



# **Implications Of Computer Based Testing On Open And Distance Learning**

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## **ABSTRACT**

The purpose of the paper is to discuss implications of the developments in Computer-Based Testing (CBT) on Open and Distance Learning. The use of computers in schools is now becoming a common place. Computers are now used in schools for various purposes including assessment. Computer-based testing is a method of administering tests in which the responses are electronically recorded, assessed, or both. Computer-based testing is a method of administering tests in which the responses are electronically recorded and assessed and may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web. Computer-Based Testing is often restricted to the use of computers for the entire assessment process including delivery of the assessment and provision of feedback. Computer-based testing (CBT) has been available in various forms since the early 1970s. The earliest Computer-Based Tests consisted of testing terminals physically connected to a mainframe computer. The advent of personal computers in the 1980s and local area networks (LANs) made it possible to connect stand-alone microcomputers — that is, smart terminals capable of handling some or all of the processing — to centralized storage file servers and shared processing resources. Wide area networks expanded this connectivity principle to allow remote networks to be connected across multiple long distant locations. With the Internet, Computer-Based Testing is now available anywhere anytime. The impact of computer-based testing on open and distance learning is transformative. It empowers learners by offering flexibility, personalization, and instant feedback, while also enabling educators to gather valuable insights for continuous improvement.

**Keywords:** Computer-based testing (CBT); Educational technologies; Open and Distance Learning (ODL).

## **INTRODUCTION**

Computer-Based Testing like many other computer related terms is given different nomenclature by different persons. It is sometimes referred to as Computer-Based Assessment (CBA), computerized testing, computer-administered testing, Online Testing, e-testing, e-assessment, e-examination, Internet Based Testing, etc. All these terms are referring to the same thing.

Bennett cited in Buzzetto-More and Alade (2006) affirmed that “technology is central to learning and, as a result, is going to prove to be central to the assessment process”. Bennett further explained that technology will not only facilitate testing but also support authentic assessment. Computer-based testing is one of the products of the convergence of Education and Technology. Testing using technology, especially computer technology, is one of the greatest benefits of Technology in Education. The role of technology in testing is to bring about easy and efficient ways of developing and administering tests that will meet the challenges of the education system. The use of computers for testing is becoming popular

as schools continue to acquire more computers and as the students are growing in their knowledge of the computer and becoming more comfortable using the computer.

Testing is a form of assessment and assessment is the process of determining the level of the ability of a student or group of students. It is a measurement process that allows an examiner to assign a value to the degree of leaning a student has acquired (Awotua-Efebo, 1999). The assessment process provides us with information or a value of the ability of an individual. It is the systematic process that an examiner uses to gain information or knowledge of a person's ability or competence. Assessment can be done for different reasons, that is, the information acquired from the assessment can be used for different purposes (Kizlik, 2022).

A test is a measurement device or technique used to quantify behavior or aid in the understanding and prediction of behavior. Tests do not measure one's full understanding of a subject matter (Gbamanja, 2002; Singh, Sharma & Upadhya, 2008). This is because a test measures only a sample of behavior, and error is always associated with a sampling process (Newby, Stepich, Lehman and Russell, 2006). Test scores are not perfect measures of a behavior or characteristics but they do add significantly to the prediction process. Tests are made up of items or questions or problems. A test item is a specific stimulus to which a person response in an observable manner. This response can be scored or graded and be subjected to scientific inquiry. Test is a set of items that are designed to measure characteristics of human beings that pertains to behavior. Tests measure many types of behavior – including ability test and personality test (Kaplan & Saccuzzo, 2005).

#### **Test Modes**

The mode of a test refers to the medium used in delivering or administering the test. Different media are available in administering a test. The examiner decides on which of the various media should be used in administering the test. The mode of the delivery may be different but the test items or questions that make up the test may remain the same. Though, some media may have the potential of presenting some kinds of items that other media may never be able to present because of the characteristics or nature of the media. Some of these media are just emerging while others have been with us several years ago. The common modes of delivering tests in schools are the paper mode and the computer mode (Kozma, 2008).

