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Instructional Model for Teaching Metalwork Trades in Technology-based Education: An Empirical Evidence from Nigeria

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Abstract

The complicity of teaching technical skills requires teachers to devise a new skill teaching procedure. Developing technical skills requires the adoption of an interactive teaching procedure with emphasis on the psychomotor domain. This study is to develop an instructional model for teaching metalwork trades (MwTs) undergraduate students in technology-based education. The study applies the research and development design by optimizing the experimental subject. The participants were 118 lecturers/instructors and 37 industrial technicians drawn through a purposive sampling procedure. The data for the study was obtained from participants using a well-structured 15-items questionnaire and the hypothesis was tested at a 0.05 level of significance. The reliability of the "Instructional Model for Teaching Metalwork Trades in Technology-based Education (IMTMTTE)" stood at 0.77. Data were analyzed using mean, standard deviation, and independent t-test statistics. The result of the study is in the form of four steps teaching model viz: 1) Task identification 2) Material organization 3) Task performance and 4) Evaluation to enhance the teaching of practical skills in colleges. The model is preferred based on the grand mean values of participants ranging from 3.02 to 4.67 for the 15-items and the t-test analysis, which revealed no significant difference between the mean rating of Lecturers/Instructors and Industrial technicians on their preferred procedure for teaching practical skills in MwTs in technology-based education. This finding offers an interesting insight into the teaching practical skills and it is recommended for implementation in technology-based education.

Keywords: Empirical study, Instructional model, Metalwork trades, Teaching, Technology-based education

Introduction

The teaching engineering trades involve activities that equip learners not only with technical skills (Audu, Kamin, Musta'amal, & Saud, 2014; Council, 2009) but with a broad range of knowledge, skills, and attitudes that are now recognized as indispensable for meaningful participation in work and life (Chijioke, 2013; Cunningham & Kelly, 2017). At all levels of Technical and Vocational Education and Training (TVET), the goal of inculcating practical skills is the same. But, the greatest challenge which teachers have is how to prepare learners for specific jobs or types of work by equipping them with the appropriate practical skills(Chikasanda, Otrel-Cass, & Jones, 2011). Although, engineering trades practical skills can be acquired through a wide range of settings (formal and informal). Prominent among them is the formal setting (Technical colleges or higher institutions such as Universities, polytechnics, and Colleges of education). Conversely, developing psychomotor domain in learners requires that teachers identify the various aspects of practical skills needs and plan instructional procedural activities to achieve the performance objectives required(Romiszowski, 1999; Simpson, 1971). The failure to teach practical skills contents in the TVET curriculum through a scientific instructional model has been fingered as one of the reasons for students' poor competencies in engineering trades and unemployment in Nigeria (Ayonmike & Okeke, 2015; Chijioke, 2013; Onweh & Akpan, 2014).

According to (Dick, Carey, & Carey, 2005) instructional model is a systematic and reflective process of arrangement of resources and procedures for teaching. On the other hand, the model provides guidelines for proposing a new teaching system (Shafique & Mahmood, 2010). Teaching technology-related trades requires teachers to properly plan or follow a laydown guide to carryout instructional activities using available facilities to realize stipulated objectives. (Oziengbe, 2009; Raman & Donnon, 2008) maintained that enshrining teaching guide in course outlines helps to provide uniformity of content for a subject area. Besides, with the authors' years in teaching in schools, observations have shown that a well-planned learning activity could stimulate the development of new educational innovations and assists teachers to develop their capacities to create a conducive environment for teaching(Burgess, van Diggele, Roberts, & Mellis, 2020). It also assist curriculum planners to plan learning activities and content material, which provide a variety of educational experiences to learners (Harris & Hofer, 2011; Kirschner & Van Merriënboer, 2008; Obizoba, 2015).

Due to the high unemployment rate of technology school graduates occasioned by the lack of skills. The need to improve the teaching of practical skills has gained attention. (Kneebone, 2005) suggested that practical skills should be broken down into component knowledge and skill parts well in advance of the teaching session. (George & Doto, 2001; Leppink & van den Heuvel, 2015; Yuan et al., 2014) opined that teachers should restrict the number of skills taught in a teaching session to limit the effects of cognitive overload when learning a new skill. Many motor learning theorists posited the required steps to teach psychomotor skills, it is obvious that these models for teaching skills are not explicit enough, not practicable, and appear inapplicable in teaching metalwork trades (Chijioke, 2013; Nicol & Macfarlane-Dick, 2006). This lacuna might have accounted for the reason why the teaching guide operated by TVET colleges for skilled jobs in Nigeria is said to be adequate for teaching theoretical contents and inadequate for practical skills component (Olaitan, Asogwa, & Abu, 2013). It thus implies that the mere listing of topics to cover without adequately outlining the knowledge (theoretical) and skills (practical) components together with the procedural learning activities or tasks to accomplish could make teachers' approach to the course content coverage and areas of emphasis to varying.

