



Use of Computer-Based Test (CBT) in Conducting Undergraduate Basic Practical Chemistry Examinations: Implication for Acquisition of Basic Practical Skills for Sustainable Science Education

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Abstract

Computer Based Test (CBT) is an off- shoot of Information and communication Technology (ICT). CBT takes the form of objective tests with the possible answers supplied in the same page with the questions. Recently it has widely been adopted for the assessment of students at the tertiary levels of education as an alternative to paper and pen method of assessment using internet or computer-aided facility. The Basic Practical Chemistry courses designed to enable students in faculties of Sciences and applied Sciences in the universities become competent in basic skills in practical work has also taken this shape of examinations in many Nigerian universities. This paper examines the use of CBT in conducting examinations in basic practical Chemistry courses and its implications with regards to the acquisition of basic practical skills for sustainable science education in Nigeria. Recommendations were also made.

Keywords: Computer based test, basic practical Chemistry, Science education, sustainable Science education & basic practical skills.

Introduction

Quality Science education is paramount for a developing nation like Nigeria. This is because today's society needs innovative initiatives that are capable of taking the nation into the green light of development. This development will raise the standard of living for its citizens by providing employment opportunities and social amenities required for daily living. These can only be achieved by giving the citizens an education that is sustaining and progressive. Sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs" (World Commission on Environment and Development in Carlie, Trott & Andrea, 2020). According to UNESCO (2014), sustainable education is the education that allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. This implies that the citizens should be progressively in harmony with nature and the environment, understanding nature and the use of things in the environment. Science education has a vital role to play in this regard through providing the right curriculum and transformative education which will bring the society to the desired level of development and appreciate the importance of sustainability in the society. Momeke as cited in Okoli, Obiajulu and Ella (2013) lamented that science education as undertaken in Nigeria has failed to produce skilled human resources needed for transformation into national prosperity. This suggests the need to make science education in Nigeria more

sustainable. In other words, the center of focus must not just be science education but sustainable science education. Hence, Sustainable science education according to Nwosu, (2015) is the Science education that meets the needs of the societies' present and future generation; through providing solutions to environmental challenges, unemployment challenges, providing skills and reducing poverty. Sustainable Science education therefore, focuses at empowering citizens to get the required knowledge and scientific skills for innovations to improve the society and life, better the environment and make the citizens self sufficient. The major subjects that form the basis of all the disciplines in science education are Physics, Chemistry, Biology and Mathematics. Among these, Chemistry is considered as the central science because it unifies all the science disciplines. Chemistry is linked to the understanding of all the sciences including but not limited to Agricultural science, Biological sciences, Physical sciences, Health sciences, Engineering among others.

Chemistry is the branch of science concerned with the substances which matter is composed of, the investigation of their properties and reactions of such matter to form new substances and their uses. Consequently, Chemistry is a practically oriented discipline, which is packed with a lot of stand-alone practical courses in the universities; such as the basic practical Chemistry courses offered by undergraduate first year and second year students of all the Science-based courses in all the Nigerian universities, colleges of education and polytechnics with different



nomenclatures. This practical Chemistry involves laboratory work where students work on individual capacity or in groups; thereafter the students are assessed to determine the level of practical skills acquired. According to Barkhshi and Rarh (2012), Chemistry education has three important components which are: curriculum, the teaching- learning process and examination/assessment. Thus, having developed requisite curriculum content with specified objectives for undergraduate basic practical Chemistry courses, after undergoing the teaching and learning process, it is imperative that the learners at the end should be tested in a concrete practical laboratory setting. The importance of practical exposition in Chemistry education and the acquisition of basic skills for sustainability cannot be overemphasized. Practical Chemistry according to Aliyu and Talib(2019) enhances students' understanding of scientific concepts, development of practical and problem solving skills, inculcating scientific minds and habits, appreciating the basic principles of science among others. The first hand evidence of the acquisition of these skills is through a practical test. For sustainability in Chemistry education, undergraduate students are expected to be effectively and adequately exposed to the real-life laboratory experiences and real-life practical assessment at the end of the course. This gives practical evidence of skill acquisition which may not be achieved through computer based tests, which is a mode of delivering assessment for evaluation of learning outcomes digitally, using computers as against the traditional approach-based tests.