#### **Paper Mode**

The most common medium used for testing in schools and even outside of school over the years is the print, generally referred to as paper. Since the invention of the printing press in the 15th century, the print medium has dominated the scene. The print medium has been the most commonly used in education generally and in other sectors of the society. Paper has been the dominant medium for the production and dissemination of information. It is the most common item you can see in any school. Papers are not only used in the production of textbook, notebooks and exercise books but are also used for the production of test forms. Test items for a given test are usually produced using paper; hence, these papers are popular referred to as “question papers” because these papers contain the test questions. So, paper remains the most common mode of administering tests. In fact, Articlebase.com (2022) describes Paper-based testing as “a tried and true method that has worked successfully in the past”. These tests are referred to as paper-based tests (PBT) or Paper-and-Pencil tests to distinguish them from test administered in other modes.

#### **Computer Mode**

Another medium that is becoming very common in schools and in the society in general for the production and dissemination of information and used invariably for testing is the computer. Computers have the ability to carry information which can be used for several purposes including testing. The development of microcomputers in the early 1980's and recent developments in the computer industry has made the price of computers affordable to many including schools. The use of computers in schools is now becoming a common place. Computers are now used in schools for various purposes including assessment.

The computer can be used to create and deliver tests of any length or size. The test forms or “question papers” that were usually produced in print form can now be done even better using the computer. The computer can be used to create innovative interactive test items that the paper medium will not be able to create. The multimedia characteristics of the computer enable it to create and present these items that can

include animations, sound and video. Also, the computer has the ability to score and grade test as it is being taken. This gives the test taker the opportunity to know the result of the test at the end of the testing. Any test administered on a computer is referred to as a computer based test (CBT).

Test can be delivered or administered using any of the two common modes or media – paper or computer. Paper has remained the dominant mode of administering test in schools over the years, but computer from behind is gradually coming to replace it, if possible. Technological developments in the near future will determine when and how computers will take over paper in the delivery of tests in schools. Awotua-Efebo (1999), in discussing the role technology is playing in the area of assessment, stated that technology will continue to play a major role in assessment including changing the way assessments are conducted.

Means (2022) define Computer-based testing as a method of administering tests in which the responses are electronically recorded, assessed, or both. Ridgway, McCusker and Pead (2004) on the other hand defined e-assessment as the use of electronic technologies to drive student learning assessment. Also, Articlebase.com (2022) define Computer-based testing as a method of administering tests in which the responses are electronically recorded and assessed and may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web. Computer-Based Testing is often restricted to the use of computers for the entire assessment process including delivery of the assessment and provision of feedback.

The British Psychological Society (2002) considers Computer-based assessment to include any psychological assessment that involves the use of digital technology to collect, process and report the results of that assessment. This definition of computer-based assessment or computer-based testing emphasizes the use of digital technology in the assessment process. And digital technology includes several devices apart from the computer. Digital technology may include portable devices such as digital cameras. These devices are to be used in the collection, processing and reporting of assessment results.

Health Professions Council of South Africa (2022) defines computerized test or computer-based test as a test where the administration and scoring of the test is done on computer. The instructions are presented by computer and the responses are entered on computer. Also included are tests that may be answered on paper but the scoring is done by entering the responses into the computer (Charman & Elmes, 1998).

CBT is presently a broad-based industry that encompasses a large variety of assessment types, purposes, test delivery designs, and item types appropriated for educational accountability and achievement testing, college and graduate admission testing, professional certification and licensure testing, psychological testing, intelligence testing, language testing, job recruitment testing, adult education and military use. Testing locations or sites include dedicated CBT centers, classrooms or computer labs in schools, colleges, and universities; temporary CBT testing facilities set up at auditoriums, hotels, including other meeting halls; and even personalized testing in the privacy of one's home, using a PC with an Internet connection and an online proctoring service (Luecht & Sireci, 2011)

The items or assessment tasks available for CBT include many variants of simple multiple-choice or selected-response formats, constructed or extended-response items, essays, technology-enhanced items using novel response-capturing mechanisms involving a mouse or another input device, and complex, computerized performance exercises that may simulate real-life tasks using synthetic challenges made engaging through virtual realism. Test assembly and delivery formats also vary widely and may include pre-constructed test forms (i.e., where everybody sees the same items), test forms constructed in real time, or many varieties of computer-adaptive tests (CATs) that tailor the difficulty of each test form to the proficiency of every examinee. In fact, CBT is not constrained to a particular technology but it is a growing collection of technologies (ibid.).

