DEVELOPMENT AND VALIDATION OF COMPUTER-BASED COURSEWARE, IN TEACHING AND LEARNING PHYSICS IN SECONDARY SCHOOLS IN MINNA METROPOLIS

BY

OKORO, Praise Samuel

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ABSTRACT

The study developed and validated a computer-based courseware in teaching and learning of Physics in secondary schools in Minna Metropolis. The study employed the experimental research design. Fifty (40) students from which comprised of male and female selected from senior secondary school students. The treatment and data collection instrument was validated by experts before administration. Four research questions were answered and two hypotheses were tested. The data were analyzed using mean, standard deviation. The results revealed that students taught using computer-based courseware performed significantly better than students taught using conventional material; male students did not perform better than their female counterparts in Physics. Based on the findings and implications, it was recommended amongst others that seminars, conference and workshops should be organized and put in place for the teachers on the use of computer powered courseware as instructional materials.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The job of science and technology for any countries can't be overemphasized. It is vital to take note of that without the information on physics, Nigeria as a country may be given up in the logical and mechanical race. Nigerian government understood the lack of technology for public turn of events and this made her to incorporate physics into Senior Secondary School educational plan.

One of the significant goals of physics is to empower the individual learner to get suitable abilities, capacities and skill to live and contribute adequately to the advancement of his general public. To accomplish this target, there is the requirement for sufficient responsibility in the instructing and learning of physics in Nigeria senior secondary schools so that learner's terrible performance in the subject will be wiped out.

"In Nigeria specifically, the birth of ICT via the computer and the improved involvement of the computer are opportunities available to overcome historical disabilities and becomes the master of one 's own destiny. Educational policies are always proposed considering the computer, thus the computer helps in prioritizing viable alternative and re-ordering policy direction" (Oyelekan & Olorundare 2009).

Quite possibly the most frequently utilized terms after the pandemic is the expression "new typical." The new ordinary in schooling is the expanded utilization of online learning apparatuses. The COVID-19 pandemic has set off better approaches for learning.

All around the globe, educational learning centres are looking toward online learning stages to proceed with the way toward instructing students. The new typical presently is a changed idea

of instruction with online learning at the center of this change. Today, computerized learning has arisen as a fundamental asset for students and schools everywhere on the world. For some educational establishments, this is an altogether better approach for schooling that they have needed to embrace. Online learning is currently relevant to learn scholastics as well as it likewise reaches out to learning extracurricular exercises for students also. As of late, the interest for online learning has risen essentially, and it will keep doing as such later.

"Computer-based learning (CBL) is the term used for any kind of learning with the help of computers. Computer-based learning makes use of the interactive elements of the computer applications and software and the ability to present any type of media to the users. Computer-based learning has many benefits, including the advantage of users learning at their own pace and also learning without the need for an instructor to be physically present." (Techo-pedia, 2016).

Computer based instruction is a methodology which summarize the computer software with study hall materials. It conveys preparing as well as educational goal to the clients. Understudies finish their exercises and view materials on a PC screen as opposed to tolerating the information from made material or an instructor presentation. There are three terms utilized for computer-based instructions like computer-based training, computer helped learning and computer helped instruction. In various manners CBI can be utilized in the class or alone as single apparatuses. Various teachers use CBI for different purposes like drills, re-enactments, instructional activities and assessment instruments.

Courseware is a term that combines the words "course" with "software." It is software containing educational content, instruction, and instructional strategies. Its meaning originally was used to describe additional educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer. Courseware learning is the

process of learning through Courseware. CAI and educational software are terms that are also used to describe Courseware. CAI stands for computer assisted instruction or computer aided instruction. CAI is a program that contains instruction contents and assistance to instruction using a computer. It is difficult to distinguish between CAI and courseware. Sometimes Courseware and CAI were used as the same concepts in reference to a sort of educational software which refers to all types of software for education.

It is of great necessity that computer-based learning (CBL) is integrated while teaching difficult subjects. This includes discipline subjects specified as Physics or chemistry.

Physics is not easy for students to master since it requires our ability to visualize, comprehend, and apply the concepts learnt in the topic with exactness in the most practical sense. Topics and concepts such as forces and motion, quantum physics requires more than cognitive abilities, it also requires the ability to apply them in practical situations.

Physics is one of the subjects taught to student starting from the senior secondary school level to the university level in Nigerian educational system. Physics is very important because it provides some basic theories in technology. In conjunction with the mathematics, it the foundation of progress and basis of many fields of theoretical and applied knowledge in science and technology (Omosewo 2012).

Omosewo (2012) therefore sees it as an unfortunate situation for a growing country like Nigeria not to take a full advantage of the subject in accomplishing its strategic goals. According to her, physics education is a very important for country like Nigeria, which is making efforts to join a world in which science and technology have become a part of our lives.

Furthermore, the raw and crude memorisation of such topics and concept has been examined to be a setback for students who aim to apply the knowledge in the practical and real-life

situations. Thusly, it is important that different methods such as Computer based learning are integrated in enhancing the instruction and learning significance on students.

1.2 Statement of the Problem

Anunobi (2018) says that currently, Nigeria is similar to other growing nations across the world experiencing fast increase in acceptance of computers, smart phones, networks and world-wide web technology.

Due to the more practicable utilization of Computer based learning for complementing teaching and learning, most Nigerian private schools have adopted Computer based learning to replace the traditional method of teaching. This is targeted towards migrating from the teacher centered method of teaching as this has been one of the major causes of poor performance among secondary school students.

There is an urgent demand to improve the quality of teaching and learning. In recent times, there is so much demand for other effective instruction techniques such as mobile learning, web-based learning, computer-based learning, Game-based, simulator-learning programs etc.

Computer based learning is one of the student-centered forms of learning and it is yet to be integrated in teaching and learning in Nigerian Schools. Computer-based instruction can be utilized to metamorphose classroom instruction into a broadcast of colorful memorable experiences and thusly, reduce ambiguity and forgetfulness in teaching and learning subjects such as physics. There is therefore an urgent need to develop and validate computer-based instructional courseware for physics in Nigerian secondary schools.

1.3 Aim and Objective of the Study

The aim of this study is to develop and validate an computer-based courseware for senior secondary school physics students in Nigeria. Specifically, the study sought to:

i. Develop a computer-based courseware for senior secondary school physics students in Nigeria.
ii. To validate the developed computer-based courseware.
iii. Determine the effectiveness of the developed computer-based courseware on students' performance in physics
iv. To analyse the impact of gender on students' achievement when taught using multimedia

1.4 Research Questions

The following research questions were asked to guide the study

i. To what extent can an interactive computer-based courseware be developed for teaching and learning the concept of force and motion in senior secondary schools?
ii. What are the educational technology professional's assessment of the developed courseware in terms of its conformity and relevance to instructional design models?
iii. What is the impact of computer-based courseware on physics students' achievement in senior secondary schools in Niger State?
iv. What is the impact of gender on students' achievement when taught using computer-based courseware?

1.5 Research Hypotheses

HO_1: There is no significant difference in the mean achievement scores of those students taught physics using computer-based courseware and those taught with conventional teaching methods.

HO_2: There is no significant difference in the mean achievement scores based on gender of students taught physics using computer-based courseware

1.6 Significance of The Study

The findings of this study would be of benefit to teachers, students, the government, curriculum designers, school administrators and fellow researchers.

The result of this study would be of significance to teachers as they would be fully aware of the impact of computer-based courseware on student's academic performance and to know how to utilize it in the classroom.

The result of this study would also be of great benefit to students while using for learning. This will make learning easier, simpler, fun and exciting as abstract concepts would be easily visualized using the courseware.

The findings of this study will be of great benefit to government because knowing the influence of computer-based courseware on student's academic performance would spur them to make available computer-based infrastructure and visual instructional materials in secondary schools.

The findings of this study would motivate curriculum designers to formulate a standard policy for institutions that would make provision of relevant equipment and materials in school curriculum.

School administrators will find this study to be resourceful since they will realize the importance of computer-based courseware in teaching and learning. The findings of this study will motivate them to promote the use of Computer-based in classroom teaching and learning.

The findings of this study will also be of great benefit to fellow researchers as it will help build upon existing literature and contribute to new and current body of research work.

1.7 Scope of the Study

This study explored the processes of developing and validating an interactive computer-based course-ware for teaching secondary school physics students in Minna Metropolis. The course-ware developed is for the purpose of teaching physics in senior secondary schools and the topics captured in this course-ware is FORCE AND MOTION. The validation of this courseware was confined to some selected secondary schools in Minna metropolis that are offering physics. The validation/implementation of this courseware was limited to areas where there is availability of computers with regards to learning Physics subject in senior secondary school and the strategy used was questionnaire and tutorial strategy.

