© Universiti Tun Hussein Onn Malaysia Publisher's Office

JTET

http://penerbit.uthm.edu.my/ojs/index.php/jtet
ISSN 2229-8932 e-ISSN 2600-7932

Journal of Technical Education and Training

Developing Framework for Teaching Technical Skills to Metalwork Undergraduates in Vocational-Based Education in Nigeria

Arikpo Sampson Venatius[1]*, Aede Hatib Musta'amal[2], Ogumbe Boniface Ekwok[1]

[1]Department of Technical Education,
Cross River University of Technology, Calabar, NIGERIA

[2]Department of Technical and Engineering Education,
Universiti Teknologi Malaysia (UTM), Johor, MALAYSIA

*Corresponding Author

DOI: https://doi.org/10.30880/jtet.2023.15.02.002
Received 24 November 2022; Accepted 15 May 2023; Available online 21 June 2023

Abstract: The rising prevalence of unemployment and high demands at workplaces require vocational-based education teachers to devise an appropriate practical skills procedure. Teaching through a well-designed instructional procedure that stresses learners' involvement in skill practice is an alternative to cultivating skills. This study proposes a scientific procedure for implementing a vocational-based education curriculum in colleges of education by identifying key activities that lecturers and industrial technicians considered to be important for teaching undergraduate technical skills in Nigeria. There is no accepted framework for teachers to teach skills and evaluate their instruction. Efforts have been made to create such a prospective framework, but none has been put into use (Bannister et al. 2018) because they are poorly understood (Sarker, Vincent, and Darzi 2005). The study utilized the Delphi research strategy to gain consensus about the processes and activities involved in teaching skills. Then, employed the Four D Model (4-D model), which included the steps of Task identification, Material arrangement, Task execution, and Task evaluation, was developed in the research. We test a model of factors predicting the appropriate teaching model. Structural Equation Modeling (SEM) was used to analyze the data. The result revealed the differential effect of the variables considered. However, the activities in each stage were utilized to design the scientific procedure for teaching technical skills in colleges of education. Because learning skills that are shielded in hands-on activities rely upon teaching procedures and skill practice opportunities, we concluded that effectively utilizing this scientific framework in colleges would improve students' practical skills acquisition and make them active in the learning process.

Keywords: Framework for teaching, practical skills, vocational-based education

1. Introduction

Vocational-based Education (V-bE) is an intervention designed to provide learning with technical skills which would make people economically productive (Dike 2009). V-bE pedagogy process emphasizes workshop practices that encourage motor skills to achieve its goals. Activity-based learning exhumes learners' creative experience, which may lead to technical and intellectual knowledge acquisition (Ekong and Ekong 2018) Shift in technological innovations around the world has led to changes in workplaces (Nicholls et al. 2016). These changes heightened interest in three

*Corresponding author: svarikpo@graduate.utm.my

emerging issues. i) The need for a new teaching and learning approach (Rogers et al. 2011; Akpomi and Amesi 2013), ii) the specific skills and capabilities needed to function effectively in the world of work (David and Foray 2003; Willis 2015), and iii) the learning models needed to develop skills and capabilities for teaching technology-related courses (Bannister et al. 2018) because learners require the right teaching assistance to develop their capacity to understand the complex task and their acquisition of technical abilities is not automatic, motor skills must be actively taught, evaluated, and remarked upon (Ajjawi and Smith 2010; Glaeser and Guay 2017).

Research reports like those of (Huitt 2003) laid claims to the fact that the delivery of instruction through the application of a guide is very rewarding. Similarly, (Hidayat et al. 2018) strongly advocated the development and use of models in Technical and Vocational Education and Training (TVET) instructional delivery. Since the teaching of engineering-related courses requires attempts to help learners acquire skills, attitudes, and knowledge through a Practical-Based Learning (PBL) process. A situation whereby teachers effectively involve the learner in a task, which could be driven with direction from the instructor or students-driven, with the learner having the freedom to explore materials (Motschnig-Pitrik and Holzinger 2002) and accounts for the need for teachers to consider learning situations that require the more active involvement of students to process information in multiple ways to be a fruitful and effective learning method for the teaching of practical skills if it is well planned (Boud and Molloy 2013). Scholars cannot dispute the correlation between students' growth of psychomotor skills and learning by doing, which is supported by a successful experimental learning practice directed by an instructional technique. The success of Singapore's educational system serves as evidence, which was reached because teachers adopted the usage of academic frameworks that demonstrate the transmission of factual and procedural knowledge in instruction. (Hogan et al. 2013; Venatius et al. 2020). Besides, teachers must develop a solid knowledge basis, efficient cognitive processes, and the capacity to observe and effectively direct students' thought processes when teaching to teach complicated skills (Ajjawi and Smith 2010).