Modern CBT can be implemented in any of five ways: (a) on a stand-alone personal computer (PC); (b) in dedicated CBT centers; (c) at temporary test centers; (d) in multipurpose computer labs; or (e) using a laptop, netbook, tablet, or hand-held devices such as smart phones connected to the Internet or intranet, possibly remotely proctored. With the exception of using stand-alone PCs, CBT usually requires some level of connectivity, with the most successful implementations having the capability to link multiple

computers to the testing software or platform, and to rapidly transmit test materials, results, scores, and other information where and when they are needed (ibid.).

Computer-based testing (CBT) has been available in various forms since the early 1970s. The earliest Computer-Based Tests consisted of testing terminals physically connected to a mainframe computer. The mainframe computer did all of the processing; the workstations which were “dumb” terminals merely displayed the information on screen and collected responses via a keyboard. The advent of personal computers in the 1980s and local area networks (LANs) made it possible to connect stand-alone microcomputers — that is, smart terminals capable of handling some or all of the processing — to centralized storage file servers and shared processing resources. Wide area networks expanded this connectivity principle to allow remote networks to be connected across multiple long distant locations. With the Internet, Computer-Based Testing is now available anywhere anytime.

### **Types of Computer-Based Tests**

Envisage International Corporation (2022) states that there are two major categories of computer-based tests: linear and adaptive.

#### **Linear Computer-Based Test**

A linear test is a full-length exam in which the computer selects different questions for you without consideration of your performance level. It consists of a full range of test questions – from easiest to most difficult – but not always in order. The linear test is scored in the same way as a paper-based test. Some examples of Linear Computer Based Tests are:

The linear Computer-Based Test (CBT) is one in which the paper version of the test is presented and administered via computers. In a linear CBT, the items on both versions are identical, in general, and scoring methods and procedures are the same. The change from PPT to CBT, therefore, only involves the change of administration mode (Wang & Shin, 2009).

Some examples of Linear Computer Based Tests are:

- Computerized Fixed-Test (CFT)
- Multiple Fixed Test (MFT)
- Linear-on-the-Fly Test (LOFT)

#### **Computerized Adaptive Testing**

The Computerized Adaptive Testing (CAT) is one in which not only the medium of administration changes from paper to computer but also the test delivery algorithm turns from linear to adaptive. This adaptive testing paradigm allows the test items to be selected and administered so that they are tailored to each test taker’s ability (Wang & Shin, 2009).

A computer adaptive test is one in which the computer selects the range of questions based on your performance level. These questions are taken from a very large pool of possible questions categorized by content and difficulty. The test programme usually begins by administering several items to obtain a first estimate of a person’s ability level. Subsequent items varying in difficulty are then administered to refine this estimate until some stopping rule (acceptable level of error in making the estimate) is reached. As well as providing a more efficient (shorter) method of testing, research has shown that adaptive testing is also more motivating for the test taker since items which are too easy or too difficult are avoided.

Some examples of Adaptive Computer Based Tests are:

- Computer-Adaptive Test
- Testlet Based Computer-Adaptive Test
- Multistage Computer-Adaptive Test
- Constrained Adaptive Testing using Shadow Test
- a-Stratified Computerized Adaptive Testing
- Computerized Classification/Mastery Test

### **Benefits of Computer Based Testing**

Computer based testing offer several advantages over paper based test. These advantages as pointed out by Meissner (2007) and Blazer (2010) are discussed below:

1. The use of interactive and engaging item types: Computer based tests are capable of including interactive and engaging question types such as: hot spot/point and click, drag and drop, integrated multimedia, simulations, online experiments, graphing etc. This allows examiners to measure skills that are not easily assessed by paper based tests.
2. The ability to adapt to individual students' ability level: Computer adaptive tests adjust item difficulty based on students' responses to previous items. Incorrect responses evoke less difficult items, while correct responses evoke increasingly difficult items. This results in a more refined profile of skill levels for each student.
3. Provision of a rich array of test data: Unlike paper based tests which provide only the basic information required for simple analysis like item number, response and the answer key; computer based tests collect far more information than the candidates responses. They allow educators to collect data which may include: start and end time, break periods, time spent on each question/section, testing strategies, intermediate progress, thought processes and Final results.
4. Provision for the needs of special populations: Computer based tests can be easily designed to meet the needs of students with disabilities and those from diverse linguistic backgrounds.
5. Timely feedback: Computer based tests increases the speed and accuracy of score reporting. Test administrators have the option to provide students with a test result immediately after completion of the test.
6. Standardization of test administration: Computer based tests provide for greater standardization of test administration by enforcing a structure that ensures consistency and reliability. For instance, computers are used to manage test timing very accurately. Timing is rigidly controlled so that every student has exactly the same amount of time available. Also, other test aides can be incorporated directly into the test, eliminating paper exhibits that can be lost or damaged. Furthermore, dedicated testing centers typically used for computer based testing apply a degree of standardization that would very difficult to achieve with paper based testing.
7. Provision of digital test aides: Computer based test can make available additional educational tools on an item- specific basis. For example, dictionaries can be made available for certain questions and turned off for others; one part of a test might require a full scientific calculator while another part might require only a simple four-function calculator. In addition, external applications such as spreadsheets, word processor, and custom software can be invoked through simple interface controls with data flowing to and from the test driver.
8. Security: Instead of storing testing materials at school sites for days before a test administration, test items can be uploaded minutes before the exams and so reducing the possibility of questions being exposed prior to the test. In addition, item sequence can be randomly scrambled for each student. Furthermore, test security is enhanced through computerized candidate authentication including biometrics such as fingerprinting and digital photograph of the candidate to eliminate impersonation.
9. Cost: Electronic delivery is less expensive than printing and moving large quantities of test materials. The challenge of paper based testing most of the time comes not from the actual administration of the test itself but from all the activities that take place before and after the test day. Activities before the test day may include securing testing facilities, developing and printing test materials, arranging for secure transportation and storage of the materials, training of invigilators, etc. The activities after the test day may include sorting the scripts, scanning and scoring of test materials, etc. These activities can be time-consuming, labour-intensive and very expensive. Computer based test eliminates many of these activities and therefore reducing cost.
10. Friendly to the environment: Computer base testing significantly reduces the consumption of paper. This "green" computing protects the environment by reducing waste from paper.

11. Elimination of Data Entry: Computer based tests reduce the cost associated with entering students' scores for aggregation and analysis. Students' scores are automatically maintained in a database at the completion of the test.
12. Scheduling Flexibility: Computer based testing offers flexible delivery of test administration windows. With scheduling flexibility, computer based tests can be administered once or twice in a year like most paper based tests or the test could be made available on-demand continuously all the year round. Test takers realize optimum convenience when the test is offered on-demand, year-round.
13. Presentation flexibility: Computer based tests offer unique content presentation styles. Items may be presented individually, with one item per page, or multiple items could be presented per page just like the paper based tests. Presenting a single question per page may be used to guide against exposing the rest of the items when necessary.