1.8 Operational Definition of Terms

Computer based instruction: Computer based instruction is a methodology which summarize the computer software with study hall materials

Computer-based learning (CBL): is the term used for any kind of learning with the help of computers

Courseware: software containing educational content, instruction, and instructional strategies. Its meaning originally was used to describe additional educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The goal of this study is to develop and validate a computer-based course-ware for teaching the concept of force and motion in Nigerian secondary school but Minna metropolis specifically. Thus, the literature relevant to this study will be reviewed accordingly.

2.1 Conceptual Framework

2.1.1The Concept of Physics

Physics is one of the oldest research disciplines, if not the oldest, since it includes astronomy. Physics, chemistry, biology, and some branches of mathematics have been a part of natural philosophy for most of the past two centuries, but during the Scientific Revolution in the 17th century, these natural sciences arose as distinct academic efforts in their own right. Many interdisciplinary fields of study, such as biophysics and quantum chemistry, overlap with physics, and the limits of physics are not well established**.**

Physics seeks to explain how everything around us works, from the motion of tiny charged particles to the motion of humans, vehicles, and spaceships. In reality, the laws of physics can accurately explain almost anything around you. Consider a smartphone: physics explains how electricity interacts with the device's various circuits. This knowledge aids engineers in selecting the right materials and circuit layout for the smart phone.

Physics is general divided into two categories namely: Classical physics and Modern physics

(i) **Classical physics:** Classical physics refers to a collection of physics theories that preceded current, more systematic, or generally applicable theories. If a newly accepted theory is considered modern, and its implementation reflected a significant paradigm change, prior theories, or new theories centred on the older paradigm, are frequently alluded to as "classical physics."

Modern physics: Modern physics is a branch of physics that was founded in the early twentieth century and beyond, or that was influenced greatly by early twentieth-century physics. Quantum physics, special relativity, and general relativity are all essential branches of modern physics. Classical physics is usually concerned with daily situations: speeds that are much slower than the speed of light, proportions that are much larger than atoms, and energies that are comparatively low. Modern physics, on the other hand, is concerned with more extreme situations, such as high velocities approaching the speed of light (special relativity), small distances approaching the atomic radius (quantum mechanics), and extremely high energies.

2.1.1 Major Objectives and content of secondary school physics curriculum

According to Adeyemo (2010) Physics is one of the major science subjects offered in Nigerian Senior Secondary Schools, it has been discovered to be the foundation of scientific and technical development around the globe.

Our Physics curriculum has a few features which are for the most part acknowledged and accepted to enlarge the information and increment the skyline of comprehension of physics by the students. These highlights are made fundamental since it is accepted that in the event that they are properly and basically followed and applied in some random circumstance and at some random timeframe will actually want to make this subject simple to fathom by students by nullifying the misguided judgments of individuals, students, teachers of physics, different subject teachers, guardians and local area at large about physics. (Adeyemo, 2010)

Adeyemo (2010) outline some of these features:

- There should active interaction between teachers and students. In this situation, it is concluded that it is proper and helpful interaction between the instructor and students that

enables the student to express themselves to ask questions whenever the encounter challenges.

- It was recommended that emphasis be placed on the theoretical part of physics as well as practical aspect. So that any theories taught in physics could be tried and trusted at all given situation.
- It was recommended that each topic to be taught should have specific objectives to be achieved at the end of each lesson.
- Evaluation/assessment should not only be based on the cognitive domain, but also affective and psychomotor. So that the student can be completely developed all round to serve the society better.

Omosewo (2012) says, the content of the outdated Nigerian secondary school physics curriculum was constructed based on an abstract approach. The two basic concepts that permeate the entire curriculum are motion and energy. Core concepts which relate directly to these two concepts, their sub concepts and a mixture of these have been categorized into five sections and a number of topics.

The topics are: Space, Time and motion, Conservation principles, Waves, Field and Quanta

The construction of the new curriculum is not abstract based but thematic based. The previous topics have been changed to themes. The reason for the adoption of the thematic approach was to meet the national and global demands. The six themes which have similar contents are:

- Interaction with space, matter and time
- Conservation principles
- Waves: motion without material transfer
- Fields at a state rest and in motion
- Energy quantization and duality of matter

- Physics in technology

The old and new curriculum shares the same objectives which are outlined as stated by Omosewo (2012);

- To make available fundamental literacy in physics for functional existence in society.
- To propagate and promote creativity and skills
- To acquire basic skills and attitude as a prerequisite for the application of the principles of modern physics.

To acquire basic knowledge and principles governing physics as a preparation for further studies.

2.1.2 Computer Based Learning

Computer based learning refers to the use of the computer as a tool for facilitating and improving instruction. CBL programs use tutorials, drill and practice, simulation and problem-solving approaches to present topics and to test the student's understanding (Han *et al,* 2013). CBL uses a combination of multimedia element which is combination of text, graphics, sound and video in the learning process. It is especially useful in distance learning situation. It is also integrated the use of Internet or intranet in the process of teaching and learning. According to Lee (2012), CBL improves students' attitudes, motivation and academic achievement. Han *et al,* (2013) noted that in 1999, Smart School commenced in Malaysia. It is a learning institution that has been systemically reinvented in terms of teaching and learning practices and school management in order to prepare children for the information age. Most of the teaching and learning practices in Smart School have been carried out through ICT initiatives. The Smart School solution package includes ICT-enabled learning courseware for Bahasa Malaysia, English, Sciences and Mathematics. Presently, the whole courseware package has been distributed to all Smart Schools in Malaysia. It was aimed to produce analytical and creative

students with widespread use of computers in school. Its concept was to develop thinking students with information technology tools playing an important role in the teaching and learning process (MSC, 2007). In 2003, courseware became one of the support tools in the "Implementation of Teaching Science and Mathematics in English" program which known as PPSMI. PPSMI is an initiative to teach Science and Mathematics subjects in English rather than Bahasa Malaysia. The purpose of this initiative is to allow students to be better connected to the rest of the world, as English is a universal language. It will allow students to move seamlessly shift from their primary and secondary education into international tertiary institutions.

2.1.3.1 Potential of Computer Based Learning in Physics

There are recent studies reveal that Computer Based Learning (CBL) serves to establish more effective learning situations than traditional teaching methods which involve teacher presentation, question and answer techniques, and discussions (Ragasa, 2008). The use of computer in conjunction with effective teaching strategies has great potential in the teaching and learning process (Hoon, Chong and Azilah, 2010).

Lee (2010) showed that the courseware constructed in her research showed positive effect on students. She claims that CBL improves students' attitudes, motivation and academic achievement. In addition, the research conducted by Janier, Afza and Wan Fatimah (2008) is also receiving a positive feedback too. The reason for this is that the CBL enables the students to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process (Mudiana, et al., 2011). Moreover, Vansia (2012) stated that CBL has ability to provide quantifiable and instantaneous feedback for its users. Besides, CBL motivates students to learn better by providing them with the immediate feedback and reinforcement and by creating an exciting and interesting atmosphere (Sharina, Fatimah and

Mazyrah, 2010). There a lot of research been conducted to prove the positive effect of Computer Based Learning. Research conducted by Liao (2007) proved that CBL had a positive effect on individuals by comparing 52 research studies carried out in Taiwan in his meta-analysis study.

In 2009, Mahmud, Arif and Lim (2009) created a courseware called 'G-Reflect'. The focus of their study was to develop and evaluate a courseware, 'G-Reflect' on students' achievement and motivation in learning Mathematics. The courseware was developed using Geometer's Sketchpad (GSP) software. The research indicated that students were motivated in learning mathematics and performed better than students taught in the conventional method. He further suggested the mathematics' topics that suitable to use the GSP software in teaching and learning activities in the secondary school Mathematics syllabus such as Translation, Rotation, Dilation, Polygons, Perimeter and Area, Coordinates, Graphs of Function, Circle, Trigonometry and Linear Equations. In the same year, Teoh and his colleagues (2009) study the cognitive effects, in terms of the gain scores and time-on-task of a computer courseware by using mastery learning and collaborative strategies. A total of 262 Form Four students interacts with two Matrices courseware. The students were randomly selected from four suburban secondary schools. For each school, three classes were chosen randomly. They are randomly assigned to the computer-assisted Cooperative Learning (CCL) treatment, Computer-assisted Mastery Learning (CML) treatment, and Computer-assisted Cooperative Mastery Learning (CCML) treatment. All students had not been exposed to the topic of Matrices. The whole lesson on Matrices took four to six hours to finish. Students took a test after each subtopic. Students in CML complete all formative tests or quizzes independently. If CML students fail, they would receive supplementary instruction and corrective activities immediately until the requirement is met. Students in CCL and CCML groups undergo all designated cooperative learning activities. CCL students received no corrective activities but if CCML students fail,

they will receive supplementary instruction and correction activities immediately after each question until the requirement is met. Each student in CCML must wait until all members in the group have achieved the level of 80%. The achieved students are encouraged to help the others. This study showed that, CML and CCML are effective learning tools. If the time allocated for the learning process is longer, CCML would be the most ideal strategy otherwise CML is generally preferred in the learning process.