Metalwork Technology (MT) is an engineering discipline that deals with metal welding, maintenance, and repairs of machines, machine-related equipment, and appliances used in the creation or design of products (Yalams 2001). Welding and fabrication, machine operations, equipment mechanics, mechanical engineering craft practice, foundry craft practice, instrument mechanics, and marine engineering craft are among the topics covered in the courses (Peter, Abiodun, and Jonathan 2010) and when compared to other engineering professions, MT is the most liberal program because it shares concepts and ideas with the majority of engineering fields. (Barrett and Donnelly 2008). The earliest technology involving the manipulation of metals to make specific parts and other objects began in factories in the mid-19th century in the United States American (USA), the 18th century in the United Kingdom (UK), and China. Many nations today have used metalworking technology to progress the planet. (Lee, Bae, and Choi 1988). Mechanical trades' skilled manpower is the indispensable agent of converting other resources to mankind's use and benefits.

We anchor this study to the Experiential Learning Theory (ELT) propounded by John Dewey in 1969. According to Dewey, learning is conceptualized as a process of knowledge modification and re-formation through the continuous reconstruction of experience through connected encounters. It provides a clear image of where knowledge and experience intersect. The ELT paradigm shows two dialectically associated modes of experience grasping (Concrete Experience, CE, and Abstract Conceptualization, AC), as well as two dialectically connected modes of experience transformation (Concrete Experience, CE, and Abstract Conceptualization, AC) (Reflective Observation, RO and Active Experimentation, AE). Learning occurs when these four learning modalities' creative tensions are resolved. The learner "touches all the domains" of experience (CE), reflection (RO), thinking (AC), and acting (AE) in a cyclical process that is responsive to the learning context and what is being learned. This is shown as an idealized learning cycle or spiral. Thoughts and observations are based on recent or genuine experiences. These ideas are absorbed and divided into abstract concepts, which can lead to the emergence of new action implications (Kolb and Kolb 2017; Joy and Kolb 2009). The theory is related to the present study in that, creative and innovative thinking are elements of psychomotor skills learning. The wrong delivery of practical course contents can gear cognitive conflict that may affect students' learning outcomes. During the skills learning process, students are expected to formulate a problem, connect ideas, analyze the problem, and see what happens.

2. Literature Review

2.1 Psychomotor Skill Learning Sequence in Vocational-Based Education

Psychomotor skills are those skills and abilities for performing a technical task that requires a physical component rather than just using the mind to think (Kovács and Dancs 2019). These skills are rooted in vocational education bearing in mind the need for progressive skills development, from apprentice to journeyman and master. The formalization of vocational education is a process that saw the development of several educational taxonomies. All perspectives of existing frameworks for teaching/learning technical skill contents serve as logical and scientific sequences towards enhancing the effectiveness of instruction and as a means of systematizing information in the area of knowledge, skill, and attitude leading to the discovery of unknown facts (Richardson 2005). Based on the field survey we conducted in selected colleges; it was observed that the skill-teaching pattern of vocational-based education is dominantly teacher-centered. i) Students do not have the opportunity to be actively involved in the learning process, ii) teaching is limited to theoretical practice, and iii) there is no clear teaching strategy for affecting practical skills. We found out that using the right teaching approaches might give learners supportive information in the learning of complex skills. In a sequential teaching approach, learners will not be overwhelmed by the complexity of a task as it enables tasks to be taught from easy to difficult. They will have support and guidance when needed and different information will be presented precisely at the right time to learners. (Andreatta and Dougherty 2019), noted that the difficulty for instructors and students is to place student abilities within a procedural context, allowing students to securely pick up new skills while practising what they have already acquired. The briefing-intraoperative-debriefing (BID) model, which they introduced, is based on the Dave taxonomy of the psychomotor domain and enables faculty and trainees to deliberately and cooperatively plan and monitor the cycle of psychomotor acquisition and development of mastery in any surgical context.

Table 1 - Researchers' instructional framework for teaching psychomotor skill

Author	Sequence	Observation
Simpson, 1972	Perception, Set, Guided response, The mechanism, Complex overt responses, Adaptation and Organization	Does not possess all-inclusive applicability in defining the psychomotor domain for TVET Instruction (Yalams 2001).
Dave, 1975	Imitation, Manipulation, Refining, Articulation and Naturalization	Applicable for achieving the goal of vocational at the Pre-vocational training level
Harrow, 1972	Reflex movements, Fundamental Movements, Perception, Physical abilities, Skilled Movements & Non-discursive Communication	The categories are not mutually exclusive. There is some form of overlapping among the categories and subcategories. As a result, it is not comprehensive enough to define psychomotor learning in TVET (Chijioke 2013).
Padelford, 1984	Perceiving, Motivation, Imitating, Performing, Adapting, and Innovating	The model appears comprehensive in stating learning Objectives as it conforms to the requirement of psychomotor behaviour in terms of diversities
Seymour, 1966	Handwork with tools, Single purpose machine, Group purpose machine and non-repetitive work.	The model is based on studying a skill in industrial setup and is inapplicable in the formal TVET system since it is not explicit in the dimension of skills involved in using the tools and machines.

