Innovative Assessment Method for Evaluating Industrial Technical Education for Enhancement of Nigeria's Economy

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Abstract

The study explores assessment methods for evaluating industrial technical education in tertiary institutions in Nigeria for the enhancement of the economy. It re-examines the objectives of technology education in Nigeria and reviews the literature on evaluation procedures. The study argues that an efficient evaluation of practical skills achievement is not just the ability to measure and evaluate objectively but also the process from which evidence is obtained. The study finds performance tests as the most suitable tool for measuring practical skill achievement in vocational and technology education programs. It suggests a weighting of 60% for practical and 40% for theories to be a more realistic proportion of the total mark allocated to practical skill achievement. The study concludes that a 60/40 weighting will make it less likely for students who perform poorly in practicals to obtain passing marks in core courses in technology education programs as a yardstick for industrial performance and economic emancipation.

Keywords: Technology, Innovation, Assessment Method, Skills, Performance

Introduction

Economic uncertainty is a significant challenge faced by Nigeria; a third-world industrially developing country. This uncertainty is caused by various factors such as volatility in financial markets, changes in macroeconomic policies, natural disasters, and political instability, and especially educational returns. The Nigerian education system prioritizes technology and vocational education as a solution to these issues.

Technology and Vocational Education (TVE) is the name given to education programs designed to train students for various trades, crafts, and careers in skilled professions. TVE is a form of education that focuses on imparting practical skills, attitudes, understanding, and

knowledge related to various sectors of economic and social life (Federal Government of Nigeria, FGN, 2013). It is a practical and theoretical course that puts students at an equivalence to deal with specific vocations or technical tasks in engineering, computer technology, electronics, mechanical skills, and more in the context of technology education.

Generic skills are skills that are complementary to technical expertise, and necessary for being ready for work, lifelong learning, and adaptability. These skills are essential to enabling students to adjust to different working environments, solve complicated problems, and communicate effectively as well as working with other people. Generic skills are so much emphasized in TVE institutions, particularly technical colleges, as they can accelerate employment among youths and school leavers (Audu et al., 2014). Without these skills, youths may be disadvantaged in competing for employment after graduation. The ultimate goal of vocational and technology education training is to acquire knowledge, attitude, and practical skills for sustainable development, preparing students to become technicians, technologists, and other skilled personnel who can fit into the nation's production and service industries (Olaitan, 2013). In other words, these educational programs aim to teach technical skills and attitudes suitable for enhancing economic and social life, improving access to jobs, and reducing unemployment. This can only be achieved through effective assessment programmes realized from a meaningful achievement test. Help-professor (2024) described an achievement test as a developed skill, knowledge, or standardized test that is related to aptitude and or cognitive trait which is used to measure attainment of teaching and learning. Education, generally cannot do without assessment hence achievement test is a mechanism set to assess students' performance in a particular field. It is a system of checking educational outcomes. Therefore, an innovative assessment method needs to be initiated by the relevant bodies. Modern achievement tests are indispensable and measure learners' abilities including Intelligent Quotient (IQ) thinking skills, observations, and practical performance which utilizes different assessment methods that cover learners' engagement in the curriculum. Innovative assessment is a modern way of assessing student's learning outcomes and is strategic in modern-day teaching and learning which a valuable guide to the enhancement of performance is hinged.

Crochett (2024) stated that innovative formative assessment is what defines any modern classroom since it provides crucial information about how the learners understand and what they do not understand which thereby improves learning. Innovative assessment through various strategies such as tests, assignments, and other examination tools exposes learners' current knowledge, attitude, and skills about any subject realized through achievement tests.

Achievement test most relates to aptitude and or cognitive traits of the learner. Therefore, an achievement test is any test that measures the accomplishment of an individual learner after a period of training or learning. In the same vein, practical tests which is prime to this work include but are not limited to laboratory and workshop tests are situations where students are observed in manipulative workshop duties that demonstrate scientific and engineering concepts and principles. Laboratory test provides concrete and direct experiences that promote and enhance test and measurement.

Ineffective evaluation of major aspects of control must be considered and as well put in place, which include fidelity, validity, and reliability that must be designed to measure performance against all fixed odds. A performance assessment or test is an educational test that involves the application and show of skills and knowledge through various accomplishment tasks aimed to improve the learning experience of the students. Performance tests often use components such as developmental checklists; portfolios of student's work and progress reports (Indeed Editorial Team, 2023). The performance assessment method often seeks to lead students to problem-solving, critical thinking, and experiment that display ability and confidence hence it provides an effective evaluation model that allows for self-evaluation and practical interaction between the teacher and the student that enhances expertise.