Furthermore, in 2010, S-Reflek courseware was developed by a researcher (Lee, 2010) to enhance the achievement of the higher lever thinking and the motivation in learning Mathematics of the student. S-Reflek was developed by using Geometer's Sketchpad program which allowed students to learn the topic of Reflection, a Mathematics Form 2 subject, using hands on and minds on. The research applied Problem Based Learning (PBL), an active learning's strategy which supports the constructivism theory. Through PBL, students would learn based on problems given and they would solve the problems with the aid of computer software. This would give students the opportunity to explore knowledge in their own pace. A number of 180 respondents were involved in this study. The research showed that PBL with S-Reflek increase the students' level in mastering the topic of reflection and improved their achievement. Students were able to explain in details about the concepts of reflection after the learning process and master higher lever thinking after the learning process. Thus, the learners' motivation level was considered as high motivation. To sum up, the application of PBL strategy with S-Reflek showed positive effect on students. Noordin and Fatimah (2011) utilised the Van Hiele's levels for teaching and learning Lines and Planes in 3 Dimensions. Based on an early study, students had been identified of having problems in visualising figures. To overcome this problem, a multimedia courseware was developed based on a framework that utilised Van Hiele's Geometric model for visualizing 3D models. A testing was conducted with 60 high school students aged 14-year-old to measure the courseware's effectiveness as an aid for

visualising 3D models. The results showed that the students had demonstrated the ability to visualise and enhance their understanding on the topic after learned using the courseware. In the same year, the research of Zuraini and Fatimah (2010) evaluated on the effectiveness and usability of a 'Li2D' courseware. The interactive learning environment provided by 'Li2D' enabled students to visualize the movement of the locus and steps in constructing the locus. A total of 63 Form Two students were involved in the study. The students were divided into two groups which are control and experimental. The experimental group had to interact with 'Li2D' courseware as part of the learning activities while the control group used the conventional learning methods. Usability evaluation was accomplished based on four constructs of usability, which were efficiency, learn ability, screen design and satisfaction. The research also conducts an evaluation on the multimedia elements. The results showed that the experimental group performed better than the control group in understanding the Loci in the topic of Two Dimensions. In a nut shell, from several recent studies above proved that the use of computer in conjunction with effective teaching strategies has great potential in the teaching and learning process.

2.1.3.2 Constraint in Adoption of Computer Based Learning

Integrating technology in teaching has been a challenge to teachers since they need to make effective use of it in order to develop student's independent learning skills and enhance students' learning. It also influences the way physics is taught and learn. In addition to that, it provides the way for developing independent learning skills and an alternative for learning. For instance, to solve a problem in physics, students need to explore ideas, see the relationship between concepts and finding a solution to a problem. With the advancement of multimedia technology, the problems can be solved (Lee and Kim, 2012; Zuraini and Fatimah, 2010). However, research studies show that most teachers do not make use of the potential of ICT to contribute to the quality of learning environments, although they value this potential quite

significantly (Smeets, 2005). Courseware can increase student engagement and motivation, providing students with a greater level of individualized instruction (Barrow, Debraggio and Rouse, 2008; Chong, Horani and Daniel, 2005). Heo, J., & Han, S. (2021) noted that Smart School courseware for self-directed learning, individually-paced, continuous and reflective. Students thought that Smart School courseware was attractive, highly interactive, and usable and it has a potential to replace the conventional teaching and learning materials but the surrogate user especially the teachers had thought otherwise (Jaafa, 2008). Therefore, in order to achieve better result, some courseware need for improvement and development for future utilization (Murni, 2006). In addition, it was found that only 12% of the 609 students claimed to have frequent use of Smart School courseware in school (Jaafa, 2008). According to the research conducted by Lee (2010), the findings revealed the need for improvement in courseware for future utilization as individual differs in traits such as skills, aptitudes and preferences for processing information and applying in real world situations.

There are lots of barriers for teachers to integrate ICT in teaching. Goktas, Yildirim, and Yildirim (2009) indicate that a majority of teachers believe that the main barriers for integrating ICT are lack of in-service training, lack of appropriate software and materials, and lack of hardware.

Furthermore, teachers lack access to computers and have negative attitudes toward the integration of technology in teaching (Johnson, 2016). Some of them fear of change (Avidov-Ungar, 2014). In fact, many teachers still fear using ICTs, and thus they are reluctant to integrate them in their teaching (Martin, Khaemba and Chris, 2011). They have contributed to the limited impact of computer-based learning tools (Kay and Lauricella, 2011).

Kay (2011) opined that time constraints is one of the factors teachers are unwilling to integrate ICT in teaching. Besides, studies and observations in schools provide consistent evidence that

teachers show minimal or inappropriate use of ICT applications in mathematics teaching and learning at all levels. Only a few teachers are confident in using a wide range of ICT resources. Then, the limited confidence affects the way the lesson is conducted (Martin, Khaemba and Chris, 2011). Moreover, according to Lee (2010), many instructors claim that the courseware is ineffective for certain students. The researcher claims that courseware has some strong factors that may de-motivate the learners (Lee and Kim, 2012). Some of the factors are unattractive presentation, boring style of writing, undefined/ambiguous learning objectives, irrelevant content, content that is too simple or too complex and too much to grasp in one go (Lee and Kim, 2012).

The next barrier is the interface designs that fail to support learning and also presents unattractive presentation (Norfadilah, 2010). Interface design for existing courseware should be improved to support the quality of learning experiences. It includes the level of interactivity and the availability of the interfaces to interact with the users. As suggested by Samah et al. (2011), the interactivity function should be considered by instructional designers in order to develop learning materials. So those external conditions of learning such as feedback and attentions devices will be meet the students' need. Besides that, the lack of knowledge about the role of interface design by the designers in the development process is also the reasons that most acknowledged (Norfadilah, 2010). Yet, sometimes the problem is the way the courseware is used as a tool for teaching and learning (Bortolossi, 2012). The way CBL is applied in teaching and learning can affect its effectiveness. Therefore, new studies are needed to clarify the effect of CBL in contemporary students' environment (Hassan, 2008). Besides, it is needed to study the courseware whether it meets the requirements before it is being used (Mutalib, 2008). In fact, CBL allows the educators to expand their repertoire of methods, tools and strategies beyond those that are frequently used in the classrooms. So, in relation with that, the courseware needs to be tested (Mudiana, et al, 2011)

2.1.4 Importance of Computer-Based Instruction in Learning

The core function of the computer as a tool for learning it's in its ability to process information fast. One of the major advantages of using a computer as a tool for learning is that it simulates real life experiences it adds flavour to learning experience.

When using computer to learn leaners don't need to follow a rigid learning schedule but are granted the liberty to learn at their own pace. Leaners no longer has to be burdened with the fact that they are either fast or slow learners because the computer is programmed to respond to the leaners request and provide desired information and feedback at any time of the day.

Jebakirubai (2015) stated some importance of computer-based instruction they are:

i. **Critical Thinking Ability**: Case studies, simulations, and problem solving are all examples of computer resources and applications, and intelligent systems can help to expand this capability. This ability is a critical component of success in the information society.

ii. **Process Design Ability**: Seeking the perfect way to connect and access necessary resources is critical to completing the task. In today's multi-resource world, students must learn to develop an efficient method for accessing and evaluating knowledge. In order to complete the desired tasks, students must design a method with specific strategies for accessing, manipulating, and using knowledge.

iii. **Team Work**: In places of work nowadays successful performance of tasks are based strongly on team work. With the use of computer-based instruction method students can now communicate with each other through the internet using social media sites like WhatsApp or collaborative tools such as zoom where student can meet and share ideas in order to successfully carryout tasks and assignment.

iv. **Change in Teaching Approach**: with the invent of computer as a tool for learning, the approach to instruction has moved from teacher centre to leaner centred approach. Leaners now have freedom to learn at their pace.

2.1.5 Information technology and teacher education

Mukai & Norman (2020) observed that due to the extreme pervasive existence of technology, which now enables students to access education from anywhere, at any time, and at their own pace, technology is now considered a vital toll in improving teaching and learning in universities.

The role of information and communication technologies (ICTs) in general, and in the teaching and learning process in particular, cannot be overstated. ICT is used to compile, store, modify, and transmit information to a wide range of different users in different of settings, including higher education. The latest advances in ICT have had and will continue to have a significant effect on how teachers teach and how students comprehend. (Chinyere & Paul, 2019).

The exponential development of information and communication technology, as well as other technical advances in culture, has had a significant impact on teacher education programs.

Imig and Switzer (1990) stated that developments in information technology would radically alter the essence of teacher training programs because the bulk of instructional environments require contact between learners, teachers, and information provided to students. Moreover, technological consequences can alter the design of these interactions in a number of ways, including the methods for obtaining, manipulating, and displaying information in a content-specific teaching and learning environment.

