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DEVELOPMENT AND EVALUATION OF L1 (MOTHER TONGUE) HAUSA BASED ICT ENHANCED TEACHER DEVELOPMENT (ICTETD) MODE OF INSTRUCTION IN PHYSICS

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ABSTRACT: *This study was designed to evaluate the effect of L1 Hausa based ICT instructional mode on the cognitive learning outcomes of Senior Secondary Schools Physics Students in Kontagora Municipal area, Niger State. Four (4) research questions and four (4) hypotheses were answered and tested respectively. A quasi-experimental design using Pre-Post Test intervention, was adopted for the study. A sample of participants, in three groups, totaling ninety-eight (98) was purposively selected from Senior Secondary School II Students studying Physics. Classical Physics Achievement Test (CPAT), which was used as the instrument for data collection was validated and its reliability index was 0.71. The data obtained was analysed using comparison of means and Analysis of covariance (ANCOVA) at 0.05 level of significance. Results of the study revealed that students who were taught Physics using Hausa and those who were taught Physics in Hausa with the aid of ICTeTD instructional mode achieved significantly better than the students taught using English language as the medium of instruction. The result also revealed that students taught Physics using Hausa with the aid of the web-based package achieved better than those taught using Hausa only, with an effect size of 27.2% by partial eta squared estimates. There was no significant difference in the achievement of students based on gender. Based on the findings of this study it was recommended that ICTeTD instructional mode should be adopted in the teaching of Physics in students' mother tongues to aid their understanding of Physics concepts.*

KEYWORDS: evaluation, instructional mode, Kontagora, mother tongue, Hausa, web-based package.

INTRODUCTION

The importance of mother tongue in nation building cannot be over emphasized. It has been said that when somebody talks to you in a language you understand, you respond from the head but when someone talks to you in your mother tongue, you respond from your heart. According to Mkwinda-Nyasulu (2014), the socioeconomic development of a child depends on the development of his/her language because it is a major means of communication and interaction. Based on this, it is imperative and urgent to develop each child's ability to use language for maximum proficiency in learning through listening, viewing, reading and fostering effective use of these skills. Science, Engineering, Technology and innovation (SET & I) have been harnessed as the bedrock of a successful economy, particularly as nations are moving toward knowledge-based economies, communication of SET& I knowledge plays a fundamental role in shaping policy on science related issues and can be considered a driving force for socioeconomic development (Senera & Sarıdoğan, 2014).

National technological breakthroughs can be achieved easily when there is a communication link between scientific knowledge in formal education and the informal education of the local street technicians and artisans. Countries like America, Britain, China, Germany, and currently India that are advancing technologically use their mother tongues to instruct scientific concepts in their schools. In this way it is, easier for their indigenes to understand what they are learning and pass the knowledge to improve on local technology.

Osoba (2014) was of the view that the overall teaching in the schools has very little relationship to the realities of their host communities. For instance, in Nigeria, the language of instruction is alien or foreign in origin. Most of the books used are foreign and unavailable. The knowledge imparted to the youngsters is abstract, far-sounding and of little practical value to their immediate environment.Fafunwa and Fasokun (2000) observed that many of those who worked as illiterate technicians developed the habit of 'Yorubanizing' technical terms. Thus, there were such 'Yorubanized' words as 'kopulu' for couple, 'boila' for boiler, 'wosa' for washer, 'wagunu' for wagon and 'braketi' for bracket. A second scenerio that convinced Fafunwa of the urgent need to promote mother-tongue education happened in Ibo land in the eastern part of Nigeria in 1963, while he was observing the teaching of nature study in Primary IV—a class of 10-year-olds. According to him, the teacher had a colourful picture on the wall showing different animals and vegetation. He wanted the children to describe what was in the picture. Several hands were up. However, when the teacher indicated that he wanted the answers in English, all hands went down. This was a painful situation to Fafunwa and he vowed to promote mother-tongue education whenever the opportunity arose. From the foregoing it shows that we can not undermine the importance of education in one's mother tongue since the learners experiences cannot be separated from his environment if meaningful learning will take place.