This paper attempt to get the perception of metalwork trades teachers and industrial technicians on the procedure that they would like to follow to teach metalwork trades (MwTs). The guiding research question and hypothesis are as follows:

1. What is the procedure for teaching practical skills in metalwork trades at technology-based education?

Ho_1: There is no significant difference between the mean ratings of Lecturers/Instructors of technology-based education and industrial technicians on the procedure for teaching practical skills in MwTs.

2. Literature Review

2.1. Some designed instructional models for teaching skills

Instructional models are a useful guides in writing learning objectives for psychomotor skills(Baxter & Gray, 2001; Tärnvik, 2007). It enhances the effectiveness of the TVET instruction as it serves as a means of systematizing information, which is contained in an area of knowledge, skill, and attitude, thereby leading to the discovery of unknown facts. There is no one adopted skill teaching taxonomy for use by teachers for schools in Nigeria. However, most teachers in Nigeria follow the observing, imitation, manipulating, performing and perfecting of task model in teaching practical skills. In this model, the sequence of learning skills starts with observing the skill, and then follow by imitating through perfecting. According to (Chijioke, 2013)Garba and Yelamsapplied this model in their separate studies on the development of an instrument for evaluating practical projects in woodworking at the technical level to classify learning objectives and assessment process and on the development of metalwork processes evaluation scheme at the technical level. The authors observed that the teaching model is not explicit on levels of complexities of skills, do not possess all-inclusive applicability in defining psychomotor domains for practical instruction because it does not specify aspects of psychomotor skills of the sequences, which makes it is inapplicable to achieving the goal of technical education at tertiary level in Nigeria.

(Kusumaningrum, Ganefri, & Hidayat, 2015) developed a learning design model to teach production in the context of vocational education and training (VET) to develop learners' knowledge, attitude, and skills in production. The research work adopted the Research and Development design. The findings suggest that the use of the model will help learners develop critical thinking and motivate them to be more active in the production learning process. Although, the model is learner-centered because it focuses on building students' competencies in skills and their entrepreneurship prowess, but does not incorporate how teachers will guide the learner. (Ituma & Twoli, 2015) developed an instructional model to support the teaching of investigative practical work. The authors employed the Design-Based Research (DBR) approach in developing the design process. The testing of this model proved that it was effective in supporting the teaching of practical activities as it provides guiding principles and processes in the organization and development of instructional materials for practical lessons. The model gives a route map to organize the development of instructional materials for use in the learning of practical work making learners and teachers intellectually and physically involved in the learning activities. (Nicholls, Sweet, Muller, & Hyett, 2016) proposed an eleven steps model to teach complex psychomotor skills beginning with task analysis and cognitive load awareness, which means that before the skill teaching session, the knowledge needed to perform the task should be broken down into chunks and the steps to teach each skill chunk itemized to contain no more than seven in any one skill teaching session. The authors believe that psychomotor skills could be taught using different accepted and published teaching models haven't been aware that many disciplines use skill-teaching models with a variable number of skill steps to teach manual tasks. However, they feel that the use of most existing models in teaching skill acquisition and retention may not be good to teach complex skills, in contrast to simple skills. The review showed that scholars do not advocate one particular model as the best for teaching skills but select and modify elements based on the skill required. The review showed similarities in most of the models. Many of them are simply restatements of earlier models using somewhat different terminology with differences in steps. Most of the models reviewed were developed in countries outside Nigeria involving different subjects' areas only a few of them dealt with the psychomotor skills learning model. On this note, one can argue that employing these instructional models in teaching may not apply to Nigeria and metalwork trades.