Sakar (2012) states that, the desire to learn information is a defining feature of humans, and what makes knowledge an irreplaceable prerequisite is man's ability to possess and then

transfer this knowledge to others. One of the most basic social advantages of humans is the sharing of knowledge, which is the cornerstone of learning. Chinyere and Paul (2019) opined that people and the society are also affected by education. As a consequence, education is a potential tool for social, political, and economic development, without which no person or society can advance professionally.

ICTs are a necessary part of today's culture. Indeed, culture and way of life should be altered to meet the challenges of the information age. ICTs are powerful forces that have changed many aspects of people's lives. The influence of ICTs 20 to 30 years ago was significant in fields such as architecture, banking, medicine, tourism, engineering, travel, industry, and law. (Chinyere & Paul,2019).

ICT will help with educational wealth, quality scholarship and teaching, teacher professional development, and more efficient educational management, rulership, and administration, not just locally but globally (UNESCO, 2015).

Although we recognize that the use of teaching technology in tertiary education teaching and learning processes is still in its infancy in Nigeria, ICT teaching is critical to the development of information and academic researchers. ICT has been adopted by tertiary education institutions, especially those in western Nigeria, as a means of imparting knowledge and skills to students that are required by 21st century educational progression (UNESCO, 2010).

ICT now pervades the educational arena. ICT also adds importance to learning progression, as well as the organization and control of learning institutions (UNESCO (2010). Most of the world's growth and innovation is accelerated by technology in both developed and developing countries. As a result, all nations must strive to reap the benefits of technological advancement. To achieve the necessary competencies of the ever-changing world, professionals must be

educated with sound ICT backup, independent of specific computing platforms or software environments.

2.2 Theoretical Framework

2.2.1 Constructivism Theory

Constructivism is the theory that says learners construct knowledge rather than just passively take in information. As people experience the world and reflect upon those experiences, they build their own representations and incorporate new information into their pre-existing knowledge (schemas).

Related to this are the processes of assimilation and accommodation.

- **Assimilation** refers to the process of taking new information and fitting it into an existing schema.
- **Accommodation** refers to using newly acquired information to revise and redevelop an existing schema.

For example, if I believe that friends are always nice, and meet a new person who is always nice to me I may call this person a friend, assimilating them into my schema. Perhaps, however, I meet a different person who sometimes pushes me to try harder and is not always nice. I may decide to change my schema to accommodate this person by deciding a friend doesn't always need to be nice if they have my best interests in mind. Further, this may make me reconsider whether the first person still fits into my friend schema.

Consequences of constructivist theory are that:

- Students learn best when engaged in learning experiences rather passively receiving information.

- Learning is inherently a social process because it is embedded within a social context as students and teachers work together to build knowledge.

- Because knowledge cannot be directly imparted to students, the goal of teaching is to provide experiences that facilitate the construction of knowledge.

This last point is worth repeating. A traditional approach to teaching focuses on delivering information to students, yet constructivism argues that you cannot directly impart this information. Only an experience can facilitate students to construct their own knowledge. Therefore, the goal of teaching is to design these experiences.

2.2.2Technology Acceptance Model

The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use a technology.

The *actual system use* is the end-point where people use the technology. *Behavioral intention* is a factor that leads people to use the technology. The behavioral intention (BI) is influenced by the *attitude* (A) which is the general impression of the technology.

The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

- *Perceived usefulness* (PU) – This was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether or not someone perceives that technology to be useful for what they want to do.

- *Perceived ease-of-use* (PEOU) – Davis defined this as "the degree to which a person believes that using a particular system would be free from effort" (Davis 1989). If the

technology is easy to use, then the barriers conquered. If it's not easy to use and the interface is complicated, no one has a positive attitude towards it.

Technology Acceptance Model (TAM) is theory majorly in the information system. It focuses on modeling computer users and showing them on how they can accept and adopt a new technology. It was designed to predict the technology adoption decisions of users. Technology Acceptance Model is usually used to predict. It indicates that there are only two components that determine the users' acceptance of a computer system. The two components that determine computer acceptance are the perceived usefulness and the perceived ease of use of the system. The main aim of this model is that it emphasizes the potential of the users. In other words, it underscores, for example, when a developer of a given technology believes that his or her system is friendly to the users. Inversely, the system is not be accepted by the users not unless the developers share the benefits and advantages of the technology system, as stated by Ibrahim et al. (2017).

The perceived usefulness component in Technology Acceptance Model is the degree to which a computer system user believes that using a particular computer system will enhance his or her performance (Opoku, 2020). It usually refers to consumers' perceptions based on the outcome of their experience. The existence of perceived usefulness has significantly been recognized in many businesses, primarily in the banking sector. In other occurrences, it is regarded and taken as a determinant of actual behavior whereby a user is encouraged to use an innovative and user-friendly self-service technology to improve and establish greater autonomy in performing some banking activities such as transactions. However, in the banking industry, the perceived usefulness component is based. It depends on the services offered by the bank, such as applying for loans, checking balances, checking, and paying utility bills. For instance, it is a critical component in this sector since it determines the adaptation of innovation.

On the other hand, the perceived ease of use of the system is how a user accepts and agrees that using an existing model is not costly. Therefore, it is not hard or difficult to understand the perceived innovation. In this model, consumers perceive a new service better than its substitutes. This is because they can easily experiment with the latest innovation and evaluate its benefits. In the e-commerce industry, perceived ease of use is widespread. Many consumers believe that after online shopping, their performance will increase. Therefore, perceived ease of use is a practical aspect that has an impact on online shopping.

With the incorporation of the Technology Acceptance Model in schools, the main aim of the model is to change how students and teachers analyze, determine and organize information. It has democratized information in a school setting. It has also helped in differentiating instructions, especially for students with disabilities. Lubis et al. (2019) argue that many schools today are privileged to integrate Technology Acceptance Model into their systems. Technology Acceptance Model has been used in special needs children to maintain, increase and improve the capacity capabilities of the students. Thus, incorporating the Technology Acceptance Model has also benefited the students with disabilities, specifically those who are in a better position to interact with the lesson using this model. On the other hand, teachers are also in a better place to customize and change the learning process for students with special needs, as Louissaint et al. (2020) stated.

Also, with the widespread of databases in educational settings, Technology Acceptance Model is used to track individual progress. However, teachers and the staff are encouraged to identify and differentiate the learning objectives and instruction, respectively, based on the student's needs. Also, teachers and the team use TAM to attempt to present education. It makes it easy for them to learn new teaching styles. Students with special needs are educated alongside their non-disabled peers in their entire schooling activities through the Technology Acceptance

Model. Therefore, it leads to increased knowledge, personal control, and flexibility among the students. It also impacts the teachers since it makes them have a clever use of information which leads to better productivity in the educational setting.

The acceptance of the Technology Acceptance Model has wide-ranging applications in the educational setting. Applying a well-developed model, the Technology Acceptance Model, in the academic environment significantly influences the students and the teachers. Besides, much research between the students who are the consumers and the information systems is devoted to classification systems. Therefore, the development of a classification system is usually developed for domestic technologies to impact a valuable paradigm for future research positively. On the findings, it is clear that an emerging within the domain of assistive technologies such as the Technology Acceptance Model is usually designed to allow disabled and people with disabilities to gain knowledge and live independently. Thus, this critical aspect of increasing integration through TAM has increased complexity in an educational setting (Tan & Hsu, 2018).

2.3 Empirical Studies

Serin (2011) investigated the effects of the computer-based instruction on the achievements and problem-solving skills of the science and technology students. This is a study based on the pre-test/post-test control group design. The participants of the study consist of 52 students; 26 in the experimental group, 26 in the control group. The achievements test on "the world, the sun and the moon" and the Problem-Solving Inventory for children were used to collect data. The experimental group received the computer-based science and technology instruction three hours a week during three weeks. In the analyses of data, the independent groups t-test was used at the outset of the study to find out the whether the levels of the two groups were equivalent in terms of their achievements and problem-solving skills and the Kolmogorov-

Smirnov single sample test to find out whether the data follow a normal distribution and finally, the covariance analysis (ANCOVA) to evaluate the efficacy of the experimental process. The result of the study reveals that there is a statistically significant increase in the achievements and problem-solving skills of the students in the experimental group that received the computer-based science and technology instruction.

Tolbert (2015) examined the impact of computer-aided instruction (CAI) on student achievement in a business education course and examine student perceptions of the CAI of use, Programmed Logic for Automated Teaching Operations (P.L.A.T.O.). Students not achieving to their highest potential was a problem. The study compared classroom where only traditional compared a classroom where traditional instruction and supplemental CAI instruction and results of the study were based on two sets of tests for one unit of study within the course and an evaluation survey of P.L.A.T.O. The study was to include 56 participants in ninth to twelfth grade placed into two classes of equal numbers (n=28). The control class received the traditional classroom instruction and 20 minutes daily of supplemental traditional instruction. The experimental daily of instruction and 20 minutes daily of supplemental CAI from P.L.A.T.O. The experimental group participated in the student evaluation survey to gauge their perceptions of P.L.A.T.O. Independent t-tests were used to analyse the pre and post unit tests for both groups of students. The survey data were analysed using a chi-square test to examine the significant differences in the number of people agreeing or disagreeing about feelings. An analysis of the data revealed no significant difference between the two forms of instruction. The student perception surveys indicated there was no statistically significant difference in the feelings about the CAI. Overall, the students' perceptions of P.L.A.T.O. were more neutral and negative than positive. Based on the study results, continued research should be done on the impact of CAI in comparison to traditional instruction.