Source: (Chijioke 2013; O'Neill and Murphy 2010)

The researchers' perspectives contribute to the fact that teaching and learning frameworks are necessary to develop psychomotor skills and capabilities of technology-related courses. It is observed that most of these frameworks investigated are not suitable for guiding instructions to train craftsmen at the craft (secondary) and master craftsmen at the advanced crafts (post-secondary) education Excerpt for the Padeford, 1984 framework, which appears compressive in stating learning objectives.

2.2 Technical Skills Teaching Framework Theory

The Instructional Design Theory (IDT) propounded by Robert Gagne in 1965 postulates that knowledge occurs in different learning stages with each classification requiring different types of instruction. It stresses the acquisition of knowledge and skills through the formation of a given learning procedure. IDT contends that learning takes place by doing and teachers' explanations and demonstrations of each concept for students' practice of skills and correct feedback. The theory is relevant to this study in that since this study seeks to develop an instructional procedure, teachers should bear in mind that learning activities connect. Therefore, the psychomotor development of learners should be organized as a build-up from simple to complex and/or known to the unknown. Teachers should organize their behavioural (specific) objectives and teaching materials in a way that the concept in them can easily be acquired and processed by the learners' minds. In acquiring practical skills, (Motowidlo, Borman, and Schmit 2014) observed that experiential learning suggests that current learning builds upon the previous one. Therefore, practical content or topics should be delivered in stages that students can understand and in such a manner that they reinforce each other.

3. Methodology

3.1 Design

A two-category Delphi survey was used in the research to identify the most important components of skill teaching (Keeney, McKenna, and Hasson 2011). A Delphi survey gathers participant opinions in an iterative, multi-stage procedure to produce group consensus. It was adopted by (McGrane et al. 2014; Sole et al. 2019) to achieve agreement among various groups over the best way to teach complicated skills. A Delphi survey has the following advantages relevant to this research study. Employing emails and online questionnaires, preserves participant anonymity, gives them time to think about their responses, and enables the participation of individuals from various geographic areas and academic responsibilities (Wamba and Ngai 2012).

3.2 Participant

The participants were Lecturers and Instructors (n = 24) from twelve Colleges of Education (Technical) and Industrial technicians (n = 18) with at least eight (8) years of training experience from nine mechanical industries involved in the training of technical skills. Lecturers and Instructors (L & I) were considered in this study because they were directly involved in teaching the students and as end-user of the curriculum, we considered them to be in a better position to respond to issues that could influence the effective use of the instructional framework in teaching skill acquisition. Industrial Technicians (IT) were used due to their experiences in the industry as it relates to skills required by trainees and procedures for teaching them. These participants received information about the study through email, along with a link to the survey online. Except for two colleges that did not submit their permission owing to internal issues, the study was accepted by 10 colleges of education that provide TVET programs. Participants were interested in the results since they were completely aware of the study's goal. We utilized SurveyMonkey software to administer online questionnaires (San Mateo, CA, USA). Both respondents (Lecturers and Instructors and Industrial technicians) were recruited using identical methods. Three weeks separated each round of the Delphi survey, each of which included a four-week open period. For each participant, demographic information was gathered, including gender, years of experience in teaching/training, the primary area of practice, highest academic certificate, and present teaching/training position. Codes were used to identify questionnaires, and all information was stored on a computer system that required a password to access it. We analysed the results after downloading them from SurveyMonkey into an Excel file. The use of template analysis, a type of theme analysis in which a coding template is created based on a subset of data and then applied to other data, was made (Brooks et al. 2015). The open-ended responses were read and reread by the researchers, who then classified and synthesized significant traits or objects into themes. The research team met in person to discuss the themes and their important elements or qualities. Themes were generated at the end of the coding exercise and revised at the final stage before reporting. This two-phase model approach was allowed to enrich and further strengthen the study (Clark and Creswell 2014). For each category, demographic information such as age, gender, years of work experience, and highest academic degree was gathered.

24 Lecturers and Instructors and 18 Industrial Technicians participated in the data collection, which represented 38% and 56% of the total number of metalwork teachers and industrial technicians in south-south, Nigeria, respectively. 2 (5.55%) were females and 34 (94.44%) were men. Most of them (85.8%) had years of working experience above 10 years and 14.2% between 8-9 years. 78% were above 38 years of age. Participant qualifications were PhD (11.11%), M.Sc/M. Ed (36.11%), B.Sc/B.Ed/HND (44.44%) and NCE/OND (8.33%). These percentages were proportional to those of the reference population.