According to Haque, Nasrin, Yesmin, and Biswas (2013), most often, pupils acquire the mother -tongue through the informal educational system before they start primary school and they use the languages simultaneously in communication at school. Linguistic studies are generally in consensus that children learn better in the long run when they first build a solid academic foundation in a language they understand, especially a language they speak at home (Alidou, 2004; Dutcher, 2004; Heugh *et al*., 2007; Smits *et al*, 2008). First-language literacy strengthens rather than competes with or subtracts from second-language literacy (Hanemann, & Scarpino, 2016).

It is disheartening that most of science concepts taught in schools are not understood by the students, what we perhaps measure as teaching is simply the understanding of the 'English' of the concept which the students acquire via rote learning. This kind of learning can never transform to any technological development in the country. This is perhaps why over fifty years of Prof. Fafunwa's outcry, the nation has still remained underdeveloped in Science and Technology.

Osoba (2014) opined that in Nigeria, as in all nations of the world, this tends to be the primary goal of establishing secondary and tertiary institutions such as grammar and high schools, the polytechnic, colleges of education and universities. The knowledge and skills acquired in these institutions are therefore expected to translate into concrete personal and national advancement socially, economically and politically. Language naturally provides a ready means for transferring skills and expertise which in turn impact on the students in pursuit of personal and national development goals. Thus, there is the need for competence in the use of the language of education as well as in language of general communication.

From critical observation of science teachers, it has been realized that the issue of language still remains a bottle neck for students in understanding science concepts. Students first struggle to understand the English in the concept before understanding the meaning of the concept itself (Snow, 2010; Bird, Welford, 1995).

In 2017, the Federal Government of Nigeria constituted an inter-ministerial committee comprising Federal Ministry of Science and Technology and the Ministry of Education. The inter-ministerial committee was expected to help develop the capacity of the local languages to serve as effective tools for teaching Mathematics and Science subjects. According to the then Minister of Science and Technology, the project was expected to help Nigerian students to understand Mathematics and science subjects better. ("Nigeria Begins", 2017). According to him, countries like India and China adopted a related strategy by teaching Mathematics and the science subjects in their indigenous languages at the primary school level, and those countries were making advancement in science and technology. ("Nigeria Begins", 2017).

To aid content delivery in mother tongue, there is need to train both In-service and Pre-service Teachers on the use of ICT along the language of the environment. Inclusion of ICT in delivery of content in Science was suggested by UNESCO-IICBA in a model called ICT enhanced Teacher development (ICTeTD) Model (Engida, 2011). This model focuses the teacher who then delivers the content to the students. The domain of the ICTeTD is the use of technology in facilitating students. The ICTeTD model is conceptual in the sense that it provides a visual representation of the concepts/knowledge bases from which teachers draw from during their teaching. The teacher in this case develops in his knowledge of ICT implementation of content delivery from the emerging, to applying, infusing, and transforming stages where he achieves great skills in the teaching of content while inculcating ICT to aid dissemination. A pictorial representation of the model is shown in figure 1.

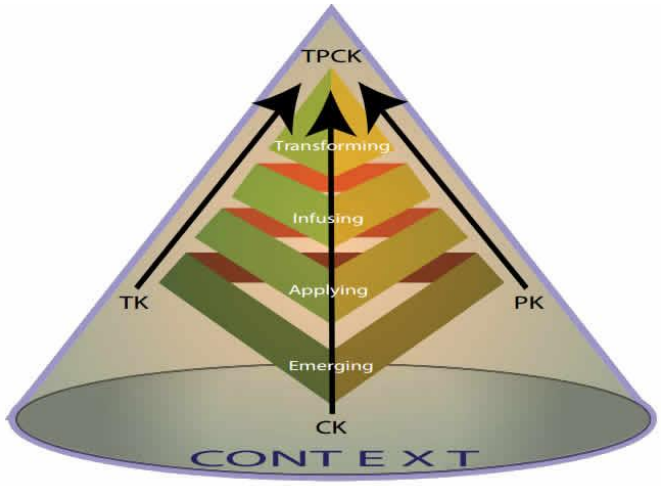


Figure 1. ICTeTD Model (Engida, 2011)

