance between the mean achievement scores of high ability students and low ability students taught ED with instructional model

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	26.683[a]	2	13.342	8.373	.001
Intercept	631.774	1	631.774	396.499	.000
Pretest	14.925	1	14.925	9.367	.004
Ability Level	4.335	1	4.335	3.025	.121
Error	63.735	40	1.593		
Total	26716.000	43			
Corrected Total	90.419	42			

***Significant at sig of F< .05**

Table IV shows that F-calculated value for ability level is 3.025 with a significance of F at .107 which is greater than .05. Hence, the null hypothesis is therefore accepted at .05 level of significance. With this result there is no significant difference between the mean achievement scores of high-level ability learners and low level ability learners taught ED with instructional model.

Discussion of results

The data presented in Table I provided answer to research question one, finding revealed that the main effect of instructional model on students' achievement in ED is higher than the main effect of the students taught without models (conventional method only). Furthermore, analysis of covariance was used to test the first hypothesis, Table III, at the calculated F-value (3.734), Significance of F (.003) and confidence level of .05, there was a statistically significant difference between the main effect of (instructional model and conventional method) on students achievement in ED confirming that the difference between the main effect of instructional model and conventional method was statistically significant. The implication of this finding is that the use of instructional model is more effective than conventional method only (without the instructional models) in enhancing learners' achievement in ED. The findings that instructional model has positive effect on students achievement is similar to the finding of Anikweze (1988), who stated that the use of model was effective in geography lesson compared to the conventional teaching method. In a similar vein, Gambari (2010) carried out a study on the effect of model on student achievement in geometry and found out that instructional model is effective in enhancing students achievement in geometry. Basham (2007) noted that instructional models in three-dimension have significant communication advantages by representing object more realistically. Ishiaku (2021) conducted a similar study on the effect of petrol engine model on academic achievement and interest of motor vehicle mechanics students and discovered that constructed petrol engine model is effective in improving academic achievement of students in motor vehicle mechanics. Oyenuga (2010) also discovered in his study that using model has a significant effect on the academic achievement of students in auto-mechanic work. Cakir (2017) also conducted a metal–analysis study on the effect of 5E learning models on academic achievement, attitude and science process skills and discovered that the method applied for each dependent variable was found to favour experimental group. A comparison of the spread of their scores also shows that the model produced achievement with the least variability. A possible explanation for the effectiveness of the instructional model is opportunity provided for the learner to interact with the model. In learning, providing opportunities to interact with course material through the use of interactive materials tends to change the course from teacher-centred approach to one that is more student-centred, and focused on the cognitive development and construction of knowledge in the students (Sund & Trawbridge, 1993). Hence, one means of constructing knowledge is to create meaning by doing and interacting. Creating support for knowledge construction within the students is a critical component to the success of developing self-motivated, intellectually stimulated learners. In addition, Toma and Neculai (2017) advocated for student-centred learning innovative strategies such as the use of models in teaching technical drawing. Student-centred education philosophy is that teachers, students and institutions need to reflect constantly on systems of teaching, learning and infrastructure in a manner that would continuously improve the learning experience of students and to ensure obtaining the required learning outcomes of a particular course or programme component in a manner that stimulates critical thinking of learners and develop their transferable skills. This should be characterized by innovative methods of teaching aiming at promoting learning through communication with teachers and other students involved in the learning process (Toma & Neculai, 2017). Similarly**,** Ridhollah, Arwizet and Yolli (2024) explored the implementation of experiential learning to improve students' understanding and skills in mechanical drawing using CAD software. The results show that this approach is effective in improving students' understanding of detailed drawings and practical skills. The implementation of Experiential Learning also improved students' cognitive learning outcomes and psychomotor skills in mechanical drawing. The findings highlight the importance of adaptive and technological approaches to engineering education that are aligned with modern industry needs.