3.3 Data Analysis

Confirmatory factor analysis (CFA) was initially performed on each scale. An output covariance matrix was created to run the models. To assess the adequacy of measurement models with limited degrees of freedom, we utilized the Tucker-Lewis index (TLI) and comparative fit index (CFI), which show adequate fit when values are approximately 0.90 or above, which show satisfactory fit when values are around 0.90 or higher (Medsker, Williams, and Holahan 1994; Kenny 2015). Additionally, suitable factor loadings above 0.40 were looked at. The internal consistency was assessed using Cronbach's alpha test. Second, the means, standard deviations, and correlations of the variables were calculated. Then, we first established a structural equation model (SEM) for the entire sample to evaluate the sub-constructs. The covariance matrix values generated for the CFA were utilized to run SEM models utilizing the original scale items as the observed variables. We used the root mean square error of approximation (RMSEA) value, which is an indicator of excellent fit when it is below 0.05, although an RMSEA value of roughly 0.08 or less is also acceptable, the previously mentioned CFI and TLI, as well as the 2 per degrees of freedom (2 /df), which indicates a good fit when the value is equal to or below 3 (Kline 2005). The estimated impacts for male and female teachers were compared using a multiple-group model to determine whether they were similar. To assess measurement invariance for this, changes in fit between the configural, weak invariance, and structural models were looked at. If CFI0.015, the assumption of model invariance was considered a tenable (Chen 2007). However, frequency count, percentage, and mean statistics were used to descriptively assess the quantitative data (see Table 4).

4. Result

The result of the CFA indicates that it fails to agree to the acceptable limits of the goodness of fit with the value of Chi-square (x^2) = 310.002, Df = 106, GFI = .668, CFI = .609, NFI = .589, TLI = .519, IFI = .601, RMSEA = .266, Ratio = X^2/Df = 2,924 and P-value = 000. However, none of these indicators of the standardized estimate fit well with the corresponding data of all the respondents. The factor loadings for the observed variables, 1 = 0.64, 2 = 0.71, 3 = 0.69, 4 = 0.80, 5 = .86, 6 = 0.73, 7 = 0.60, 8 = 0.67, 9 = 0.73, 10 = 0.66, 11 = 0.42 and 12 = .33 indicates that item1 to 10 recorded high factors loading that met the recommended CFA requirement. Therefore, variables with small factor loadings than 0.5 were deleted or trimmed and the CFA was re-run to confirm the suitability of the variables for the modified model of the teaching framework to obtain a good model fit. After that, a multiple-group model was put to the test to see if the predicted effects for lecturers/instructors and industrial technicians were the same. To do this, modifications in fit throughout the changed measurement model were examined to test standardized residual covariance. Most of the standardized residual covariance values were less than two (2) in absolute. According to (Chen 2007), the assumption of the calculated observed variables met the SEM recommended requirements across models and tenable if [RMSEA=0.000, CFI=0.007, CFI=0.007]], which showed that the model is suitable for Lecturers/Instructors and Industrial Technicians in teaching practical skills.

Table 2 - Residual covariance of the initial measurement model of the instructional framework (TFk) for teaching technical skills

	IFk12	IFk11	IFk10	IFk9	IFk8	IFk7	IFk6	IFk5	IFk4	IFk3	IFk2	IFk1
IFk12	.112											
IFk11	-.331	.090										
IFk10	1.099	.811	.201									
IFk9	-306	-.209	.111	.701								
IFk8	2.911	.104	.505	.383	.018							
IFk7	.992	.574	-.810	.081	.438	.657						
IFk6	.819	.472	-.991	.409	-.333	.017	.666					
IFk5	.108	.749	.918	.436	1.720	.820	.325	-.221				
IFk4	1.620	.428	-1.21	.901	.361	.110	.201	.344	-1.00			
IFk3	.009	-1.28	.216	.014	-1.00	.376	.519	.200	.602	.728		
IFk2	.775	.672	.991	.901	.365	-1.02	.338	.591	.183	.077	.319	
IFk1	-1.88	.109	.582	.337	.718	-1.22	.881	.091	.005	-1.88	.209	.771

Table 3 - Mean, standard deviation, correlation matrix, and cronbach's alpha

Variables	M	SD	α	1	2	3
Task Identification	4.12	.68	.75			
Material Organization	3.30	.53	.81	.37***		
Task Execution	3.91	.61	.80	41***	.40***	
Evaluation	4.02	.64	.76	.32***	.36***	.27***

***p < .001, α = Cronbach's alpha, M = Mean and SD =Standard Deviation

Table 4 - Result of SEM analysis

	B	*SE*	β
Task Identification	0.56	0.09	.31***
Material Organization	0.31	.013	.11***
Material Organization	0.22	0.07	.18***
Task Performance	0.40	0.10	.09*
Task Performance	0.34	0.06	.21***
Task Performance	0.21	0.09	.15***
Evaluation	0.19	0.12	.06*
Evaluation	0.31	0.10	.27***
Evaluation	0.22	0.03	.14**
Evaluation	0.53	0.08	.30***

*p < .05, **p < .01, ***p < .001, B stands for "unstandardized beta," SE for "standard error," and for "standardized beta."