While some grading systems such as criterion-referenced measurement, fault-free performance scores, or error deduction may require a simple pass or fail, an effective scoring tool or system needs to have a skill checklist. This is an essential part of the practical evaluation (Fresher), 2022). The checklist enables the teacher to examine all essential aspects of performance that technical education requires to be gathered from experiences expressed through workshop teachings and practices; practical evaluation connects theory with practical.

In today's era of economic uncertainty that is rapidly controlled by technology, it's emphasized that learning practical skills involves cognitive, affective, and psychomotor realms of learning (Osinem & Nwoji, 2015). These are cognitive skills, that help in acquiring technical knowledge required in trade or occupation. Affective skills reflect an individual's values, emotions, motives, and interests. Psychomotor skills involve expert and effective movement of body parts, such as fingers, hands/arms, legs, body, and head (Thomas & Amaechi, 2016). Graduates who wish to work relevantly and successfully need to develop all-round skills. This makes it imperative for vocational and technology institutions to ensure the development of these faculties in their curriculum to produce skilled technicians with numerous opportunities to specialize in the production and service industry. Also, vocational

and technology institutions in Nigeria is expected to train youths with high technical skills, groomed in practical dexterity, to fit into various sectors of the economy and become technologically and economically emancipated.

From the foregoing, the production of lifelong skills requires effective teaching strategies, standard instructional materials, tools, machines, equipment, and appropriate evaluation methods. A wrong approach to teaching and evaluation of practical subjects can result in students lacking practical skills, inadequate creative power, and difficulty in securing employment (Thomas & Amaechi, 2016).

Technology education graduates, who acquire the requisite knowledge, technical skills, and attitudes, are prepared for employment in various industries, such as extractive, construction, service, and manufacturing sectors (Abdullah & Jimoh, 2018). However, low student enrolment in vocational and technology education programs in Nigerian schools due to factors such as lack of interest is a concern that denies many of the abundance of skill programs (Aina & Adedo, 2013). Recent research highlights the significant influence of the curriculum and assessment on the practical work teachers choose to do (Abrahams & Reiss, 2015; Amadi, 2017) and in the assessment of science, vocational, and technology education more broadly (Bernholt et al., 2012; Zalmon et al., 2021).

To address this issue, technology education calls for a re-thinking in various educational aspects, measurement, and evaluation inclusive. Efficient evaluation of practical skills achievement is not just about the ability to measure and evaluate objectively, but also the process from which evidence is obtained. Mudhol (2024) insinuated that due to advancements, changing industry demands, and an increasingly global workforce, the need to reassess and scrutinize the present evaluation is worthwhile. There seems to be a limitation in the present 40/60 grading in favour of practical 60% and theory 40% in Nigeria's education system.

This study focuses is on the objectives of technology education in Nigeria and the procedures for evaluating practical skills learning outcomes in tertiary institutions that need to be re-examined. Given the development of an efficient approach to evaluating practical skills acquired by students in technology education programs to enhance their industrial performance. This paper brings to the fore the need to promote the framework of placing practical skill above theories thereby drawing from pedagogical theories, utility, and existing academic framework to propose an adaptable rating that enhances productivity and increases economy. The rationale of this paper is to reevaluate the assessment method or weighting of practical skill performance against the theoretical method.

Objectives of Technology Education in Nigeria

The national policy on education in Nigeria outlines the goals of technology education, which include:

a. Provide courses of instruction and training in engineering, other technologies, applied sciences, business, and management, leading to the production of trained manpower;
b. Provide the technical knowledge and vocational skills necessary for the agricultural, commercial, and economic development of Nigeria;
c. Give training and impart the necessary skills for the production of technicians, technologists, and other skilled personnel who shall be enterprising and self-reliant.;
d. Train people who can apply scientific knowledge to solve environmental problems for the convenience of man; and
e. Give exposure to professional studies in the technologies (FGN, 2013).

These aims must be pursued by all institutions of technology, with students needing adequate exposure to practical works to acquire the necessary skills for optimum utilization, repair, and maintenance of machinery and economic development. Efficient evaluation of acquired skills is crucial for both the formative and summative stages of the programme. Quality teacher education is essential for accountability, as poor quality could lead to a national disaster. Therefore, the objective of the work is to submit a comprehensive, scalable framework for assessing learning outcomes and to examine the real implications of implementing the new rating scale.