2.2 Technology-based education practical skill pedagogy

As stated earlier, there is no acceptable practical skills delivery in technology-based education(Lucas, 2014). Adopting change for preparing technology teachers to teach skills is cooperatives as educational standards and objectives are changing with methods of instruction. Educational practitioners agree that teachers cannot teach practical skills if they do not master the sequence of skill teaching(Gleason et al., 2011). Technology-based education teachers wouldn't bridge the gap of practical skills when they do not focus on new techniques ofteaching skills. Although, different countries have attempted to address learners' outcomes through increase training of technical workforce and investment in school facilities and equipment. To achieve the goal of technology-based education, teachers must consider the changing world of work, which places greater emphasis on technical skills(Chappell & Johnston, 2003). This requires teachers to adopt a pedagogical model that is hinged on inductive learning whereby students are first presented with challenges and then learn to address these challenges(Cornelius-White & Harbaugh, 2009). Teachers are aware that their students hold incorrect ideas about technological concepts, and they would like to address these conceptual difficulties in their teaching using active-learning teaching strategies that have been shown to improve student performance and engagement in technology and engineering related trades classrooms(Pelletreau et al., 2018). The innovative potential the study of (Stevens & Galloway, 2017)raises was it ability to develop quantitative models of team dynamics that will allow comparisons in classroom across teachers and students when performing tasks, and training protocols.These authors believethat because skills are hard to teach thereis a need for collaboration of ideas. For instance, it is difficult to understand certain concepts except by teamwork. Education has for long highlighted the importance of practical skills which in itself has demonstrated to predict important educational and employment outcomes(Martin, Maytham, Case, & Fraser, 2005). Thus, engaging in collaborative learning opportunities with fellow students can give a lasting impact on individual student learning. The pedagogical of teaching practical skills in technology-based education should provide different ways that support triangulation of skills, a task should provide sufficient challenge to learners, it should include the task that establishes real-world problem contexts and task should strive to make students reasoning and thinking visible.

3. Method

3.1. **Research design**

This study adopted the research and development (R&D) strategy. The R & D approach employs research findings to design new procedures of a system, followed by testing and evaluating of the procedures to meet the standard for use (Gall, Gall, & Borg, 2007; Putra, 2012). The subjects in this study are metalwork trades experts. The data include questionnaire based on the 4-D model of {1} Task identification {2} Material organization {3} Task performance and {4} Evaluation. However, in this preliminary study, the study was limited to only the design phase.

3.2. Participants

Participants were experts in technology-based education in the formal and informal settings in Nigeria. Lecturers/instructors of technology-based education and industrial technicians were the elements enrolled in the study. About the Lecturers/Instructors participants, the highest frequency of 109 representing 92.37% is male, while the lowest frequency of 9 representing 7.63% is female. About half of the Lecturers/Instructors (49.15%) are between the ages of 25-35years of age, while 20.34% are of 46years and above. Based on working experience, 47 of them representing 39.83% have been working between 7-12years. Regarding Lecturers/Instructors' educational qualifications, 67(56.78%) have HND/B.Sc/B.Ed/B.Engr, 43(36.44% have M.Sc/M.Engr and 8(6.78%) holds Ph.D. degree. Also, the demography of Industrial technicians shows that 35 of them (94.59%) are male, while 2(5.41%) are female. Based on age, 32(62.16%) fell between 36 - 45years of age, while 5(13.51%) are from 46years and above. Regarding working experience, 21(56.76%) have 7 - 12 years of working experience. Finally, in terms of educational qualifications, 18(48.65%) have OND/NCE, 14(37.84%) hold HND/B.Sc/B.Ed/B,Engr, 3(8.11%) holds NTC/ANTC and only 2 representing 5.41% have M.Sc/M.Engr degree. The study was approved by ten colleges of education offering a TVET programmes except for two colleges that did not turn in their approval due to internal crises. As a result, participants were fully aware of the purpose of this research and were interested in the outcome.

3.3. Data collection tools

A well-structured 15-items research questionnaire was the instrument tittled "Instructional Model for Teaching Metalwork Trades in Technology-based Education (IMTMTTE)" used to collect data for the quantitative study in response to the research question: *What is the procedure for teaching practical skills in MwTs in Nigeria colleges of education?* The constructs were arrived at after thorough analysis of the NCE (Technical) course content for metalwork technology as contained in the NCCE minimum standard (2012 revised) and the gathering of information from related kinds of literature in this course area. The instrument was subjected to a face, content and construct validity by giving the instruments to three experts to ascertain the appropriateness and suitability of the items. It is their amendments and suggestions that resulted in the final draft of the instruments. The instrument was divided into two sections (A and B). A collected data of the respondents such as the name of the organization, gender, qualification among others. B has 12-items that collected data on the preferred order respondents would like to teach MwTs based on a four-point Likert scale. To determine the reliability of the instrument, it was administered to ten lecturers/instructors and five industrial technicians who are part of the population but are not part of the sample frame of the study. The Cronbach alpha reliability method was adopted to determine the internal consistency of the instrument and a reliability coefficient of 0.77 was obtained.