Computer Based Test (CBT) as a mode of Assessment

Students' assessment is a very vital factor in any teaching- learning situation. Assessment according to Kandeel, (2018) is the systematic processes of using empirical data to measure knowledge, skills, attitude and achievement for the purpose of improvement in the future performances. This implies that assessment is formative and process oriented, therefore learning outcomes must be assessed with the appropriate approach in order to arrive at a decisive result. CBT is a type of assessment tool that makes use of computer resources via internet or computer-aided facility rather than Pen and Paper Test (PPT). It takes the form of objective tests or Multiple Choice Questions (MCQ) with the possible answers supplied in the same page with the questions. According to Bolanle (2021,) CBT

is an assessment and evaluation media that requires students to supply answers to questions presented to them on the screen of a computer based on their subject specification. Hence it is a mode of examination that involves the use of electronic devices like computers and mobile phones, in administering test and grading as well as publishing students' grades.

Since the inception of Information and Communication Technology (ICT), the mode of tests and assessment gradually changed from Pen and Paper Test (PPT) to Computer Based Test (CBT) in educational systems especially with the increase in population of students. Examination bodies like Joint Admissions and Matriculation Board (JAMB), West Africa Examination Council (WAEC), National Examinations Council (NECO), National Business and Technical Examination Board (NABTEB), and National Teachers' Institute (NTI) began to use it for enrolment and examination of their candidates due to increase in the population of their candidates. Subsequently, a number of universities adopted the format of CBT in conducting course examinations, not only for theoretical courses but also, basic practical Chemistry examinations as an alternative to the actual practical session of assessment.

In view of the fact that the basic practical Chemistry courses are designed to prepare future technologist, engineers, science educators, meteorologists, and medical personnel among others for basic scientific skill acquisition, the use of CBT for the assessment of learning outcome in such courses will certainly not be appropriate. Using CBT in such assessment situations cannot indicate how far a student has acquired the necessary practical skills. For the desired national development to come through sustainable science education, acquisition of scientific skills ought to be tested appropriately. In as much as there are numerous advantages of using CBT in tests and assessments such as; self administration, immediate scoring, integrated information and administrative framework, Daramola (2018) opined that the primary factor in determining whether an assessment program is beneficial or not depends on whether the assessment tasks are relevant to the purposes and learning outcomes for the course, not forgetting the attitudes and skills that are to be examined. Fluck as cited in Daramola,(2018) is of the view that online appraisal may not be viable for assessing imagination, critical thinking capacity, basic skills, reflection, among other qualities of profound and successful learning. This means that, acquisition

of practical skill can only be established if an individual can properly manipulate the appropriate instruments and arrive at concrete results. Thus, use of CBT cannot ensure the actualization of the objectives of practical Chemistry courses.

Objectives of the Basic Practical Chemistry Courses

Basic practical Chemistry is a course designed to enable undergraduate science students in faculties of Sciences and applied Sciences and Science Education department in the universities; colleges of education and polytechnics become competent in basic skills of practical Chemistry. The course goes with different nomenclatures depending on the institution. For instance, in the University of Nigeria, the undergraduate science students are exposed to; First year and second year basic practical Chemistry courses such as; first year basic practical Chemistry (CEM.171) which consists of three parts: Volumetric Analysis, Qualitative Analysis, Organic Preparations and Physical Determinations, Basic Physical Chemistry practical (CHEM 271), Basic organic practical Chemistry (CHEM 273), Inorganic practical Chemistry (CHEM.274). These courses are offered by students in all the science based disciplines in the university, including science education students. The objectives of the course as stated in the Basic Practical Chemistry Manual Chemistry Department University of Nigeria, Nsukka. (2017 reprinted edition) are:

1. To enable the student acquire and become competent in the basic skills of practical Chemistry
2. To illustrate by experiment some of the theoretical concepts which has been introduced to the student in the lecture courses. (p. 6)

. To achieve these objectives is to achieve the fundamental necessity for sustainability. Therefore, the students are expected to participate fully in the practical sessions and be assessed with real practical tests at the end of the course to ensure that the expected skills are acquired. Nonetheless, in most Nigerian universities, undergraduate students that take these courses are exposed to the ideal practical sessions throughout the semester but at the end of the semester, examinations on them are conducted through CBT. The achievement of the objectives of such courses cannot be evaluated if the course examinations are through computer-based objective tests. In a dynamic world as this, there is need to shift from life-

long education to life-long learning (Nwosu, 2015), this is sustainability in education. Any form of examination given to test practical skills without the learner carrying out the actual practical test will certainly lead to merely life-long education not life-long learning. Tawil and Cougourex,(2013) cited in Nwosu,(2015), posited that life-long learning is based on four pillars; learning to know, learning to do, learning to be and learning to live together. This then necessitates that for sustainability, examinations in all practical Chemistry courses should be conducted using real-life laboratory practical to ensure acquisition of skills for life-long learning.