### **Limitations of Computer-Based Testing**

Efforts to adopt computer based testing have been limited by a number of methodological and technological challenges. Some of these limitations associated with computer-based testing discussed by Blazer (2010) include:

1. Computer crashes: When the testing server crashes, the test and the entire student data are lost.
2. Prohibitive Start-up cost: The initial cost of setting-up a computer based test may be very prohibitive. These costs may include hardware, software, network facilities, connectivity (bandwidth), item banking, staff training, and technical support.
3. Equity: Computer based testing can lead to equity issues if some students have more access to computers and greater computer literacy skills than others.
4. Security: There is the possibility of unauthorized persons gaining access to a "secure" test form and making it public without the knowledge of the test administrators.
5. Lack of uniform testing environments: Schools computing facilities vary considerably and it is often difficult to ensure that students are provided with uniform testing environments. Equipment often varies from one school to the other and sometimes from one machine to the next within the same school. Variability in testing conditions and procedures, such as hardware and software specifications can affect test validity and reliability.
6. Performance reduction: When large numbers of students take a computer based test simultaneously, there is the possibility of network and server congestion resulting in fluctuation of speed and possible disruptions in service.
7. Technical support: Many schools lack the technical support needed to keep computerized systems functioning properly and equipment running smoothly.
8. Disruption of other school activities: Most schools do not have the capacity to test all students on computers in one session. Therefore, administration of computer based tests usually involves changes to existing teaching schedules and personnel assignment.
9. Training of staff: Considerable numbers of staff need to be trained in the administration of computer based tests. Test administrators need knowledge and skills related to loading of files, ensuring uniform assessment conditions, disabling certain software features, etc.
10. Difficulty in scoring open-ended responses: Answers to the questions have to be simple, either straightforward choices or unambiguous character strings. It is very difficult to test a student's skill in extended, free-flowing answers. Higher abilities (such as analysis, synthesis, evaluation, and extrapolation of knowledge into new areas) are the hardest to test - some would say impossible to test - on a computer (Callear & King, 2022).

Despite the numerous limitations and drawbacks of Computer-Based testing, this mode of testing is still very useful in assessment procedures for Open and Distance learning. In this age of technology, it will be very difficult or almost impossible to practice Open and Distance learning without the use of technology. Computer-Based testing is one of the innovative methods of assessment in the digital age and is inevitable

in the practice of Open and Distance learning which is heavily dependent on technology especially computer technology (Ogom, 2007).

In Nigeria, the higher education sector is facing some challenges including but not limited to lack of infrastructure, qualified personnel and funding. The facilities in the higher education institutions are grossly inadequate and limited. Therefore, these institutions are no longer able to meet the increasing demand and quest for access to higher education. As a result, innovative instructional approaches like Open and Distance Learning (ODL) especially online learning is urgently required to significantly increase access to higher education.

Obviously, the demand for higher education in Africa, especially Nigeria, is growing by the day. Every year the number of candidates that are seeking for admission into the available higher education institutions (HEIs) in Nigeria and actually sit for the “Unified Tertiary Matriculation Examination (UTME)” is usually above 1.7 million. Of this number, only about 30 percent are able to secure admission into the nation’s higher education institutions (Adesulu, 2022). This clearly shows that the demand for enrolment into higher education in Nigeria is far more than the supply. The carrying capacities of these institutions are so limited that they are only able to accommodate just a few of the applicants.

The problem of access to education especially higher education is becoming very serious in developing nations like Nigeria. It is on record that the number of candidates seeking admission into higher education is exponentially higher than the number that the available higher education institution can admit (Asomba, 2022). This phenomenon of picking few out of many over the years has created serious problem of access to higher education in Nigeria in particular. In recent times, the Nigerian government has tried to solve this problem of access to the higher education system by giving approvals to private individuals and organizations to establish private universities and other higher educational institutions but this has not still solved the problem.

In response to this growing demand for access to higher education, some of the higher education institutions are beginning to adopt the distance learning approach to increase access to higher education. It is true that distance education is not new, but recent developments in Information and communications Technologies have made it easy for education institutions to develop and deliver effective distance learning programmes that are equivalent or even better than the traditional face-to-face classroom programmes.

Distance education is experiencing a tremendous growth in recent times all over the world as tertiary institutions are beginning to explore the distance option as an alternative to traditional education. Higher education institutions are using the distance education approach as an alternative solution to the growing demand for higher education by increasing accessibility to higher education at a distance. There is a mass movement of students towards Open and Distance education. The “National Center for Education Statistics (NCES)” in the United States of America reported that “from 2000 to 2008, the percentage of undergraduates enrolled in at least one distance education class expanded from 8 percent to 20 percent, and the percentage enrolled in a distance education degree program increased from 2 percent to 4 percent” (Radford, 2011, p. 3).