Hashemyolia (2014) determined the effects of Rosetta stone's English Language Courseware (RSELC) on third grade students' performance in public secondary school in Iran. More specifically, this study also aimed to evaluate students' perception about the usefulness of language courseware. This study utilized a quasi-experimental method using only post-test design which consists of two groups. Control group was taught using traditional instruction and experimental group was taught using educational software, namely RSELC. Both groups consist of 31 Iranian secondary school students. In addition, A questionnaire was used which developed by researchers. Quantitative analyses revealed that there was significant difference between the groups on the overall performance in favour of experimental group. Based on obtained results, the current study concluded RSELC that was an effective tool for teaching and learning English language at the third-grade secondary school in Iran.

Julius (2018) investigated how the use of Computer Aided Instruction (CAI) affects students' achievement, self-efficacy and collaborative skills in learning Chemistry when compared with the use of Conventional Instructional Methods (CIM). The objectives of the study were: To investigate the effect of CAI on students' achievement in Chemistry when compared with CIM, to establish gender difference in Chemistry achievement when students are taught using CAI, to assess students' self-efficacy in the learning of Chemistry when taught using CAI and CIM, to establish gender difference in students' self-efficacy in Chemistry when students are taught with CAI, to determine students' development of collaborative skills in Chemistry when taught using CAI and CIM, and to establish the challenges of employing CAI in Chemistry. The study adopted quasi-experimental design, based on Solomon Four-Group, Non-equivalent Control Group Design. There were 15secondary schools with computer laboratory in Maara District, Tharaka Nithi County. Four Extra-County secondary schools with computer schools with sampled which included two girls' only and two boys' only schools. The four schools were then randomly assigned to either experimental or control groups. The study control groups 174

Form Two Chemistry students from the four sampled schools. The study involved two Experimental groups which were taught through CAI method (use of tutorials, simulations and drill and practice applications) and two Control groups which were taught through CIM (non-computer aided methods) on the topics "Atomic structure, Periodic Table and Chemical families" for six weeks. Data was collected using three instruments namely; Chemistry Achievement Test (CAT), Students' Self-efficacy Scale (SSES) and Classroom Observation Schedule (COS). Each of the instruments was administered before and after exposure of treatment (CAI) to both experimental and control group. Pilot testing of the treatment instrument, CAT, SSES and COS was done in two secondary schools in Maara Sub- County having the same characteristics as the sample schools. The reliability coefficients of the CAT and SSES were estimated using Cronbach's Alpha Coefficient and an alpha coefficient of 0.720 and 0.884 was obtained respectively. The researcher administered the CAT and SSES instruments with the assistance of Chemistry teachers in the sampled schools while the COS was utilized by the researcher. Data was analysed using both and inferential statistics. The differences between the group means were analysed using t-test, Analysis of Variance and Analysis of Covariance. The statistical significance was tested at $\alpha = 0.05$. The study descriptive revealed that, the students who were taught chemistry with CAI obtained higher chemistry achievement scores, higher self-efficacy scores and higher collaborative skills scores than the students who were taught with CIM. The study further revealed that girls obtained higher chemistry achievement scores and also higher self-efficacy scores than boys when taught with CAI. The study further revealed that chemistry teachers faced some challenges including inadequate ICT resources when employing CAI in classroom instruction. The findings of this study would be beneficial to chemistry teachers in adopting instructional strategies that would help improve students' achievement, self-efficacy and collaborative skills

in chemistry. In addition, the findings would be valuable to all stakeholders concerned with the enhancement of learning chemistry.

Yusuf and Afolabi (2010) investigated the effects of computer assisted instruction (CAI) on secondary school students' performance in biology. Also, the influence of gender on the performance of students exposed to CAI in individualised or cooperative learning settings package was examined. The research was a quasi-experimental involving a 3 x 2 factorial design. The sample for the study comprised 120 first year senior secondary school students (SSS I) sampled from three private secondary schools, in Oyo State, Nigeria. The students' pre-test and post test scores were subjected to Analysis of Covariance (ANCOVA). The findings of the study showed that the performance of students exposed to CAI either individually or cooperatively were better than their counterparts exposed to the conventional classroom instruction. However, no significant difference existed in the performance of male and female students exposed to CAI in either individual or cooperative settings. Based on the research findings recommendations were made on the need to develop relevant CAI packages for teaching biology in Nigerian secondary schools.

2.4 Summary of Literature Reviewed

From the literature reviewed the researcher discussed the concept, types of physics and the physics curriculum in Nigeria. Several literatures on the importance of computer-based learning as a component of ICT was also reviewed as it unravelled the role computer-based learning plays on enhancing academic performance of students when used effectively. Two theories were found to support the study which were the constructivism and technology acceptance model (TAM). The constructivism theory advocated for student centred learning whereby learners "construct" their own learning from prior experience, hence allowing for individualized method of instruction. The technology acceptance Model (TAM) explains how people perceive the use of technology either in the workplace or academic setting. Both theories

were found to be relevant to the study as they both share the idea of computer-based courseware in instructional delivery. Finally, the empirical studies revealed from previous research that computer-based learning was capable of enhancing academic performance of students.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the research methodology employed by the researchers and therefore, provides information on the research design, population and sample size, sampling technique, data collection instrument, procedure for data collection, procedure for data analysis.

3.2 Research Design

The researcher used the experimental design in studying the impact of an independent variable (computer courseware) on dependent variable (academic achievement), a comparison was made between the experimental group who studied by using the computer-based system which uses electronic content along with a teacher, and the other group is a control one who studied by using the conventional teaching and dialogue, along with a teacher. The variables were controlled, which mean that both groups are equivalent in terms of specialty, academic level, teacher and teaching location and the two groups have undergone a pre and post academic achievement tests.

3.3 Population of the Study

The study population was all the 3156 senior secondary school students in Minna Metropolis, the target population for the study is the Physics students in senior secondary schools in Minna Metropolis.

S/N	Schools	Population
1	FUT Model Secondary School, Bosso	205
2	Ahmadu Bahago Secondary School, Minna	532
3	Maryam Babaginda Secondary School	450
3	St. Clement Secondary School	529
4	Bosso Secondary School, Minna	390

5	Government Girls Secondary School, Minna.	481
6	Government Day Secondary School, Minna	569
	Total	**3,156**

3.4 Sample and Sampling Technique

A sample refers to a small group of elements drawn through a definite produce from a specific population. Shapiro (2008) refers sample as the "number of units that were chosen from which data were gathered". The sample was randomly taken from two purposively selected schools. A sample size of 40 SSIIA students was drawn from two senior secondary schools; Ahmadu Bahago and FUT Model Secondary school.

S/N	SCHOOLS	POPULATION
1	Ahmadu Bahago Secondary School, Minna.	20
2	FUT Model Secondary School, Bosso, Minna	20
	Total	40

To produce the sample, the simple random sampling technique was employed to select the subjects from the purposively schools, balloting was used to represent the experimental and control groups. The sample for the experimental group of the level was used as experimental group and the other as the control group. Twenty (20) students formed the experimental group and another twenty (20) students formed the control group making a total of fifty (40) students for the study. The researchers divided them into control group and experimental group. The experimental group was given a lecture on "Force and Motion" using the computer powered courseware, whereas the control group was given the same lecture through using the traditional ways of teaching (teacher, lecture, discussion).

3.5 Research Instrument

The researcher designed a computer powered physics courseware that covers two key subjects in Physics; force and motion. The courseware was used as the treatment instrument to teach

"Force and Motion" The researcher constructed a test instrument; Physics Achievement Test (PAT) used for data collection. The instrument was constructed by the researcher and it consists of Twenty (20) items drawn from with the help of physics subject experts in the department of Educational Technology to measure the different levels of academic achievement. The achievement test consists of multiple-choice questions with four (4) options (A-D) out of which one serves as the correct answer. However, at the second face (post-test) the options were interchanged likewise the numbering method (reshuffled). Each score per correct answer is one (1) mark. The questions were selected to determine effects computer courseware on academic achievement.

3.5.1 Procedure for Developing the Computer-based System

The researcher developed a computer powered courseware using PowerPoint and HTML to develop a concise executable package that contains the physics concept to be taught, a quiz system was embedded in the courseware. The content was designed based on the senior secondary school curriculum.