Table 5 - Analysis of the responses of L & I and IT on the themes and items measured on the appropriate instructional framework for teaching technical skills

S/n	Statement		L & I %Agree	Mean	IT % Agree	Mean
1	Task identification					
	i.	The primary and supporting tasks should be listed	98.7	4.22	96.2	4.12
	ii.	Analyse the lesson plan's assignment	98.1	3.90	94.9	4.01
2	Material organization					
	i.	Before instruction begins, display all the tools and equipment that will be used to teach practical skills.	96.7	4.24	98.2	4.03
	ii.	Show the actual item, video, or image that demonstrates the practical skill that has to be learned.	95.2	3.97	97.3	3.90
3	Task execution					
	i.	Demonstrates the specific and whole expertise uninterruptedly from start to finish	98.0	4.22	94.5	4.19
	ii.	Repeats the process while clarifying each step and responding to student inquiries.	96.6	4.10	89.4	3.87
	iii.	Integrate current tasks with prior learning and practical experience.	89.9	3.89	89.1	3,68
4	Evaluation					
	i.	Allow students to articulate the procedures required to perform a skill	99.2	4.33	98.6	4.29
	ii.	Allows students to practice the skill either alone or with other students	98.7	4.21	98.2	4.20
	iii.	Enables students to recognize their errors and fix them with minimal supervision	98.3	4.00	97.9	4.05
	iv.	Allow learners to address challenges on their own once expertise has been attained	97.8	3.86	97.3	4.11
	v.	Encourage students to apply their abilities to actual situations.	97.5	4.28	96.8	3.96
	vi.	Correct mistakes and outline adjustments that must be made as you master the skill.	97.3	3.33	96.4	3.87
	vii.	When practicing a skill, stop and correct incorrect learning practices to stop them from becoming second nature	96.9	4.28	95.7	3.80
	viii.	Practice sessions should be concluded with a successful performance or display of the skill.	96.6	3.69	94.3	3.98

To take a decision on the procedure for teaching technical skills, Agreement was put at 50% and above (=> 50%) on the five (5) point Likert scales of strongly agree, agree, undecided, disagree, and strongly disagree for a procedure considered as accepted. While items with percentages less than 50 (< 50%) do not reach consensus and are considered as not being accepted as how technical skills are taught at colleges.

4. Discussion

In the present study, we try to find the nexus between respondents' opinions of teaching practical skills in line with the belief that teachers find it difficult to teach complex skills in TVET. We found out that a greater percentage of the participants opined that they would like to teach practical skills in the following order task identification, material organization, task performance, and evaluation. Most participants believe that they should list the primary and supporting tasks to be completed and analyse the task to be taught under task identification, display machines, and tools, provide learning materials, list all the materials and tools required to teach the skill and display actual objects, videos, or pictures of the practical skills to be learned under material organization. When performing a task, show all the steps involved from beginning to end, connect the current activities to prior knowledge and real-world situations, repeat the process while outlining each step, and correct incorrect learning behaviour during skill practice to avoid mastering incorrect techniques and determine whether the new skill that has been learned led to the development of a new idea, enable students to explain the steps necessary to do the skill(s), assist students in connecting the skill(s) to a real-world scenario, let students practice the skill(s) both individually and in groups, correct mistakes, and explain modifications that must be made to learn the skill(s)