Open and Distance learning (ODL) mode can provide a viable alternative to the conventional approach to education. ODL uses technology to mediate the communication and interactions between staff and students and amongst students. Malaysian Qualifications Agency (2011) defines ODL as “the provision of flexible educational opportunities in terms of access and multiple modes of knowledge acquisition” (p. 2). They stated that Flexible means that the students have the choices make available to them for their educational endeavours to be able to study anywhere, anytime and anyhow. Access refers to the removal of all barriers in terms of place of study and time of study and the opportunity of making education available for all. Multiple modes refer to the diversity of educational resources and delivery systems for learning. The Open and Distance learning process provides for flexibility in terms of when, where and how to study. The learner chooses when he wants to study, where he would like to study and how he or she would prefer to study. The Open and Distance learning process actually provides the opportunity to those who have problem of time due to either their work or family engagement to have access to quality

educational programmes. Distance is no longer a limitation since ODL has completely removed and eliminated the barrier of distance. The learner does not need to travel to a specific location called school to proceed with his or her education. The school has been brought to the learner to meet him or her at his place of comfort and at his or her time of convenience. The school is the one going to the learner not the learner going to school. The school is brought to the learner by using multiple modes of delivery systems and resource materials. The learner is provided with specially designed instructional materials and multimedia resources.

UNISA (2008, p. 2) defines ODL as “a multi-dimensional concept aimed at bridging the time, geographical, economic, social, educational and communication distance between student and institution, student and academics, student and courseware and student and peers. Open distance learning focuses on removing barriers to access learning, flexibility of learning provision, student-centredness, supporting students and constructing learning programmes with the expectation that students can succeed.” ODL can be used to eliminate all the barriers to education. It is a tool that can be used effectively used to achieve the popular slogan of education for all.

UNESCO (2002, p. 8) states that “the term open and distance learning reflects both the fact that all or most of the teaching is conducted by someone removed in time and space from the learner, and that the mission aims to include greater dimensions of openness and flexibility, whether in terms of access, curriculum or other elements of structure.” The term “Open and Distance learning” can be seen as having two dimensions – Distance learning and Open learning. Distance learning could refer to the separation of the learner or student from the teacher/instructor in time and space. While Open learning refer to the flexibility in terms of access, curriculum and delivery systems.

UNICEF (2009) stated that:

the term ODL or open and distance learning is frequently used as an umbrella term to cover educational approaches that reach learners in places that are convenient or accessible to them, provide learning resources for them, or enable them to qualify without attending school or college in person, or open up new opportunities for keeping up to date no matter where or when they want to study. Open and Distance learning can be seen as a range of educational approaches that takes education to the people at places and time convenient to them by delivering professional developed learning resources for them to study. (p. 5)

### **Generations of Open and Distance Learning**

Distance educators have classified these historical developments in distance education into generations. Each generation is a reflection of the dominant technology in the historical development of that generation of distance education. Some distance education researchers has categorized the historical developments in distance education into three generations (Wang & Sun, 2001; Heydenrych & Prinsloo, 2010; Aoki, 2012; UNESCO, 2000). Some of these researchers are Nipper and Garrison. Other distance education researchers have classified the historical developments in distance education into five generations (Mvkee, 2010; Taylor, 2001; Heydenrych & Prinsloo, 2010; Aoki, 2012). Those associated with the five generation classification are Taylor and Moore and Kearsley.

#### **First generation**

The first generation distance education also known as the correspondence model (Taylor, 1995) or correspondence generation (Wang & Sun, 2001) is mainly characterized by the use of a single technology such as the print (Sherron & Boettcher, 1997). Print was the dominant technology in this generation of distance education and communication was done via the postal system. The development of the print technology and the postal system characterized the first generation (Aoki, 2012). In the correspondence generation, interaction between the students and the teacher was by mail. The type of interaction that was effective in this generation was the student-content interaction. The postal system was the major means of communication. The learning materials used in this generation were highly structured and prepackaged for stand-alone delivery (Sherron & Boettcher, 1997).