The data presented in Table II provided answer to research question two. Findings revealed that learners with low level ability had a higher mean gain score than students with high level ability in the achievement test. In the same vein, Analysis of covariance was employed to test the second hypothesis, Table IV, at the calculated F- value (3.025), significance of F (.121) and confidence level of .05; there was a significant mean difference in the achievement scores of high level ability students and low level ability students. This finding compared favourably with the findings of a research conducted in Los Angel, United State of America by Mac Iver (1988). Mac Iver (1988) based on stratification of pupils ability conducted a study on pupils who enrolled in Junior High school mathematics, using multiple regression analysis, found out that ability group types were significantly associated with task structure, grade dispersion and talent dispersion. Gambari (2010) also conducted a study on the effect of instructional model junior secondary school ability level in geometry and discovered that instructional model enhanced the ability of the students in geometry. In a study on comparative effects of two and three dimensional techniques of AutoCAD on spatial ability, interest and achievement of national diploma students in engineering graphics, Jimoh (2010) asserted that 3D AutoCAD technique improved student spatial ability more than those that were taught using 2D techniques. In contrast to this findings, Oyenuga (2010) discovered that Ability level has no effect on the academic achievement of students in auto-mechanic work. Model as instructional material if properly used, has positive and significance effects on student learning outcomes (Kohut, 2017), especially the low achieving students. Selvi, Chandramohan, Elangovan and Ganesh (2019**)** examined the advantages of adopting model – based teaching and learning for the course, Engineering Drawing for first year engineering students. The results revealed that using models had a significant impact on the academic achievement of the students. Based on their performance in the continuous assessment, it was concluded that models were very helpful in improving the marks, and played an effective role in the comprehension of concepts

Conclusion

The quality of teaching and learning impacts educational outcomes, including students' academic achievement, social, and emotional development. Model is an operationally conceivable strategy for teaching ED at the SSS level and models as instructional tools could be effectively used to achieve instructional objectives in ED at the SSS level. Findings in this study show that while each splendid student would profit considerably when approached with conceptual models, the low achiever will benefit more if the learning atmosphere is relaxed and interesting through the use of instructional materials such as models and real object. In addition, the impact which this innovative technique had on the achievement scores of the experimental subjects indicate that they are capable of ushering in a 'shadow of life' to ED as a school subject.

Based on the findings of this study, suggestions were made that:

1. Engineering Drawing Teachers should embrace the use of models in teaching to involve learners in decision making activities which impacts numerous patterns of human exercises and make ED lesson available in secondary school.
2. To appropriately receive the rewards using models, ability grouping of classes is suggested so that teachers can approach each group according to its degree of intellectual abilities. This will provide opportunities for the weak students to actively participate and cultivate good leadership and followership attributes through helpful comments from

among scholarly equivalent, rather than being submerged under superior thought processes of the brilliant learners. This will likewise allow both the brilliant learners and the average ones to move along at their own rates.

3. Engineering Drawing teachers should look for ways of operationalizing the use of models and Examination bodies should also include it in the SSS Certificate examination to clearly demand for learning acquired from participating in the use of models in teaching ED.

4. Students should also be encouraged to produce models as this will help in moving them closer to the understanding of the concept to be taught and make learning of ED more concrete.

5. Government should make available various models of 3D for effective teaching and learning of ED in the classroom

6. The use of Instructional models in other fields of study such as environmental, engineering, sciences should be encouraged in order to enhance students learning outcomes

7. The study can also be replicated in other regions and countries for effective teaching of technical and related courses

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APPENDIX
ENGINEERING DRAWING ACHIEVEMENT TEST (EDAT)

Name of School:
Class: SSS II
Time Allowed: 25 minutes
Instruction: Answer all questions
Each question is followed by four options lettered A – D. Identify the correct option for each question and tick (√) on the letter that bears the same answer as the option you have chosen.

1. A tetrahedron has four equal ____ faces
A. Square
B. Rectangular
C. Triangular
D. None of the above
2. The internal angle of regular hexagon is ___ degree.
A. 72
B. 108
C. 120
D. 150
3. The side view of an object is drawn in
A. Vertical plane
B. Horizontal plane
C. Profile plane
D. Any of the above
4. In first angle projection method, object is assumed to be placed in
A. First quadrant
B. Second quadrant
C. Third Quadrant
D. Fourth quadrant
5. The internal angle of regular pentagon is ___ degree.