3.4Data analysis

The data generated from the questionnaire were analyzed in line with the research question and hypothesis formulated for the study. This was done descriptively using mean and standard deviation to answer the research questions. For a decision to be taken, the cut-off point of 2.50 was adopted with respect to the mean scores. This follows that any item with a mean below 2.50 was rejected indicating that the respondents disagreed with the items while those of 2.50 and above were regarded as accepted indicating that the respondents agreed to the items. However, the hypothesis will be analyzed using inferential statistics (Independent sample t-test) to determine the mean differences of the groups at 0.05 level of significance using the Statistical Package for Social Sciences (SPSS) version.

Results

The summary of the analysis are presented in Table 1 below

Research Question: What is the procedure for teaching practical skills in metalwork trades at technology-based education?

Table 1: Mean and Standard deviation analysis of perceived procedure for teaching practical skills in metalwork trades between Lecturers/Instructors and Industrial technicians(Ind.Tec .).

		Lecturers		Ind. Tech.			
		$\bar{X}_1$	σ_1	$\bar{X}_2$	σ_2	Grand	
S/n	**Item statement**	$N_1 = 118$		$N_2 = 37$		**Mean**	**Rmks**
	a. Task identification						
1.	List the main and sub-task to be perform	4.98	.21	4.14	.25	4.56	Agree
2.	Conduct analysis of the task to be taught	4.76	.19	4.55	.22	4.67	Agree
	b. Material organization						
3.	Display all the tools and equipment to be used to teach practical skill before commencing teaching	4.09	.10	3.98	.17	4.04	Agree
4.	Display the real object, video or picture showing the practical skill to be learnt	4.33	.11	4.91	.18	4.62	Agree
	c. Task performance						
5.	Demonstrates the individual and entire skill from the beginning to end without interruption	4.77	.26	4.03	.16	4.40	Agree
6.	Repeats the procedure whilst explaining each step and answering questions from students	4.01	.18	4.68	.12	4.35	Agree
7.	Link the current activities to previous knowledge and real life	4.21	.28	4.66	.22	4.44	Agree
	d. Evaluation						
8.	Allows learners to describe the steps involve in performing skill	3.88	.10	4.51	.16	4.20	Agree

9. Allows learners to practice the skill individually or in a group	3.00	.17	3.03	.20	3.02	Agree
10. Allows students to identify and correct their own mistakes under limited supervision	2.35	.19	4.00	.21	3.18	Agree
11. Allows students to use their own technique to solve problems after mastery has been achieved	3.15	.29	3.00	.11	3.08	Agree
12. Guide students to link the skills to real life situation	3.49	.05	4.89	.13	4.19	Agree
13. Correct errors and explain changes that must be made in learning the skill	4.01	.09	4.13	.20	4.07	Agree
14. Interrupt and correct the wrong learning behaviors during skill practice to prevent mastery of the wrong techniques	3.20	.49	3.16	.38	3.18	Agree
15. End practice sessions on a correct performance or demonstration of the skill	3.79	.33	3.88	.41	3.84	Agree
Cluster mean = 3.99						

Notation:

$\bar{X}_1$ = *Mean responses of Lecturers/Instructors,* N_1 = *Number of Lecturers/Instructors,* σ_1 = *Standard deviation of Lecturers/Instructors.* X_2 = *Mean responses of Industrial technicians,* N_2 = *Number of Industrial technicians,* σ_2 = *Standard Deviation of Industrial technicians.* ***Rmks*** *= Remarks.*

The results presented in Table 1 above show the opinion of MwTs lecturers on the procedure they would be used in teaching MwTs in technology-based education in Nigeria. All the items (1-12) have grand mean values for the 15-items ranging from 3.02 to 4.67 with a cluster mean score of 3.99. These mean scores reveal that participants are of the view that they will list the main and sub-task to be performed and conduct analysis of the task to be taught under task identification, display tools/equipment and machines, provide learning materials, name all the instruments and materials needed to teach the skill and display real objects, videos or pictures showing the practical skills to be learned under material organization. during task performance, demonstrate all the steps involve in carrying out the task from beginning to the end, link the current activities to previous knowledge and real-life situation, repeat the procedure while explaining each step and correct wrong learning behaviour during skill practice to prevent mastering of the wrong techniques and find out if the new skill(s) learned led to the development of a new idea, allow learners to describe the steps involved in performing the skill(s), guide learners to link the skills to a real-life situation, allow learners to practice the skill(s) individually and in group and correct errors and explain changes that must be made in learning the skills.