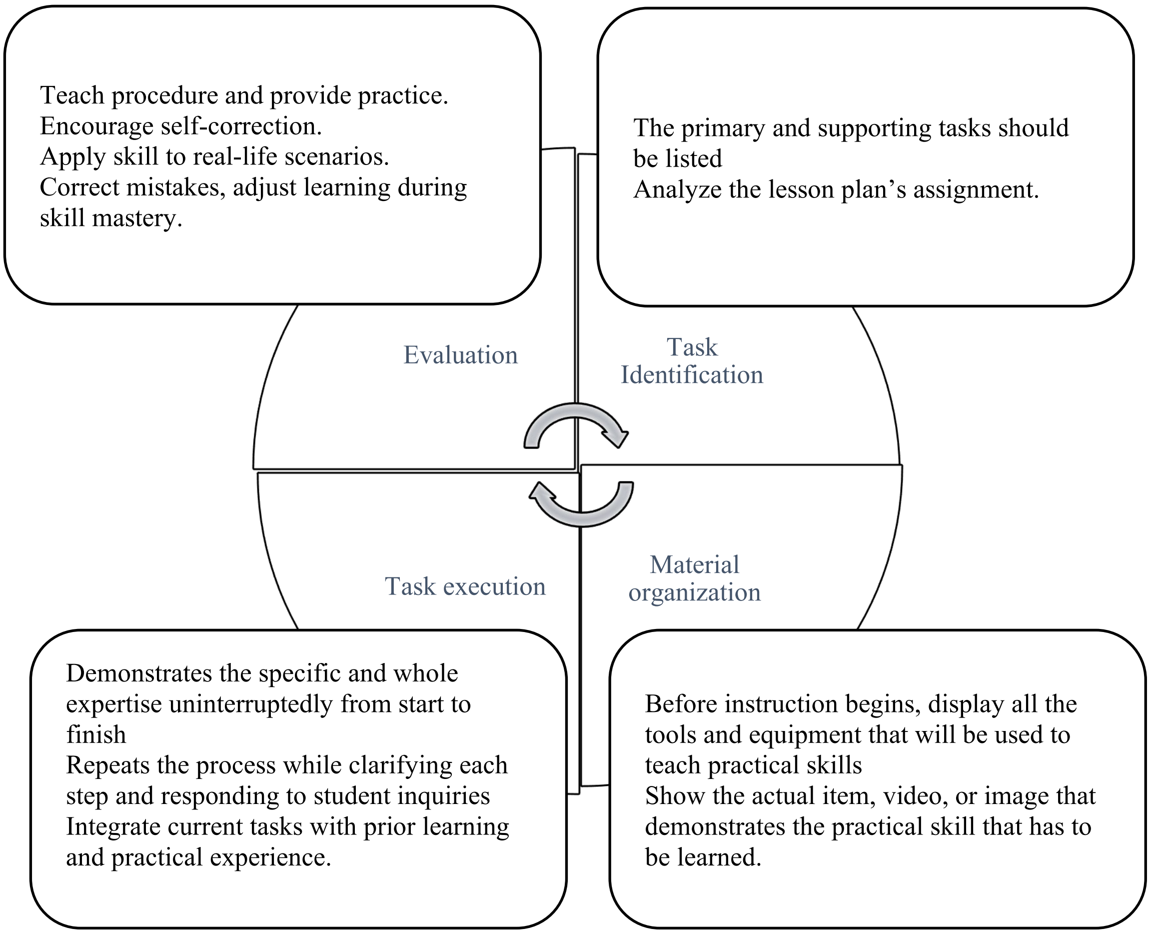

Fig. 1 - Proposed framework for teaching practical skills at vocational-based education

The teacher determines what to teach during task identification and divides each skill into smaller, more manageable parts based on the learner's capacity. The goal is to provide teachers with guidance on how to group demanding and difficult-to-understand practical abilities at once (Li, Wang, and Bai 2015; Luan et al. 2018). The teachers determine the necessary skills and the level of detail in the task analysis by doing this. The necessary skills required to master the primary skill are then decided by the instructors. Because task identification allows teachers to determine whether it is important to teach steps from the last step forward, from the first step to the end, or to teach steps throughout the sequence before putting it all together, it aids in the individual teaching of complex skills for different learners (Wong and Matsumoto 2008). Step 2: After deciding which practical skills need to be taught, teachers should choose the materials required to carry out the activity. This needs to be determined by the student's level and the resources the teacher has available (Orlich et al. 2012). An actual C-clamp, a wrench for removing the calliper bolts, a lug wrench, gloves, safety glasses, and a brand-new brake pad must all be provided by the instructor to demonstrate how to change a brake pad. This is because, in most circumstances, genuine materials are ideal for teaching technical skills, while images and video can be utilized to depict actual suffering (Liu et al. 2003). Utilizing real teaching materials has the advantage of fostering a relaxed learning environment and getting students actively involved in the learning, teaching, and experiential processes. Step 3: Task completion is when the actual teaching process starts. Here is when the teacher uses his capacity for knowledge impact to good use. Before repeating the process, clarifying each step, and taking questions from students, teachers should first show the specific ability in the issue as well as the full technique without interruption.

The current educational activities should therefore be connected to the student's prior knowledge and actual circumstances. This will enable them to confidently solve problems outside of the classroom using the knowledge they have learned in the classroom. Step 4: Evaluation - At this point, pupils are free to practice the skills or teaching activities under the guidance of the instructor. Students, for whom the curriculum is most specifically intended, most often show the ability to demonstrate that a behaviour change has taken place. Without it, efforts are useless. Since we know that hands-on activities should highlight student involvement in the learning process to improve their creativity, originality, psychomotor competence, and direct experience, we produced more activities for the students. Instructors provide individual or group guidance to students as they put what they have learned into practice in this step. To prevent students from mastering improper techniques, instructors address mistakes and outline modifications that must be made to how the skill is performed as well as incorrect learning patterns.

6. Implication

This process was created by us to serve as a framework for the instruction of practical skills at vocational colleges. (Figure 1, above) although the framework puts the student at the centre, the processes are in the learner's external context and are under the teachers' control. According to the results, learners were able to connect knowledge, practice, and accumulated experiences during the teaching process by employing a variety of reasoning techniques, a sequential approach, and reflective practice. This process gradually broadens one's knowledge and experience. According to (Delany and Golding 2014) complexity of information and abilities should be demonstrated in a way that has a decreasing level of supervision and educational scaffolding and an increase in autonomy. As a result, the results provided a teaching sequence for educators who use a vocational approach to teaching and an awareness of sub-activities at the time of the study. To stay current, teaching strategies need to be continually reviewed and updated. The Cross River State Board for Technical Education (CRSBTE) has advised teachers to use this framework in technical colleges. The conclusion of this study. Although a unified teaching resource has not directly come out of this research, there is agreement on the types of activities that should be used to teach skills. The study also raises awareness of the variety of various instructional methods and resources, (Allery 2009; Waldrop 2013). The creation of teaching tools and exposure to workshop practice are additional needs for teaching skills. For instance, case-based learning and ongoing reflection are techniques that help people develop vocational identity and thinking (Sica et al. 2022; Carvalho et al. 2017) which is why technical reasoning skills acquisition by students can be facilitated by open discussion and collaboration between teachers and students since the development of work skills is accelerated by the approaches of teaching experiences.