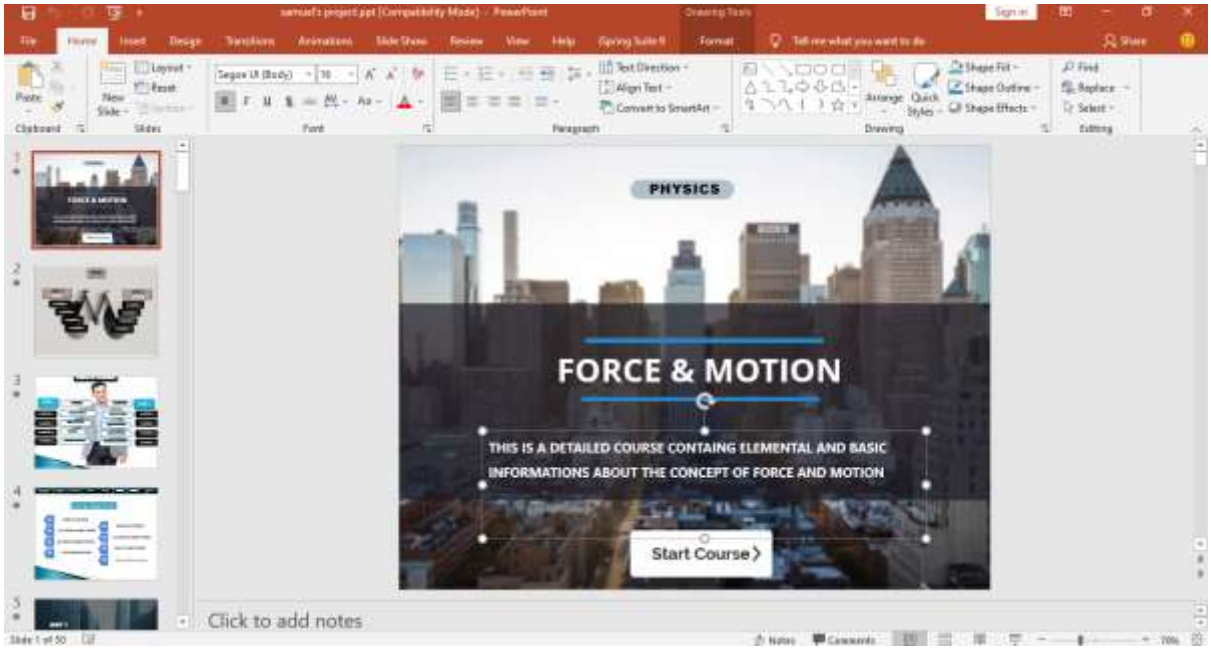

Fig 3.1 Courseware Design on PowerPoint

Fig. 3.2 Courseware Displaying Lesson Objectives

3.6 Validity of Instrument

The Physics Achievement Test (PAT), which consists of twenty (20) multiple choice questions was face and content validated by two experts from the Department of Educational Technology in the School of Science and Technology Education (SSTE), Federal University of Technology Minna. Meanwhile, the computer courseware was also validated by two experts in the department of Educational Technology. These experts scrutinized the instruments and made necessary corrections and modification to the subject, proper wording of the items, appropriateness and adequacy of the items for the study, structure and adequate timing. The comments and recommendations of these experts helped to identify and correct the items in the instruments.

3.7 Reliability of the instrument

The reliability of the Physics Achievement Test (PAT) was determined through pilot test by administering the instrument to 20 senior secondary school students in Bosso secondary school, Minna, after instruction with computer-based which is not among the sampled department for the study, a reliability coefficient of 0.89 was determined from the data using Kuder Richardson 21.

3.8 Method of Data Collection

The selected schools were visited by the researcher. Permission was taken from the HOD of the department, which was given. The aim and mode of research was explained to the students for their maximum cooperation. Thereafter, the students were sampled; the students were sampled from the two created groups (control and experimental); pretest was administered to the students in order to assess their entry behavior. The test was administered to the two groups used for experimental and control groups in the first week. The Physics Achievement Test (PAT) consists of 20 test questions which were constructed with assistance from experts in the Department of Educational Technology. Each question is followed by four multiple-choice optional answers (A-D) and students were expected to choose the correct answer. Each correct answer chosen earn one mark, zero awarded to any wrong answer chosen and overall score is then converted to percentage. The test lasted for thirty (30) minutes; the lesson commenced in all groups in the second week of experiment. The experiment continued for two (2) weeks followed by revision. The two (2) groups were taught "Force and Motion" for this period of two weeks. The experimental group was taught with the computer courseware while the control group was taught without the electronic courseware. On the third week, post-test was administered to the two schools to test the achievement of the students for both experimental and control groups. The same items contained in the pre-test were used but this time around the questions numbering were reshuffled as well as the options. Each correct answer chosen earn one mark, zero was awarded to any wrong answer chosen and the overall score is then

converted to percentage. The test lasted for 30 minutes and scripts were collected immediately for scoring.

3.9 Method of Data Analysis

Mean and standard deviation were used to answer the research questions while t-test was used to test the hypotheses at 0.05 level of significance. This level of significance formed the basis for rejecting or accepting each of the hypotheses, from which findings, discussions and summary will be arrived at. Computer software Statistical Package for Social Science (SPSS) version 25.00 was used for the analysis.

CHAPTER FOUR

4.0 RESULT ANALYSIS

4.1 Result

In this chapter, data for the study were analyzed and presented based on the research questions and hypotheses that guided the study. The research questions were answered using mean and standard deviation while t-test statistics was used to test the research hypotheses. All the hypotheses were tested at $P < 0.05$ level of significance.

Research Question One: To what extent can an interactive computer-based courseware be developed for teaching and learning the concept of force and motion in senior secondary schools?

The researcher developed a computer courseware utilizing HTML and PowerPoint applications to design an eye-catching and powerful courseware based on the SS II Physics curriculum to teach Force and Motion. The researcher made use of his programming expertise to code and embed the relevant multimedia interactions into the package to be used for teaching Physics. Subject matter experts were also consulted and textbooks in Physics were used to design the courseware.

Research Question Two: What are the educational technology professional's assessment of the developed courseware in terms of its conformity and relevance to instructional design models?

The treatment instrument; computer powered courseware was validated by experts in the Department of Educational Technology, Federal University of Technology Minna, these experts made relevant recommendations and corrections before the administration of the instrument (computer powered courseware). The courseware was developed by adopting the ADDIE model in its design as the researcher made sufficient analysis through the problem of the study and design and development of the courseware was done to remediate the problems

identified. The implementation phase led to researcher administering the instrument to twenty students in FUT Model Secondary School and lastly the scores were evaluated to check for the instrument's effectiveness by the means of post testing which was carried using the Physics Achievement Test (PAT). The instrument was validated by subject matter experts and experts in the field of Educational Technology which helped assess the courseware in terms of conformity and relevance.

Research Question Three: What is the impact of computer-based courseware on physics students' achievement in senior secondary schools in Niger State?

Table 4.1 Mean and Standard Deviation of posttest scores of the experimental and control group

Group	N	Pretest		Posttest	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental	20	13.65	2.70	18.35	0.58
Control	20	10.15	3.68	11.65	4.38

Table 4.1 indicates that experimental group who made use of the computer powered courseware had a mean achievement score of 18.35 with a standard deviation of 0.58 at the post-test while those taught using the conventional method had a mean achievement score of 11.65 and a standard deviation of 4.38. from the post-test mean scores, it is revealed that the experimental group who were taught Physics using the computer powered courseware achieved higher than the control group who were taught using the conventional method as revealed by the post-test scores. The level of significance is presented in table 4.3

Research Question Four: What is the impact of gender on students' achievement when taught using computer-based courseware?

Table 4.2 Mean and Standard Deviation on gender of the experimental group

Gender	N	Post-test	
		$\bar{x}$	SD
Male	11	18.4545	.68755
Female	9	18.2222	.44096

Table 4.2 reveals the influence of gender on the mean achievement scores of students taught using the Computer powered courseware. The male students had a mean achievement score of 18.45 and a standard deviation of 0.68 at the post-test, the female students had a mean achievement score of 18.22 and a standard deviation of 0.44. This indicates that males achieved higher than their female counterparts, although the difference in the mean achievement score is shown in table 4.4

4.2 Hypothesis Testing

HO_1: There is no significant difference in the mean achievement scores of those students taught physics using computer-based courseware and those taught with conventional teaching methods

Table 4.3 T-test for the post-test scores of the experimental and control groups

Group	N	Df	$\bar{x}$	SD	t-value	p-value	Decision
Experimental group	20		18.35	0.58			
		38			6.78	0.00	S
Control group	20		11.65	4.38			

Significant at $p < 0.05$

The t-test for table 4.3 shows the mean achievement scores of students taught Physics using the computer powered courseware and those taught using convention method. There was a significant difference between the mean achievement scores of students taught Physics using

computer powered courseware and those taught using conventional teaching methods as determined by the t-test analysis with a t-value at 6.78 and a p-value of 0.00 < 0.05. students taught using Computer powered courseware (M=18.35, S.D=0.58) scoring higher than students taught using the conventional method (M=11.65, SD=4.38). Therefore, the null hypothesis was rejected which implies there is a significant difference in the achievement of the experimental group as compared to the control group.