4.2 Hypothesis: There is no significant difference between the mean ratings of Lecturers/Instructors of technology-based education and industrial technicians on the procedure for teaching practical skills in MwTs.

Table 2: Independent t-test analysis of the responses of Lecturers/Instructors and industrial technicians on the procedure for teaching practical skills in MwTs in technology-based education.

S/n	Item statement	Lecturers $\bar{X}_1$	σ_1	Ind. Tech. $\bar{X}_2$	σ_2	t-cal	Rmks
		$N_1 = 118$		$N_2 = 37$			
	a. Task identification						
1.	List the main and sub-task to be perform	4.98	.21	4.14	.25	.19	Not Sig.
2.	Conduct analysis of the task to be taught	4.76	.19	4.55	.22	.33	Not Sig.
	b. Material organization						
3.	Display all the tools and equipment to be used to teach practical skill before commencing teaching	4.09	.10	3.98	.17	1.01	Not Sig.
4.	Display the real object, video or picture showing the practical skill to be learnt	4.33	.11	4.91	.18	.97	Not Sig.
	c. Task performance						
5.	Demonstrates the individual and entire skill from the beginning to end without interruption	4.77	.26	4.03	.16	1.08	Not Sig.
6.	Repeats the procedure whilst explaining each step and answering questions from students	4.01	.18	4.68	.12	.44	Not Sig.
7.	Link the current activities to previous knowledge and real life	4.21	.28	4.66	.22	1.00	Not Sig.
	d. Evaluation						
8.	Allows learners to describe the steps involve in performing skill	3.88	.10	4.51	.16	.68	Not Sig.
9.	Allows learners to practice the skill individually or in a group	3.00	.17	3.03	.20	.91	Not Sig.
10.	Allows students to identify and correct their own mistakes under limited supervision	2.35	.19	4.00	.21	.88	Not Sig.
11.	Allows students to use their own technique to solve problems after mastery has been achieved	3.15	.29	3.00	.11	.49	Not Sig.
12.	Guide students to link the skills to real life situation	3.49	.05	4.89	.13	.91	Not Sig.

13. Correct errors and explain changes that must be made in learning the skill	4.01	.09	4.13	.20	.73	Not Sig.
14. Interrupt and correct the wrong learning behaviors during skill practice to prevent mastery of the wrong techniques	3.20	.49	3.16	.38	.66	Not Sig.
15. End practice sessions on a correct performance or demonstration of the skill	3.79	.33	3.88	.41	1.07	Not Sig.

Not significant at .05 alpha level, df = 153, p-value = 1.96

Notation:
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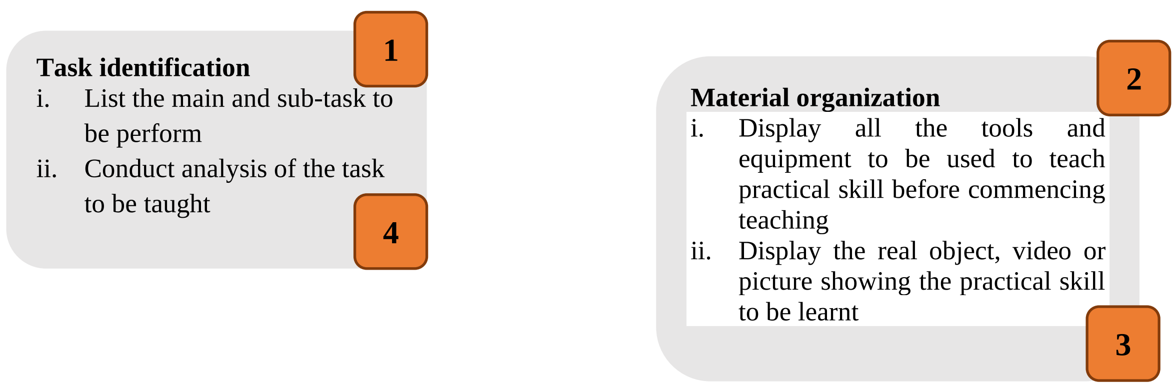
$\bar{X}_1$ = *Mean responses of Lecturers/Instructors,* N_1 = *Number of Lecturers/Instructors,* σ_1 = *Standard deviation of Lecturers/Instructors.* $\bar{X}_2$ = *Mean responses of Industrial technicians,* N_2 = *Number of Industrial technicians,* σ_2 = *Standard Deviation of Industrial technicians.* ***Rmks*** = *Remarks.* ***t-cal*** = *Calculated t-value,* ***Sig*** = *Significant*