In figure 1, Technological knowledge (TK) and pedagogical knowledge (PK) are in the plane of the page whereas content knowledge (CK) is outward (towards the reader) of the page. In this model, the three knowledge areas are at the same level of forming the pyramid. The pyramid is made of 'fleshes' of TPCK Technological Pedagogical Content Knowledge (TPCK), a transformed knowledge through proper interactions of CK, PK and TK.(Engida, 2011). In this way, even though ICT is used the content Knowledge and the pedagogy are retained and the teacher here enhances the learning of students.

There is need for this kind of models as trends in technology have drifted the attention of most young and even some older people from the traditional ways of doing things. People are more fascinated to things they see and do, than things they read or talk about. From observation, the teaching of Science in this present day is faced with the challenge of drifting interest of students from talk and chalk pedagogy. Students are no longer interested in reading and performance of rigorous calculations with pen and paper especially in Science, Technology, Engineering and Mathematics (STEM) Education (Temaugee & Oladipo, 2015). This has become alarming in the recent years. A close observation has shown that these are years where sophistication in mobile phone and computer technologies have evolved in rapid succession, such as Computer games and Social Media networks (Facebook, 2go, twitter, Instagram, Youtube, Telegram and WhatsApp).

Around the world, most people have come to believe that the approaches which place a greater emphasis on student centered learning processes in which students construct their knowledge and are responsible for learning, rather than the approaches based on teacher centered instruction should be used. Applying such methods, it will be possible to bring forth the creative thinking, intelligence and individual skills of students (Winey & Squibb, 1991; Banerjee & Yager, 1995).

Research has also shown that the use of first language or mother tongue in teaching science and mathematics yields better results (Fafunwa & Fasokun, 2000; Alidou, 2004; Dutcher, 2004; Heugh *et al*., 2007; Smits *et al.*, 2008). Thus, the need to develop an instructional mode that is based on mother tongue in Physics. With the advent of the computer age, many researches has been undertaken to determine the contribution of technology to learning outcomes. The results vary widely according to context, but it is theorized that technology can have a positive impact on the developing world where teachers and resources are scarce. (STELLAR, 2013). Nigeria has yearned for technological development for a long time but there have been many setbacks, and language, among others cannot be exonerated as long as the lingua franca has a place in the teaching and learning process.

It is worthy of note that Fafunwa's project on the teaching of mathematics and Science in indigenous language (Yoruba) was a success and as such this can be replicated in many other languages and subjects. Hence, well strategized instructional modes can bring about meaningful learning that will transform Nigeria. This is what this work seeks to experiment using an ICTeTD based model of teaching Physics using Hausa. In testing a mode of instruction, it is instructive to check whether or not it will have any gender effect. Research conducted (Abdullahi, et al 2015, Adigun, et al 2015, Akano, et al 2018 and Ekemezie, 2019) on the use of ICT in teaching Physics that gender has no significant effect on the level of achievement of students. In this study also we will check gender effect on the ICTeTD mode of instruction. English is used as the medium of instruction in Nigerian schools. However, in most states of Northern Nigeria, students do not have a firm grasp of this language, only a minute percentage of secondary school students in the population understands and speaks the language well enough to comprehend concepts that are taught. As a result, the students are unable to effectively understand and assimilate Science concepts especially those in Physics. This has led to an ineffective Physics education, which make tens of thousands of students graduating yearly unable to understand the subject.

The choice of Hausa stems from the fact that it is a Chadic language (a branch of the Afroasiatic language family) and the location of the teacher training institutes for the study Northern Nigeria host the largest number of speakers of Hausa. Hausa is spoken as a first language by some 44 million people, and as a second language by another 20 million. The total number of Hausa speakers is estimated at 63 million, according to Ethnologue (Wolff, 2013). The ancestral language of the Hausa, the language of the Hausa

people, who are one of the largest ethnic groups in West Central Africa, is mostly spoken throughout southern Niger and northern Nigeria. The home territories of the Hausa people lie on both sides of the border between Niger, where about half of the population speaks Hausa as a first language, and Nigeria, where about one-fifth of the population speaks it as a first language. It has developed into a lingua franca across much of West African countries, for economic activities. A small group, in the US that migrated from Ghana speaks Hausa (Wolff, 2013).