7. Conclusion

Based on the framework developed in this study, it can be concluded that if this framework is tested and adjudged to be implementable, it will greatly improve students' practical skills acquisition in vocational-based education, make them active in the learning process, and increase their participation during training sessions. The framework represents a systematic procedure for instruction, course, or curriculum content coverage, which ensures that all salient features of learning and instruction of skills are translated into plans for instructional activities concerning the compatibility of technical skills and knowledge.

Acknowledgement

The authors acknowledge Cross River University of Technology (CRUTECH), Universiti Tekhnologi Malaysia (UTM) (Research Grant Others:Vot. 4B769, and JTET publishers for helping bring this work to the limelight.

References

Ajjawi, Rola, and Megan Smith. (2010). 'Clinical reasoning capability: Current understanding and implications for physiotherapy educators', *Focus on Health Professional Education: A Multi-disciplinary Journal*, 12: 60-73.

Akpomi, ME, and Joy Amesi. (2013). 'Effective teaching of business subjects in secondary and tertiary institutions: Teachers preferred methods', *Business Studies Research Journal (BUSREJ)*, 2: 27-51.

Allery, Lynne. (2009). 'How to... Teach practical skills', *Education for Primary Care*, 20: 58-60.

Andreatta, Pamela, and Paul Dougherty. (2019). 'Supporting the development of psychomotor skills.' in, *Advancing Surgical Education* (Springer).

Bannister, Susan L, Mark S Dolson, Lorelei Lingard, and David A Keegan. (2018). 'Not just trust: factors influencing learners' attempts to perform technical skills on real patients', *Medical Education*, 52: 605-19.

Barrett, Terry, and Roisin Donnelly (2008). 'Dublin Institute of Technology', *EMERGING ISSUES II*: 115.

Boud, David, and Elizabeth Molloy. (2013). 'Rethinking models of feedback for learning: the challenge of design', *Assessment & Evaluation in higher education*, 38: 698-712.

Brooks, Joanna, Serena McCluskey, Emma Turley, and Nigel King. (2015). 'The utility of template analysis in qualitative psychology research', *Qualitative research in psychology*, 12: 202-22.

Carvalho, Diana PSRP, Isabelle C Azevedo, Giovanna KP Cruz, Gabriela AC Mafra, Anna LC Rego, Allyne F Vitor,

Viviane EP Santos, Ana LP Cogo, and Marcos A Ferreira Júnior. (2017). 'Strategies used for the promotion of critical thinking in nursing undergraduate education: a systematic review', *Nurse education today*, 57: 103-07.

Chen, Fang Fang. (2007). 'Sensitivity of goodness of fit indexes to lack of measurement invariance', *Structural equation modeling: a multidisciplinary journal*, 14: 464-504.

Chijioke, Okwelle 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: 25-35.

Clark, Vicki L Plano, and John W Creswell. (2014). *Understanding research: A consumer's guide* (Pearson Higher Ed).

David, Paul A, and Dominique Foray. (2003). 'Economic fundamentals of the knowledge society', *Policy futures in education*, 1: 20-49.

Delany, Clare, and Clinton Golding. (2014). 'Teaching clinical reasoning by making thinking visible: an action research project with allied health clinical educators', *BMC Medical Education*, 14: 1-10.

Dike, Victor E. (2009). 'Addressing youth unemployment and poverty in Nigeria: A call for action, not rhetoric', *Journal of Sustainable Development in Africa*, 11: 129-51.

Ekong, UO, and VE Ekong. (2018). 'Impact of information literacy skills on the use of e-library resources among tertiary institution students in Akwa Ibom State', *Nigerian Journal of Technology*, 37: 423-31.

Glaeser, Stephen, and Wayne R Guay. (2017). 'Identification and generalizability in accounting research: A discussion of Christensen, Floyd, Liu, and Maffett (2017)', *Journal of Accounting and Economics*, 64: 305-12.

Hidayat, Hendra, S Herawati, E Syahmaidi, A Hidayati, and Z Ardi. (2018). 'Designing of technopreneurship scientific learning framework in vocational-based higher education in Indonesia', *International Journal of Engineering and Technology (UAE)*, 7: 123-27.

Hogan, David, Melvin Chan, Ridzuan Rahim, Dennis Kwek, Khin Maung Aye, Siok Chen Loo, Yee Zher Sheng, and Wenshu Luo. (2013). 'Assessment and the logic of instructional practice in Secondary 3 English and mathematics classrooms in Singapore', *Review of Education*, 1: 57-106.

Joy, Simy, and David A Kolb. (2009). 'Are there cultural differences in learning style?', *International Journal of intercultural relations*, 33: 69-85.

Keeney, Sinead, Hugh McKenna, and Felicity Hasson. (2011). *The Delphi technique in nursing and health research* (John Wiley & Sons).

Kenny, David A. (2015). "Measuring model fit." In.