The result in Table 2 indicate that the calculated t-values (.19, .33, 1.01, .97, 1.08, .44, 1.00, .68, .91, .88, .49, .91, .73, .66 and 1.07) for all the items measured were less than the critical t-value (1.96) at 0.05 level of significance with 116 degree of freedom for the two-tail test. Thus, the null hypothesis for each of the items was retained. This implied that there was no significant difference between the mean rating of Lecturers/Instructors and industrial technicians on the procedure for teaching practical skills in MwTs in technology-based education

Designing of the practical skills teaching model for MwTs



Evaluation

a) Allows learners to describe the steps involve in performing skill
b) Allows learners to practice the skill individually or in a group
c) Allows students to identify and correct their own mistakes under limited supervision
d) Allows students to use their own technique to solve problems after mastery has been achieved
e) Guide students to link the skills to real life situation
f) Correct errors and explain changes that must be made in learning the skill
g) Interrupt and correct the wrong learning behaviors during skill practice to prevent mastery of the wrong techniques
h) End practice sessions on a correct performance or demonstration of the skill

Task performance

i. Demonstrates the individual and entire skill from the beginning to end without interruption
ii. Repeats the procedure whilst explaining each step and answering questions from students
iii. Link the current activities to previous knowledge and real life

Figure 2: Practical skills teaching sequence for MwTs

Step1: Task identification

In this step, the teacher discovers what to teach and breaks each skill down into smaller, more manageable components based on the learner's capability. The aim is to assist teachers to know how to organize practical skills that are challenging and difficult to understand all at once. In doing this, the teachers identify the prerequisite skills and how much detail the task analysis requires. Instructors then decide on which prerequisite skills that are needed to achieve the main skill. Task identification is important because it helps to individualized teaching of complex skills for different learners in that based on the level of the student, teachers can confirm whether it is important for the teach steps from the last step forward, teach from the first step to the end or teach steps throughout the sequence before putting it all together

Step 2:Material organization

After identifying what practical skills to be taught, teachers should select the materials needed to teach the task. This should be guided by the level of the learner and the resources at the disposal of the teacher. An instructor who wants to teach how to change brake pad mustprovide a real C-clamp, wrench to remove the caliper bolts, a lug wrench, gloves, safety glasses and a new brake pad. This is because technical skills are best taught using real materials in most cases video modeling and pictures can be used to show the real abject. The merit of using authentic teaching material is that it provides a natural learning atmosphere and helps in the active involvement of the learners, teaching, and experiencing process.

Step 3:Task performance

At this stage, the actual teaching commences. This is where the teacher brings his skill to impact knowledge to bear. Teachers should first demonstrate the individual and entire skill from the beginning to end without interruption, repeat the procedure explaining each step, and take questions from students. Then, the current teaching activities should be linked to students' previous knowledge and real-life situation. *This way they can apply the knowledge gained in the classroom to solve real-world problems and be confidence doing it outside the class.*

Step 4: Evaluation

At this stage, students are allowed to perform the skills or teaching activities with the instructor serving as a guide to direct activities. This is the hallmark of practical skill teaching because the students, whom the curriculum is designed for must demonstrate the ability to show that change in behavior has occurred. Otherwise, efforts are wasted. We created more activities for the students because we understand that hands-on activities should emphasize students' involvement in the teaching process to enhance their creativity, innovation, psychomotor competencies, and direct experience. In this step, instructors guide the students individually or in a group as they put to practice what was taught. Instructors correct errors and explain changes that must be made in performing the skill and wrong learning behaviors to prevent mastery of the wrong techniques.