HO_2: There is no significant difference in the mean achievement scores based on gender of students taught physics using computer-based courseware

Table 4.4 T-test for the post-test scores of the experimental and control groups

Gender	N	Df	$\bar{x}$	SD	t-value	p-value	Decision
Male	11		18.45	0.68			
		18			0.87	0.39	NS
Female	9		18.22	0.44			

Not Significant at $p > 0.05$

The t-test for table 4.8 shows the mean achievement scores of male and female students taught Physics using the Computer powered courseware. There was no significant difference between the mean achievement scores of male and female students taught Physics using Computer powered courseware as determined by the t-test statistics with a t-value at 0.87 and a p-value of 0.39 > 0.05. Male students (M=18.45, S.D=0.68) while the female students (M=18.22, SD=0.44). Therefore, the null hypothesis was accepted implying there is no significant difference between the mean achievement scores of male and female students taught Physics using Computer powered courseware.

4.3 Discussion of Findings

The data analyzed in this chapter were interpreted and discussed on the results derived from four research questions and hypotheses. The main objective of the research is to develop and validate a computer-based courseware, in teaching and learning physics in secondary schools in Minna Metropolis. The post-test scores in table 4.1 shows that the experimental group (M=18.35, S.D=0.58) had a higher achievement scores than the control group (M=11.65, S.D=4.38). Similarly, the p-value associated with the calculated value of t.val (6.78) in table 4.3 is 0.00 which is less than the level of significance, the null hypothesis was therefore rejected. Hence, there is significant difference in the mean achievement scores of students taught Physics with the use of Computer powered courseware. The use of Computer powered courseware therefore has a significant effect on student's achievement in Physics as compared to conventional teaching method. This agrees with the findings of Serin (2011) who revealed that there is a statistically significant increase in the achievements and problem-solving skills of the students in the experimental group that received the computer-based science and technology instruction.

The male students at post-test level (M=18.45, S.D=0.68) achieved higher than the female Physics students (M=18.22, S.D=0.44). Although, the p-value revealed there was no significant difference (p=0.39), in table 4.4 the p-value was greater than the 0.05 level of significance hence, the null hypothesis was accepted. This indicated that there is no significant difference in the mean achievement scores of male and female Physics students. This agrees with the findings of Yusuf and Afolabi (2010) who revealed that there was no significant difference existed in the performance of male and female students exposed to CAI in either individual or cooperative settings.

CHAPTER FIVE
5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The research development and validation of computer-based courseware, in teaching and learning physics in secondary schools in Minna metropolis. This chapter contains the summary, conclusion, recommendation, major findings of the study, contribution to knowledge, implications of the findings and suggestions for further studies.

5.1.2 Summary of the Study

The research developed and validation of computer-based courseware in teaching and learning Physics in secondary schools in Minna Metropolis. However, the study is divided into five chapters in which each chapter is discussed extensively.

Chapter one of the research contains the background of the study, statement of the problem, research questions, significance of the study, scope of the study, methodology, limitations of the study and definition of the terms. Similarly, in Chapter two, many relevant literatures from several authors were used to expose what various writers have done in the area of instructional materials for teaching and learning. In Chapter three of the study that based on research methodology, the quasi-experimental research design was adopted in which the research made use of the treatment instrument (computer-based courseware) and test instrument. The researcher made use of intact classes. Chapter four of the project revolved on the data analysis and interpretations of findings. The mean and standard deviation method of data analysis was used while t-test statistics was used to test the hypotheses. This chapter contains the summary, conclusion and recommendation of the study.

5.2 Conclusion

Based on the findings and discussion of the study, the following conclusion were drawn; the effective and adequate use of Computer powered courseware improves the academic achievement in Physics students. The evidence of the experimental group that use the Computer powered courseware in teaching enhances student's achievement more than the convention method. The use of Computer powered courseware has a great significant effect on student's gender achievement in Physics. Emphasis should be laid on the use of Computer powered courseware and software for teaching Physics in senior secondary schools.

5.3 Recommendation

In view of this project findings, the following recommendations was made;

1. The teachers should be encouraged to enrol in the study of educational technology whereby they can learn the process of producing Computer powered courseware and the use of modern instructional media.
2. Seminars, conference and workshops should be organized and put in place for the teachers on the use of Computer powered courseware as instructional materials
3. There should be adequate reinforcement to hardworking and dedicated teachers through prize awards as a means of appreciation.
4. Government, school administrators should show support and dedication to encourage creativity shown by co-science teachers by providing teaching materials which will promote science and technology in Nigeria.

5.4 Major Findings of the Study

The following findings have been made from the research work

1. There was significant difference between the mean achievement scores of students taught Physics using Computer powered courseware and those taught using conventional method

2. There was no significant difference between the mean achievement scores of male and female students taught Physics using Computer powered courseware.

5.5 Contribution to Knowledge

The result of the study has contributed to knowledge in the following ways

1. Design and development of a computer-based courseware to teach Physics in senior secondary schools
2. Validation of the computer-based courseware by experts.
3. Helping the teacher understand the use of instructional materials and Computer powered courseware will reduce the abstract nature of Physics concepts thereby making learning interesting.
4. Adequate use of Computer powered courseware will help save the teacher's time and energy.
5. It helps to contribute to the existing literature and use to provide platform for further research.

5.6 Implications of the Findings

Various implications have been adopted but the most important is the use of Computer powered courseware in teaching Physics in senior secondary schools so as to improve student's achievement level in Physics. Therefore, teachers should be encouraged and enlightened on the use of Computer powered courseware as it creates interaction between the teacher and the students. It can also be used to enhance the student knowledge and enables them to contribute their own quota on whatever they are been taught.

5.7 Suggestions for further Research

Areas where further research could be done are as follows;

1. The factors that foster the use of Computer powered courseware
2. Effect of Computer powered courseware in teaching and its achievement, retention and interest on student's performance in senior secondary schools in Minna Metropolis, Niger State.
3. Further research should not be limited to a specific area, it should cover a wider geographic area

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APPENDIX

PHYSICS ACHIEVEMENT TEST (PAT) (pre-test)

1) A duck flies 60 meters in 10 seconds. What is the duck's speed?

a. 600 m/s b. 50 m/s c. 6 m/s d. 70 m/s

2) A beetle crawls 2 cm/minute for ten minutes. How far did it crawl?

a. 8 centimeters b. 5 centimeters c. 20 centimeters d. 30 centimeters

3) A force is described as...

a. A push only b. A pull only c. A push or a pull d. None of the above

4) What unit do scientists use to measure force?

a. Newton b. Grams c. Meters d. Meter per second per second

5) What is the net force on the box shown below?

a. 10 N to the left b. 10 N to the right c. 60 N to the left d. 50 N to the right

6) When you slide a box across the floor what force must your push be stronger than?

a. Friction force b. Gravity c. Air resistance d. Support force

7) The SI unit of Speed is?

a. n/m^{-1} b. m/s c. m^2 d. m^3

8) Which force always pulls downward on objects?

a. Support force b. Friction force c. Gravity d. Air resistance

9) The time rate of change of position of the object in any direction is called ?

a. Speed b. Displacement c. Pressure d. Depth

10) What forces are acting on a dropped book that falls to the floor?

a. Gravity only b. Gravity and air resistance c. Air resistance d. Friction only

11) If a body rotates about an axis passing through it then the motion is called ?

a. Oscillatory motion b. Random motion c. Rotary motion d. Linear motion

12) A boy pushes forward a cart of rice with a total mass of 60.0 kg. What is the acceleration of the cart if the net force on the cart is 130.0 N?

a. 20 m/s^{-1} b. 2.167 m/s^{-2} c. 1.3 m/s^{-2}. d. 3.4 m/s^{-}

13) A change to an objects motion is caused by...

a. Balanced forces b. Unbalanced forces c. Acceleration d. Velocity

14) Which one of the following objects has the greatest inertia?

a. ping pong ball b. a golf ball c. a soft ball d. a bowling ball

15) The motion in which a nut moves to and fro or back and forth repeatedly about a fixed point, then this motion is called ?

a. Random motion. b. Oscillatory Motion c. Brownian Motion d. Circular motion

16) One of the laws of motion states that for every action there is an equal and opposite reaction select the correct law

a. newton's 4th law b. newton 2nd law c. newton's 3rd law d. Faradays law

17) When you walk across the ground and push on it with your feet...

a. There is no effect on the ground.
b. The ground pushes back less strongly than your feet.
c. The ground pushes back more strongly than your feet.
d. The ground pushes back on your feet with equal force.