### **Second Generation**

The Second Generation often referred to as the Multiple media mode (Taylor, 2001) or Telecommunications generation (Garrison, 1985). The major distance education technologies that characterized this generation are: radio, television, telephone, audiocassette and videocassette. Taylor (1995) classified the following technologies as distance education technologies of the second generation: “videotapes, audiotapes, and computer-based courseware, computer managed learning (CML), computer assisted learning (CAL) and interactive video (disk and tape)”. Aoki (2012) stated that the second generation distance education had a “highly specialized division of labor in producing and delivering instructional materials and the potential to educate thousands of students at once” (p. 3). Course materials were developed in addition to print materials with the use of television and radio as instructional media. Two-way communication, between tutors and students can occur through “postal mail, telephone, facsimile, correspondence tutoring, face-to-face tutorials and short residential schools”.

UNESCO (2000) stated that “most open universities including British Open University, Anadolu University’s Open Educational Faculty in Turkey, Korea National Open University and the Open University of Japan also started as this second generation distance learning institutions”.

### **Third Generation**

The third generation of distance education or Tele-learning Model (Taylor, 2001) started with the introduction of information and communication technologies (ICT) in the design and delivery of distance education courses and programmes (UNESCO, 2000). These technologies include audio conferencing, audiographic communication systems, video conferencing (Taylor, 1995); satellite technologies, computer networks and CD-ROMs (Passerini & Granger, 2000). These technologies provide two-way synchronous interaction for both teachers and students.

### **Fourth Generation**

Taylor (2001) calls the fourth generation of distance education “Flexible learning”. The major technologies of the fourth generation are the Internet and the Web which provide two-way synchronous and asynchronous interaction. This form of distance education technology provides for both individual and social interaction (Bates 1991 cited in Taylor, 1995). The fourth generation is characterized by the development of online learning and use of open education resources (Heydenrych & Prinsloo, 2010). The outstanding innovations of the fourth generation of distance education are the developments in Asynchronous to synchronous communication.

### **Fifth Generation**

The fifth generation of distance education or Intelligent Flexible Learning Model (Taylor, 2001) is the number five and the current model researchers have developed so far. Taylor (2001) stated that the fifth generation is an emerging generation and a derivation of the fourth generation. The major features of this generation of distance education are “the development and implementation of automated courseware production systems, automated pedagogical advice systems, and automated business systems” (Taylor, 2001 p. 2). The main educational technologies of the fifth generations are “Interactive multimedia (IMM) online, Internet-based access to WWW resources, Computer-mediated communication (using automated response systems), Campus portal access to institutional processes and resources” (Taylor, 2001 p. 3). The key factors in the fifth generation of distance education are automation and web 2.0 technologies (Bates, 2008).

### **Implications of Computer Based Testing on Open and Distance Learning**

Computer-based testing (CBT) has significant implications for open and distance learning (ODL) and can greatly impact the way education is delivered and assessed in this mode. Here are some key implications of computer-based testing on open and distance learning:

1. **Flexibility and Accessibility:** CBT enhances the flexibility and accessibility of open and distance learning. Students can take exams from their own locations, eliminating the need for physical presence at a specific testing center. This is particularly advantageous for ODL students who may be geographically dispersed or have other commitments. CBT offers ODL students the flexibility to take exams at their own convenience, reducing the need for physical presence and allowing

learners to manage their study schedules more effectively. This accessibility is especially beneficial for students who are working or have other commitments.