Concept of Evaluation

Evaluation is a systematic process of passing value judgment on the worth of a thing, object, or program. It involves examining the parts, processes, or outcomes of a programme to determine their satisfaction with the program's stated objectives, expectations, and standard of excellence. In order words, it is the estimation of the worth of something to make a meaningful decision about that thing (Abrahams et al., 2013). Evaluation encompasses testing, measurement, and assessment, with each act making use of the end-product or proceeding act (Bennett & Kennedy, 2011; Bernholt, et al, 2012; Jonah-Eteli, 2019).

Test refers to the presentation of a standard set of questions to be answered, while measurement involves obtaining quantitative data from observations, rating scales, or other devices. Assessment is the act of using the results of measurement to make decisions. Evaluation is a tripartite data-generating and decision-making process, with each higher act making use of the end-product or proceeding act. The end product of the assessment, the

evaluation, depends on testing and measurement for its validity and reliability (Jonah-Eteli, 2019).

The question arises, what type of evaluation method should be used in measuring practical skills' achievement in technology education programs? Evaluation is a judgmental process that involves collecting and transferring relevant data into information for decision-making. By incorporating testing, measurement, and assessment, evaluation helps to ensure the validity and reliability of the outcomes of a programme.

Evaluation Procedure in Technology Education Programme

Evaluation is a crucial aspect of teaching practical skills, considering factors such as attitudes, safety habits, knowledge acquisition, understanding, and the like (Goma, 2017). It determines whether the performance of learners aligns with the program's objectives, determining the congruence between performance and objectives. In skills-based training like vocational and technology education, the yardstick for measuring one's level of academic achievement should be through tests and observation (Ncharam, 2010). Academic achievement has three dimensions: high, average, and low, which help in evaluating students and identifying their strengths and weaknesses. In the context of this study, academic achievement is the relative change in the behavior of students as a result of effective teaching and learning of marketable skills.

Educators emphasize the importance of validity and reliability in educational measurement. Valid measurement provides accurate predictions of intended outcomes, while reliable measurement represents students' capability in the tested area. Differences between student scores in valid and reliable tests relate to real differences in terms of the trait measured (Stanley & Hopkins, 1972, Scannell & Tracy, 1975 as cited in Abrahams & Reiss, 2015).

Eminent educators believe that accurate measurement of these outcomes results from segregating educational objectives into behavioral domains, such as cognitive, affective, psychomotor, and psycho-productive. Cognitive (Bloom, 1956); Affective (Krathwoli et al., 1964); Psychomotor (Sampson, 1972), and lately Psycho productive; Ezewu, 1984, as cited in Abrahams & Reiss, 2015). These domains are interdependent and can be influenced by the practical learning experience. A closer look at the domain reveals some interdependence as well as the fact that a practically oriented learning experience takes the learners through the domain. Again and more importantly it has been asserted that practical skill acquisition involves complementary and supplementary relationships between behavioral objectives. (Mkpa, 1984 as cited in Egereonu 2010).

Reliable prediction of other domains can be obtained from psychomotor or psycho-productive domains, not vice versa. Therefore, evaluation of practical skills becomes- reliable when learners are provided with opportunities to carry out the act, which is adjudged valid to the curriculum. Hence, the question arises: what kinds of tests are required for evaluating practical skills achievement in technology education programs?

Tests for Evaluation of Practical Skills Achievement

A test is an instrument used in the educational process to obtain data on the performance of learners. Evaluation of practical skill achievement in vocational and technology education programs would require the use of various tests, such as oral, written, performance, or observation of learners at work. Performance tests are highly indispensable in assessing students' competence in carrying out a work procedure (Pearce, 1972; Curzon,1976, as cited in Aina & Adedo, 2013). Observation of learners at work provides an adequate measure of learning attitudes, work habits, and creativity ability, but it is often uneconomical and time-consuming.

Performance tests, on the other hand, measure students' competence in carrying out the work procedure, providing teachers with the opportunity to observe and score students strictly on their abilities. This information is in-depth enough to evaluate knowing, attitude, and doing. Performance tests are convenient, reliable, and valid, especially in tertiary institutions with a large ratio of learners to lecturers. Therefore, the choice of performance test for evaluating practical skill achievement in technology education programs is crucial. But, the question is, what type of performance test is to be adopted for evaluation of practical skill achievement in technology education programs?