18) A Ram is cycling on a straight way, then the Ram's motion is called ?

a. Translatory motion b. Gravitational Motion c. Triangular Motion d. Random motion

19) Gravity affects projectile motion _____.

a. Vertically b. Horizontally c. Sometimes d. Never

20) Projectile Motion is described as…

a. an object falling from the sky.
b. the curved path an object follows as it is thrown or propelled near earth's surface.
c. the amount of time an object takes to reach the earth's surface after falling from a certain height.
d. the moment when two forces are balanced and the object is still.

APPENDIX

PHYSICS ACHIEVEMENT TEST (PAT) (post test)

1) One of the laws of motion states that for every action there is an equal and opposite reaction select the correct law

   a. newton's 4th law b. newton 2nd law c. newton's 3rd law d. Faradays law

2) A beetle crawls 2 cm/minute for ten minutes. How far did it crawl?

   a. 8 centimeters b. 5 centimeters c. 20 centimeters d. 30 centimeters

3) Gravity affects projectile motion _____.

   a. Vertically b. Horizontally c. Sometimes d. Never

4) A force is described as...

   a. push only b. A pull only c. A push or a pull d. None of the above

5) The motion in which a nut moves to and fro or back and forth repeatedly about a fixed point, then this motion is called ?

   a. Random motion. b. Oscillatory Motion c. Brownian Motion d. Circular motion

6) What is the net force on the box shown below?

   a. 10 N to the left b. 10 N to the right c. 60 N to the left d. 50 N to the right

7) When you slide a box across the floor what force must your push be stronger than?

   a. Friction force b. Gravity c. Air resistance d. Support force

8) The SI unit of Speed is?

   a. n/m^{-1} b. m/s c. m^2 d. m^3

9) A duck flies 60 meters in 10 seconds. What is the duck's speed?

   a. 600 m/s b. 50 m/s c. 6 m/s d. 70 m/s

10) Which force always pulls downward on objects?

   a. Support force b. Friction force c. Gravity d. Air resistance

11) What forces are acting on a dropped book that falls to the floor?

a. Gravity only b. Gravity and air resistance c. Air resistance d. Friction only

12) If a body rotates about an axis passing through it then the motion is called ?

a. Oscillatory motion b. Random motion c. Rotary motion d. Linear motion

13) A boy pushes forward a cart of rice with a total mass of 60.0 kg. What is the acceleration of the cart if the net force on the cart is 130.0 N?

a. 20 m/s^{-1} b. 2.167 m/s^{-2} c. 1.3 m/s^{-2}. d. 3.4 m/s^{-3}.

14) A change to an objects motion is caused by...

a. Balanced forces b. Unbalanced forces c. Acceleration d. Velocity

15) Which one of the following objects has the greatest inertia?

a. ping pong ball b. a golf ball c. a soft ball d. a bowling ball

16) When you walk across the ground and push on it with your feet...

a. There is no effect on the ground.
b. The ground pushes back less strongly than your feet.
c. The ground pushes back more strongly than your feet.
d. The ground pushes back on your feet with equal force.

17) A Ram is cycling on a straight way, then the Ram's motion is called ?

a. Translatory motion b. Gravitational Motion c. Triangular Motion d. Random motion

18) Projectile Motion is described as…

a. an object falling from the sky.
b. the curved path an object follows as it is thrown or propelled near earth's surface.
c. the amount of time an object takes to reach the earth's surface after falling from a certain height.
d. the moment when two forces are balanced and the object is still.

19) The time rate of change of position of the object in any direction is called ?

a. Speed b. Displacement c. Pressure d. Depth

20) What unit do scientists use to measure force?

a. Newton b. Grams c. Meters d. Meter per second per second

ANSWERS (PRE TEST)

1. C
2. C
3. C
4. C
5. B
6. A
7. B
8. C
9. A
10. B
11. C
12. B
13. B
14. D
15. B
16. C
17. D
18. A
19. B
20. B

ANSWERS (POST TEST)

1. C
2. C
3. B
4. C
5. B
6. A
7. A
8. B
9. C
10. C
11. B
12. C
13. B
14. B
15. D
16. D
17. A
18. B
19. A
20. A

APPENDIX V

LESSON PLAN FOR THE EXPERIMENTAL GROUP

School	FUT Model secondary school, Bosso
Date	7th May, 2021
Number in Class	20
Sex	Mixed class
Average age	14-17
Subject	Physics
Topic	Force and motion
Time	10:00 - 10:40
Duration	40mins
Period	1st

Method of Teaching	Discussion, Demonstration
Teaching Techniques	Set induction, Questioning
Instructional materials	Whiteboard, Handout
Specific Objective	At the end of the lesson students should be able to; a. Define force and motion b. List the types of force and motion c. Explain the types of force and motion d. Solve problems on Force and motion
Introduction	Teacher introduce the lesson by asking the students the following questions: a. What is Force and motion b. Mention the types Force and motion
PRESENTATION	Teacher presents the lesson by the following steps
Step I	Teacher defined Force and motion Force: it is a push or pull that acts on an object Motion: is the state where a body changes distance with respect to time
Step II	Teacher lists the types of force and motion Types of force Types of motion 1. Frictional force. 1.Random motion 2. Gravitational force. 2. Linear motion 3. Magnetic force. 3. Oscillatory motion 4. Electrical force. 4. Rotational motion
Step III	Teacher Explain the types of Force and motion **Types of Force** a. Frictional Force: This is the force that exist when a body is draged across a surface b. Gravitational Force: This is the force exerted by planetary bodies that keeps them in orbit c. Magnetic Force: The force exerted by a magnetic field d. Electrical Force: This is the force exerted by an electrical field **Types of Motion** a. Random motion: motion of a particle without direction in a space b. Linear motion: motion of an object in a straight line c. Oscillatory motion: a periodic to and from movement of a simple pendulum d. Rotational motion: motion of a body about an axis
Step IV	Teacher solves a problem on Force and motion Problem A body moves a distance of 60m in 60min what is the speed of the body? Solution S = D/T D=60km T=1 hour

	S=60km/1hour S=60km/hr
EVALUATION	Teacher evaluates the lesson by asking the students the following questions. i. What is Force and motion? ii. Lists four types of Force and motion iii. Explain four types of force and motion iv. A body is moving at a speed of 4 m/s and wants to covers a distance of 50m what time will it take for it to cover the distance?
Conclusion	The teacher concludes the lesson by summarizing the main point of the lesson
Assignment	A body is moving at a speed of 10 m/s and wants to covers a distance of 60m what time will it take for it to cover the distance?
Reference material	New school physics for Secondary schools.

APPENDIX

LESSON PLAN FOR THE CONTROL GROUP

School	Ahmadu Bahago secondary school
Date	20th May, 2021
Number in Class	20
Sex	Mixed class
Average age	14-17
Subject	Physics
Topic	Force and motion
Time	10:00 - 10:40
Duration	40mins
Period	1st

Method of Teaching	Discussion, Demonstration
Teaching Techniques	Set induction, Questioning
Instructional materials	Whiteboard, Handout
Specific Objective	At the end of the lesson students should be able to; a. Define force and motion b. List the types of force and motion c. Explain the types of force and motion d. Solve problems on Force and motion
Introduction	Teacher introduce the lesson by asking the students the following questions: a. What is Force and motion b. Mention the types Force and motion
PRESENTATION	Teacher presents the lesson by the following steps
Step I	Teacher defined Force and motion Force: it is a push or pull that acts on an object Motion: is the state where a body changes distance with respect to time
Step II	Teacher lists the types of force and motion Types of force Types of motion 1. Frictional force. 1.Random motion 2. Gravitational force. 2. Linear motion 3. Magnetic force. 3. Oscillatory motion 4. Electrical force. 4. Rotational motion
Step III	Teacher Explain the types of Force and motion **Types of Force** a. Frictional Force: This is the force that exist when a body is draged across a surface b. Gravitational Force: This is the force exerted by planetary bodies that keeps them in orbit c. Magnetic Force: The force exerted by a magnetic field d. Electrical Force: This is the force exerted by an electrical field **Types of Motion** a. Random motion: motion of a particle without direction in a space b. Linear motion: motion of an object in a straight line c. Oscillatory motion: a periodic to and from movement of a simple pendulum d. Rotational motion: motion of a body about an axis
Step IV	Teacher solves a problem on Force and motion Problem A body moves a distance of 60m in 60min what is the speed of the body? Solution S = D/T D=60km T=1 hour

	S=60km/1hour S=60km/hr
EVALUATION	Teacher evaluates the lesson by asking the students the following questions. v. What is Force and motion? vi. Lists four types of Force and motion vii. Explain four types of force and motion viii. A body is moving at a speed of 4 m/s and wants to covers a distance of 50m what time will it take for it to cover the distance?
Conclusion	The teacher concludes the lesson by summarizing the main point of the lesson
Assignment	A body is moving at a speed of 10 m/s and wants to covers a distance of 60m what time will it take for it to cover the distance?
Reference material	New school physics for Secondary schools.