Laboratory experiences are worthwhile aspect of science education because this is where the actual drilling and practice that will lead to the acquisition of basic skills for sustainable development is done. Shulman and Tamir in Hofstein &Hugerat (2022) discussing the role of laboratory activities in science teaching and learning, listed a group of objectives that could be achieved through the use of laboratory experiments in science classes including but not limited to:

1. Arousing and maintaining interest, attitude, satisfaction, open-mindedness and curiosity.
2. Developing creative thinking and problem-solving ability.
3. Promoting aspects of scientific thinking and the scientific method.
4. Developing conceptual understanding.
5. Developing practical abilities (for example, designing an experiment, recording data and analyzing and interpreting results obtained from conducting an experiment)(p.3).In a nut shell, laboratory experience makes students to; comprehend the abstract and complex scientific concepts, gain problem solving and analyzing skills, comprehend the nature of science, develop practical experience and special talents, and develop scientific attitudes which computer based objective tests cannot asses its outcome.

Implications of the use of CBT for Basic Practical Chemistry Examination

The many advantages of use of CBT for conducting examinations including Basic Practical Chemistry examinations as mentioned above notwithstanding, as long as it runs contrary to the objectives of the curriculum, it's use goes with a lot of implications. Some of these implications are:



1. The students may not pay sufficient attention to the acquisition of the practical skills since they know that they will not be examined practically during examination. In these days of emphasis on paper qualification as a means of securing jobs especially in Nigeria, many students are only content on obtaining good grades and not necessarily acquiring needed skills and competences.
2. Whatever results are obtained by students through this mode of testing cannot be considered valid because the test instrument lacks validity. In measurement and evaluation, a test instrument is considered valid if it measures what it is supposed to measure and this is based on the specified content domain and set objectives of the course.
3. Use of CBT for basic practical Chemistry examination does not guarantee sustainability in science education. When science educators that have been produced through this mode of testing get to the field, they will not be able to deliver. A Chemistry teacher produced in this manner cannot in any way handle a class on practical Chemistry well. This may lead to their resorting to aiding and abetting examination malpractices in a bid to ensure that their students pass external examinations. These poorly prepared students from secondary schools eventually find their ways to the tertiary institutions and the vicious cycle continues. Ultimately, the long-awaited scientific and technological advancement and national development may remain an illusion.

Conclusion

Assessment is the final stage of any teaching and learning process. Its importance in any educational system cannot be overemphasized as it determines whether the objectives of the course of instruction have been achieved or not. With the advent of ICT, the mode of assessment in many educational systems has gradually shifted from PPT to CBT. The use of CBT for the conduct of undergraduate Chemistry courses examination offers many disadvantages. Its use in the conduct of basic practical Chemistry examinations do not promote sustainable science education that will lead to national development as it does not ensure the assessment of the set objectives of the course. It is therefore important that undergraduate Chemistry students be assessed with real laboratory practical

examination after undergoing the basic practical Chemistry courses to ensure that the needed practical skills are acquired.

Recommendations

The authors hereby make the following recommendations:

1. Government/School administrators should ensure the provision of adequate facilities, equipment and funds needed for the purchase of reagents for effective conduct of basic practical Chemistry in our tertiary institutions.
2. The use of continuous assessment scores is recommended to be based on actual laboratory sessions, which will be allotted a greater percentage of the scores; 70% while the examination is allotted a lesser percentage; 30%, as against 70%:30% for CBT examination and continuous laboratory assessment respectively which is applicable in some universities.
3. Government should recruit adequate number of qualified laboratory technologists to ensure effective conduct and assessment of basic Chemistry practical in our tertiary institutions.
4. Lecturers and school administrations should strongly discourage the use of CBT for basic Chemistry practical examination.

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