5. Discussion

The findings of this research show that one should follow a scientific procedure when teaching practical skills in MwTs at technology-based education. This finding is in line with the study of (Burgess et al., 2020) on the tips of teaching skills in medical education. The authors found out that the teaching of skills through the use of frameworks, observation and provision of feedback, with opportunities for repeated practice assists in the learners' acquisition, and retention of skills. (George & Doto, 2001)who averred that psychomotor skills should be taught in some kind of organized fashion that will optimize the use of time but produce a satisfactory learning experience for the student. Also, this study agrees with (Nicholls et al., 2016)whose study on the teaching of psychomotor skills in the twenty-first century through the lens of contemporary literature uncovered that contemporary motor learning and cognition literature frames instructional practices in ways that may assist the teaching and learning of complex task-based skills. This result fits with recent attention to the benefit of teaching with the help of models to provide a more realistic experience while teaching/learning technical skills. We tried to make this framework student-centered by increasing the number of activities for students. As a result, students would have more time to practice the skills. This model is however consistent with the popular saying that "practice makes perfect" nor with the result of (Nicholls et al., 2016; Raman & Donnon, 2008) suggested that increasing the number of times of practice will increase students' mastering of skills. We understand that most of the learning activities for typical practical class are traditionally carried out by the instructor: choosing and organizing the content, interpreting and applying the concepts, and evaluating student learning, with the students' focusingmajorly on recording the information.This study concur with those of (Baxter & Gray, 2001; Tärnvik, 2007) that for effective learning of skills it is desirable to move toward a model in which students are actively engaged in the learning process while the teacher acts as a facilitator and does not need to be an expert in the particular content

6. Conclusion and Recommendation

Teaching skills through a scientific learning process is fundamental to technology-based education. Since the ultimate goal of TVET is to equip learners with practical skills, there is a need for a vocational pedagogy in the training curriculum for TVET teachers. Therefore, it is important to design how this can be done effectively as it will offerteachers the opportunity to teach technical skills using a step-by-step structural approach that will improve learners' skills acquisition and retention. This model provides a useful guide as it breaks the teaching of skills into discrete steps with emphasis on learners' activities to bridge the gap between current and desired performance. From the findings, MwTs teachers should apply this model in the teaching of practical skills in colleges.

7. Conflict of interest

The authors declares no conflict of interest

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References

Audu, R., Kamin, Y. B., Musta'amal, A. H. B., & Saud, M. S. B. (2014). Assessment of the teaching methods that influence the acquisition of practical skills. *Asian social science, 10*(21), 35.

Ayonmike, C. S., & Okeke, B. C. (2015). Effects of Teaching Methods on Students' Psychomotor Performance in Brick/block-Laying and Concreting (BBC). *International Journal of Vocational Education & Training, 23*(1).

Baxter, S., & Gray, C. (2001). The application of student-centred learning approaches to clinical education. *International Journal of Language & Communication Disorders, 36*(S1), 396-400.

Burgess, A., van Diggele, C., Roberts, C., & Mellis, C. (2020). Tips for teaching procedural skills. *BMC Medical Education, 20*(2), 1-6.

Chappell, C., & Johnston, R. (2003). *Changing work: Changing roles for vocational education and training teachers and trainers*: National Centre for Vocational Education Research.

Chijioke, O. P. (2013). Appraisal of theoretical models of psychomotor skills and applications to technical vocational education and training (tvet) system in Nigeria. *Journal of Research and Development, 1*(6), 25-35.

Chikasanda, V. K., Otrel-Cass, K., & Jones, A. (2011). Teachers' views about technical education: implications for reforms towards a broad based technology curriculum in Malawi. *International Journal of Technology and Design Education, 21*(3), 363-379.

Cornelius-White, J. H., & Harbaugh, A. P. (2009). *Learner-centered instruction: Building relationships for student success*: Sage publications.

Council, N. R. (2009). *Engineering in K-12 education: Understanding the status and improving the prospects*: National Academies Press.

Cunningham, C. M., & Kelly, G. J. (2017). Epistemic practices of engineering for education. *Science Education, 101*(3), 486-505.

Dick, W., Carey, L., & Carey, J. O. (2005). The systematic design of instruction.

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). Educational research: an introduction (8. utg.). *AE Burvikovs, Red.) USA: Pearson*.

George, J. H., & Doto, F. X. (2001). A simple five-step method for teaching clinical skills. *FAMILY MEDICINE-KANSAS CITY-, 33*(8), 577-578.