2. **Time Management:** CBT allows ODL students to schedule their tests at their convenience within specific time frames. This empowers students to manage their study schedules more effectively and reduces the pressure associated with fixed exam timings.
3. **Immediate Feedback:** With CBT, students can receive immediate feedback on their performance. This prompt feedback can help learners identify areas of weakness and guide their further study efforts, contributing to a more adaptive and personalized learning experience. With CBT, students receive instant feedback on their performance, helping them identify areas of improvement and adjust their learning strategies in real time. This promotes active learning and self-directed study.
4. **Reduced Administrative Burden:** CBT can streamline the administrative processes related to test administration, grading, and result dissemination. This efficiency can lead to cost savings for institutions and quicker turnaround times for providing results to students.
5. **Security and Integrity:** Implementing secure and robust online proctoring mechanisms can ensure the integrity of CBT. Techniques such as remote proctoring, biometric authentication, and plagiarism detection help maintain the credibility of assessments and prevent cheating. CBT platforms can incorporate robust security measures like remote proctoring and biometric authentication to maintain the integrity of assessments, reducing the risk of cheating.
6. **Diverse Question Formats:** CBT enables the use of a wide range of question formats beyond multiple-choice, including interactive simulations, drag-and-drop exercises, multimedia-based questions, and more. This variety can assess different types of skills and competencies that may be required in ODL programs. CBT supports a wide range of question types beyond traditional multiple-choice questions, such as interactive simulations, multimedia-based questions, and more. This variety assesses different skills and competencies effectively.
7. **Adaptive Testing:** CBT platforms can incorporate adaptive testing algorithms that adjust the difficulty of questions based on a student's responses. This personalized approach optimizes the assessment process and provides a more accurate measure of a student's knowledge and skills.
8. **Data Analytics:** CBT generates a wealth of data that can be analyzed to gain insights into student performance, item analysis, and overall assessment effectiveness. This data-driven approach can inform instructional design, content development, and curriculum improvement.
9. **Continuous Improvement:** CBT allows for continuous assessment and feedback, which can facilitate ongoing improvement of instructional materials, assessment strategies, and the overall learning experience in ODL programs.
10. **Standardization and Quality Assurance:** CBT can help standardize the assessment process across various locations and cohorts, contributing to better quality assurance in ODL programs. CBT helps standardize the assessment process, ensuring consistent evaluation methods and criteria across different cohorts and locations of ODL programs.
11. **Geographical Reach:** CBT eliminates geographical barriers, enabling students from diverse locations to participate in assessments without the need to travel to a specific testing center. This widens the reach of ODL programs and promotes inclusivity.
12. **Personalization:** CBT allows for adaptive testing, where the difficulty of questions can be adjusted based on a student's responses. This personalized approach ensures that assessments are tailored to individual learning levels and strengths.
13. **Efficiency and Cost Savings:** CBT streamlines administrative processes, including test creation, distribution, grading, and result dissemination. This efficiency leads to cost savings for institutions and faster delivery of results to students.
14. **Quality Enhancement:** By providing timely feedback and enabling continuous assessment, CBT contributes to the ongoing improvement of course materials, instructional methods, and overall program quality in ODL.

15. **Technical Literacy Development:** CBT encourages the development of technical literacy skills among ODL students, as they need to navigate digital platforms and tools for assessment purposes. Introducing CBT in ODL necessitates that students possess a certain level of technical literacy and access to appropriate hardware and internet connectivity. Institutions may need to provide support and resources to ensure all students can participate effectively.

## CONCLUSION

In conclusion, computer-based testing has the potential to revolutionize open and distance learning by enhancing flexibility, accessibility, and assessment methods. However, careful planning, effective technology integration, and ongoing evaluation are essential to ensure its successful implementation and maximize its benefits for both educators and learners. The impact of computer-based testing (CBT) on open and distance learning (ODL) is substantial, transforming various aspects of the learning and assessment process.

Technology is central to Open and Distance learning and, as a result, is going to prove to be central to the assessment process. Technology has a crucial influence on the historical development of distance education including the assessment process. Computer-based testing (CBT) has significant implications for open and distance learning (ODL) and can greatly impact the way education is delivered and assessed in this mode.

The impact of computer-based testing on open and distance learning is transformative. It empowers learners by offering flexibility, personalization, and instant feedback, while also enabling educators to gather valuable insights for continuous improvement. As technology continues to advance, the integration of CBT in ODL is likely to play a crucial role in shaping the future of education.

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