Kline, Theresa. (2005). *Psychological testing: A practical approach to design and evaluation* (Sage).

Kolb, Alice Y, and David A Kolb. (2017). 'Experiential learning theory as a guide for experiential educators in higher education', *Experiential Learning & Teaching in Higher Education*, 1: 7-44.

Kovács, Katalin, and Henriette Dancs. (2019). 'A Pedagogical Approach to Performance Analysis in Physical Education.' in, *Essentials of Performance Analysis in Sport* (Routledge).

Li, Jiexun, Harry Jiannan Wang, and Xue Bai. (2015). 'An intelligent approach to data extraction and task identification for process mining', *Information Systems Frontiers*, 17: 1195-208.

Liu, Alan, Frank Tendick, Kevin Cleary, and Christoph Kaufmann. (2003). 'A survey of surgical simulation: applications, technology, and education', *Presence*, 12: 599-614.

Luan, Yi, Luheng He, Mari Ostendorf, and Hannaneh Hajishirzi. (2018). 'Multi-task identification of entities, relations, and coreference for scientific knowledge graph construction', *arXiv preprint arXiv:1808.09602*.

McGrane, Niall, Tara Cusack, Grainne O'Donoghue, and Emma Stokes. (2014). 'Motivational strategies for physiotherapists', *Physical therapy reviews*, 19: 136-42.

Motowidlo, Stephan J, Walter C Borman, and Mark J Schmit. (2014). 'A theory of individual differences in task and contextual performance.' in, *Organizational Citizenship Behavior and Contextual Performance* (Psychology Press).

Motschnig-Pitrik, Renate, and Andreas Holzinger. (2002). 'Student-centered teaching meets new media: Concept and case study', *Journal of Educational Technology & Society*, 5: 160-72.

Nicholls, Delwyn, Linda Sweet, Amanda Muller, and Jon Hyett. (2016). 'Teaching psychomotor skills in the twenty-first century: revisiting and reviewing instructional approaches through the lens of contemporary literature', *Medical teacher*, 38: 1056-63.

O'Neill, Geraldine, and Feargal Murphy. (2010). 'Guide to taxonomies of learning'.

Orlich, Donald C, Robert J Harder, Richard C Callahan, Michael S Trevisan, and Abbie H Brown. (2012). *Teaching strategies: A guide to effective instruction* (Cengage Learning).

Peter, Ogundola I, A Popoola Abiodun, and O Oke Jonathan. (2010.) 'Effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges', *International NGO Journal*, 5: 059-64.

Richardson, John TE. (2005). 'Students' approaches to learning and teachers' approaches to teaching in higher education', *Educational psychology*, 25: 673-80.

Rogers, Meredith A Park, Dionne I Cross, Melissa Sommerfeld Gresalfi, Amy E Trauth-Nare, and Gayle A Buck. (2011). 'First-year implementation of a project-based learning approach: the need for addressing teachers' orientations in the era of reform', *International Journal of Science and Mathematics Education*, 9: 893-917.

Sarker, Sudip K, Charles Vincent, and Ara W Darzi. (2005). 'Assessing the teaching of technical skills', *The American Journal of Surgery*, 189: 416-18.

Sica, Luigia Simona, Tiziana Di Palma, Luca Fusco, Laura Aleni Sestito, and Giancarlo Ragozini. (2022). 'Creativity and vocational identity in late adolescence. A study using the person-centered approach, *International Journal for Educational and Vocational Guidance*: 1-18.

Sole, Gisela, Margot Skinner, Leigh Hale, and Clinton Golding. (2019). 'Developing a framework for teaching clinical reasoning skills to undergraduate physiotherapy students: A Delphi study', *New Zealand Journal of Physiotherapy*, 47: 49-59.

Venatius, Arikpo Sampson, Aede Hatib Musta'amal, Murugan Subramaniam, and Ogumbe Boniface Ekwok. (2020). 'Effectiveness of instructional models in teaching and learning technical skills: a systematic review and meta-analysiS', *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17: 4313-22.

Waldrop, M Mitchell. (2013). 'The virtual lab: Confronted with the explosive popularity of online learning, researchers are seeking new ways to teach the practical skills of science', *Nature*, 499: 268-71.

Wamba, Samuel Fosso, and Eric WT Ngai. (2012). "Importance of the relative advantage of RFID as an enabler of asset management in the healthcare: results from a Delphi study." In *2012 45th Hawaii International Conference on System Sciences*, 2879-89. IEEE.

Willis, Jana M. (2015). 'Examining technology and teaching efficacy of preservice teacher candidates: A deliberate course design model', *Current Issues in Education*, 18.

Wong, Jaime A, and Edward D Matsumoto. (2008). 'Primer: cognitive motor learning for teaching surgical skill—how are surgical skills taught and assessed?', *Nature clinical practice Urology*, 5: 47-54.

Yalams, SM. (2001). 'Development and validation of metal work process evaluation scheme', *Unpublished doctoral dissertation, University of Nigeria, Nsukka, Nigeria*.