A. 72
B. 108
C. 120
D. 150
6. A point ‘P’ is above Horizontal Plane (HP) and in front of Vertical Plane (VP). The point is in
A. First quadrant
B. Second quadrant
C. Third quadrant
D. Fourth quadrant
7. When the line is parallel to both Horizontal Plane (HP) and Vertical Plane (VP), we can get its true length in
A. Front view
B. Top view
C. Both ‘a’ and ‘b’
D. Side view
8. The front view of a rectangle, when its plane is parallel to HP and perpendicular to VP, is
A. Rectangle
B. Square
C. Line
D. Point
9. The following are the Solids of revolution except
A. Prism
B. Sphere
C. Cone
D. Cylinder
10. The top view of a right cylinder resting on HP on its base rim is
A. Ellipse
B. Circle
C. Rectangle
D. Square
11. Which of the following position is not possible for a plane?
A. Perpendicular to both HP and VP
B. Parallel to both HP and VP
C. Perpendicular to HP and parallel to VP
D. Perpendicular to VP and parallel to HP
12-The following is formed by revolving rectangle about one of its sides which remains fixed

A. Cylinder

B. Sphere

C. Hemi sphere

D. Cone

13. The following are the Polyhedron except

A. Prism

B. Pyramid

C. Cube

D. Cylinder

14. The following are the Solids of revolution except

A. Prism

B. Sphere

C. Cone

D. Cylinder

15. The following is formed by revolving rectangle about one of its sides which remains fixed

A. Cylinder
B. Sphere
C. Hemi sphere
D. Cone

16. The commands Erase, Copy, Mirror, Trim, Extend, Break etc belongs to which tool bar?

A Layer tool bar
B. Style tool bar
C. Modify tool bar
D. Draw tool bar

17. For a Whitworth external thread the distance between the crest and root (d) is ____ when pitch (p) is given.

A. d= 0.75 p
B. d= 0.5 p
C. d= 0.61 p
D. d= 0.64 p

18. The command which identifies the points on drawing entities that are visible on screen is ________ and this option allows the user to pick-up the points very accurately with respect to drawing displayed.

A. OSNAP
B. TABSURF
C. SNAP
D. GRID

19. Flank is a ___________
A. line
B. point
C. distance
D. surface
20. IS 11065: Part 2: 1985 is standard for ___________________________
A. di-metric projection
B. isometric projection
C. orthographic projection
D. sizes and layout of drawing sheets
21. IS 10711: 2001/ISO 5457: 1999 is standard for________________________
A. scales for use in technical drawings
B. folding of drawing prints
C. sizes and Layout of Drawing Sheets
D. axonometric projection
22. When a double –threaded screw is made to turn 120 degrees about axis. How much the screw advances through axis?
A. ⅓ of pitch of helix
B. ⅓ of pitch of screw
C. ¼ of pitch of helix
D. The advancement is equal to pitch of helix.
23. A triple-threaded screw advances _________ times of its pitch of screw for one complete rotation.
A. 6
B. 2
C. 3
D. 4
24. The command which is used to set the viewpoint in 3D space for viewing the 3D models is ______________
A. 3DFACE
B. VPOINT
C. UCS
D. ELEV
25. The command which is used to set elevation and thickness properties for 2D wireframe objects such as line, point, circle, polygon, arc is _____________
A. 3DFACE
B. VPOINT
C. UCS
D. ELEV

MARKING SCHEME

1. C
2. C
3. C
4. A
5. B
6. A
7. C
8. C
9. A
10. B
11. C
12. A
13. A
14. A
15. B
16 C.
17. D
18. A
19 C
20 A
21. C
22. B
23 A
24 B
25. D

Improvement carried out

Methodological Rigor

On sample size

The sample size was increased to 89 and justification for the sample size was also included in the work.

On Experimental setup

A duration of seven weeks which includes the training period for the teachers, teaching period and administration of the instrument was discussed in the work. The names of all the instructional models such trapezium, cylinders, rectangular block, pyramid, polygon, etc. used in the experiment were mentioned

Clarity and Structure

Some of the sentences and phrases were restructured or rephrased for clarity purpose and languages were streamlined with relevant pedagogical theories

The summary was included in abstract and implications such of the findings such as were discussed in the conclusion

Theoretical and Practical Implications

Experiential learning theory by David Kolb of 1984 was used to beef up the the theoretical framework as suggested by the reviewers.

The discussion of findings was improved upon, discissions were made with reference to mechanical engineering and mechnical drawing. The relevance of the findings to other fields such as engineering, environmental studies and sciences and regions were discussed in the conclusion and recommendations.