Performance Test for Practical Skill Achievement Evaluation

Performance tests involve the examinees manipulating concrete equipment or material, often in the form of assignments or examinations. For instance, each time the lecturer gives assignment(s): drawing, laboratory reports, or component production in the workshop to students, they measure their progress in skill acquisition. Evaluation arising from that process may lack reliability since it cannot be guaranteed that the work submitted is the product of the student(s) concerned. This uncertainty can only be overcome if the student is adequately invigilated in the course of resolving the test problem(s) - a characteristic of examination. Practical examinations seem to provide the most objective measure of students' abilities and demonstrate the level of practical skills acquired. However, assignments should be retained as they arouse practical work habits in students. Researchers suggest allocating a maximum of half of the total Continuous Assessment Score (CAs) to practical skills mastery, as this is

sufficient to motivate interest. Therefore, the question arises: what strategy should be adopted in conducting practical skill achievement examinations in technology education programs?

Strategy for Conducting Practical Skill Achievement Examination

An achievement test is a type of standardized test that is used to examine a student or learner to assess the individual's skill, proficiency, or knowledge in any given experience. Wong (2024) identified the following types of achievement tests: diagnostic, formative, prognostic, and accuracy. Others are power, speed, summative, and performance tests. A practical skill test uses most of the above-stated tests during an examination, hence diagnostic, prognostic, and performance tests provide accuracy, speed, and power which a practical skill test requires. Practical skill as a proficient tool for greater productivity offers an opportunity for the teacher to receive feedback on delivery, technique, and competency which offers real-life situations. The primary aim of conducting a practical examination is to assess students' mastery of relevant skills for performing tasks at their level. The test focuses on either means or ends and a few processes, ensuring it doesn't span over a long period. Where the skill to be tested ends, students can carry out preliminary work at home, while the aspect to be evaluated is completed under strict invigilating. This approach overcomes issues of insufficient working equipment and instruments, and the leakage of the examination question paper doesn't affect the reliability of the evaluation.

Where the skill under test means, the test should be conducted in the examination room, such as a workshop, studio, or laboratory. This method is efficient, simple, has less energy, and is time-consuming. However, it can have a demerit or leakage if not carefully conducted. To avoid leakage, the test should be taken in groups, with the first group checked out en-mass and the next group admitted via opposite or distant entrances. Different sets of test instruments with similar difficulty levels should be prepared for different groups. The question is what proportion of the total mark should be allocated to practical skill achievement in technology education programs?

Proportion of Total Mark (Score) to be Allocated to Practical Skill Achievement

Technology education is valuable when it combines theoretical knowledge with practical skills as graduates are expected to practice and teach as specialist technologists. The curriculum emphasizes practical skills for optimal productivity, advancement, and economic development. Therefore, a balance between practical and theoretical achievements in continuous assessment (CA) and examination scores is essential. That is the reason this work is advocating for an improvement and a shift from laying more credence or weight theory against the practical. To pass a course, students must obtain a minimum pass mark in both

practical and theory. It will be worthwhile when students who are deficient in either theory or practical to be given another opportunity to remedy only the failed domain rather than the entire course. Furthermore, a 60% and 40% weighting for practical theories instead of the reverse as presently practiced is more realistic. This approach can be applied to CA's (35 marks for test and 5 marks for attendance) and Examinations (60 marks for exams). The results would be CA's (35) – 21 marks for practical and 14 marks for theories. Exams (60 marks) – 36 marks for practicals and 24 marks for theories. This proposal aligns with the objectives of technology education and makes it less likely for a student who performs poorly in practicals to obtain a passing mark in any practical-oriented course.

Conclusion

Nigeria is seeking the best technology education system to meet its needs for skilled and semi-skilled manpower, enabling it to become technologically and economically emancipated. The primary focus of technology education is the development of technological values, which require knowledge, appropriate skills, and desirable work attitudes. To achieve this, it is essential to evaluate the mastery of practical skills, rather than learning elegant theories. This requires assessing the practical component of the curriculum and measuring the mastery of each course. A weighting of 60% for practical and 40% for theories is a more realistic proportion of the total mark allocated to practical skill achievement. This weighting will help to present practice over theories; while theories shape practice, practice subsequently affords creativity, performance, and tangible growth in gross domestic product (GDP). This approach will result in transformed individuals with practical dexterity, capable of applying skills that enhance various sectors of the economy than writhing and memorizing theories without practical applications.

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