Gleason, B. L., Peeters, M. J., Resman-Targoff, B. H., Karr, S., McBane, S., Kelley, K., . . . Denetclaw, T. H. (2011). An active-learning strategies primer for achieving ability-based educational outcomes. *American journal of pharmaceutical education, 75*(9).

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Ituma, M., & Twoli, N. (2015). CHEMISTRY TEACHERS'ROLE IN CHANGING PRACTICAL WORK FROM "HANDS ON" ACTIVITIES TO "MINDS ON" ACTIVITIES. *Building Capacity Through Quality Teacher Education Nairobi, Kenya July 14-16, 2015*, 86.

Kirschner, P., & Van Merriënboer, J. (2008). Ten steps to complex learning a new approach to instruction and instructional design.

Kneebone, R. (2005). Evaluating clinical simulations for learning procedural skills: a theory-based approach. *Academic medicine, 80*(6), 549-553.

Kusumaningrum, I., Ganefri, & Hidayat, H. (2015). Improving Students' Entrepreneurial Interest using Production Based Learning Model in TVET. *Advances in Social Science, Education and Humanities Research, 14*, 69-74.

Leppink, J., & van den Heuvel, A. (2015). The evolution of cognitive load theory and its application to medical education. *Perspectives on medical education, 4*(3), 119-127.

Lucas, A. (2014). Ising formulations of many NP problems. *Frontiers in physics, 2*, 5.

Martin, R., Maytham, B., Case, J., & Fraser, D. (2005). Engineering graduates' perceptions of how well they were prepared for work in industry. *European journal of engineering education, 30*(2), 167-180.

Nicholls, D., Sweet, L., Muller, A., & Hyett, J. (2016). Teaching psychomotor skills in the twenty-first century: revisiting and reviewing instructional approaches through the lens of contemporary literature. *Medical teacher, 38*(10), 1056-1063.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in higher education, 31*(2), 199-218.

Obizoba, C. (2015). Instructional design models--framework for innovative teaching and learning methodologies. *International Journal of Higher Education Management, 2*(1).

Olaitan, S., Asogwa, V., & Abu, M. (2013). Technology competencies required by secondary school graduates in maintenance, servicing and repairing of electronic machines for agribusiness occupations to minimize wastage. *Journal of Development and Agricultural Economics*, *5*(1), 1-6.

Onweh, V. E., & Akpan, U. T. (2014). Instructional strategies and students academic performance in electrical installation in technical colleges in Akwa Ibom State: Instructional skills for structuring appropriate learning experiences for students. *International Journal of Educational Administration and Policy Studies, 6*(5), 80-86.

Oziengbe, V. (2009). Industrializing the Nigerian society through creative skill acquisition vocational and technical education programme. *International NGO Journal, 4*(4), 142-145.

Pelletreau, K. N., Knight, J. K., Lemons, P. P., McCourt, J. S., Merrill, J. E., Nehm, R. H., . . . Smith, M. K. (2018). A faculty professional development model that improves student learning, encourages active-learning instructional practices, and works for faculty at multiple institutions. *CBE—Life Sciences Education*, *17*(2), es5.

Putra, N. (2012). Research & development penelitian dan pengembangan: Suatu pengantar. *Jakarta: Rajawali Pers*.

Raman, M., & Donnon, T. (2008). Procedural skills education–colonoscopy as a model. *Canadian Journal of Gastroenterology, 22*(9), 767-770.

Romiszowski, A. (1999). The development of physical skills: Instruction in the psychomotor domain. *Instructional-design theories and models: A new paradigm of instructional theory, 2*, 457-481.

Shafique, F., & Mahmood, K. (2010). Model development as a research tool: An example of PAK-NISEA. *Library Philosophy and Practice, 2010*, 1-12.

Simpson, E. (1971). Educational objectives in the psychomotor domain. *Behavioral objectives in curriculum development: Selected readings and bibliography, 60*(2), 1-35.

Stevens, R. H., & Galloway, T. L. (2017). Are neurodynamic organizations a fundamental property of teamwork? *Frontiers in Psychology, 8*, 644.

Tärnvik, A. (2007). Revival of the case method: a way to retain student-centred learning in a post-PBL era. *Medical teacher*, *29*(1), e32-e36.

Yuan, H., Young, K. D., Phillips, R., Zotev, V., Misaki, M., & Bodurka, J. (2014). Resting-state functional connectivity modulation and sustained changes after real-time functional magnetic resonance imaging neurofeedback training in depression. *Brain connectivity*, *4*(9), 690-701.