The basic word order of this language is subject–verb–object (SVO). It is a tonal language, a classification in which pitch differences add as much to the meaning of a word as do consonants and vowels. Tone is not marked in Hausa orthography. In scholarly transcriptions of Hausa, accent marks indicate tone, which may be high (acute), low (grave), or falling (circumflex) which is also good for classroom demonstration (Wolff, 2013).

Theoretical Framework

The theoretical framework guiding this work is the constructivists learning theory. Constructivism stems from the work done by several theorists such as Vygotsky, Brunner and Piaget. The constructivist theoretical framework holds that, learning always builds upon knowledge that a student already knows. Constructivism paradigm believes that knowledge is constructed through one's own personal experiences and interactions with the outside world. Thus, the learners take up an active role in the construction of knowledge, and teachers facilitate this endeavour. Lev Vygotsky introduced social constructivism, in which social interaction with others was deemed helpful to the learner in giving meaning to information. Lev Vygotsky's (1896–1934) contribution to constructivism derives from his theories about language, thought, and their mediation by society. Two perspectives of this theory are examined in this study.

First is the Language perspective, Vygotsky noted that learners can develop a certain level of meaning on their own, but it can grow even greater after interacting with classmates and instructors. That is where the role of language comes in. Language plays a vital role in communication. Students need to understand the language of teaching to understand the concepts being taught better. In fact, the theory lays emphasis on the use of mother tongue in the process of learning since one does not learn from abstract but from what is contextualized to one's mind. (Ziglari & Birjandi, 2012).

Also, learners construct their own process and learn at their own pace by the help of teachers, parents, peers, or other people in the community as opposed to getting information from the teachers as in behaviorist approach to learning. They are active processors of information through the guidance received from the environment. According to some researchers (Kaufman, 2004; Yurdabakan, 2011) constructivism in education have its roots in cognitive and social notions. Since the environment contributes to their ability of making knowledge for themselves, the mother tongue(or what is called the language of the immediate environment) has an influence on the learner. Suffice it to say that if learners acquire knowledge in foreign languages, learning may not translate to reality around the child's environment. Hence, learning becomes abstract especially in natural sciences where the student learns as he interacts with his environment. This is because students learn better when they are able to think and/or reflect on what they are taught in the language they understand.

Another aspect of Constructivism as a major learning theory is that it connects this study particularly to the teaching and learning of science. Piaget suggested that, through accommodation and assimilation, individuals construct new knowledge from their experiences (De Lisi, 1979; Cole & Wertsch, 2002,). Constructivism views learning as a process in which students actively construct or build new ideas and

concepts based on prior knowledge and new information. The constructivist teacher is a facilitator who encourages students to discover principles and construct knowledge within a given framework or structure. The teachers aim is to help students connect with prior knowledge and experiences as new information is presented, so they can discard with their misconceptions and build a correct understanding. Feymour Papert, a student of Piaget, in his work asserted that learning occurs when people are engaged in constructing a product. Papert's approach, known as constructionism, is facilitated by model building, robotics, video editing and similar construction projects (De Lisi, 1979;London, 1988).

We can learn through any of our five senses, but the three most valuable are vision, hearing, and touch. Theorists and practitioners claim that learners have a preference for one learning style over another. Visual learners learn best by watching, while auditory learners learn best by verbal instruction, and kinesthetic learners learn best by manipulation. Due to the demands of the profession, teachers often resort to the instructional style that requires the least time and preparation, namely lecture and discussion. It should be noted, however, that even lecture can be an active learning event if students process and filter information as it is provided. Hence, technology and constructivist theory –provides a better use and integration of technology tools into the classroom in an effective manner.(Rashid, Ghose & Cohen, 2015).

Several studies conducted in Nigeria and abroad (Hogart, et al, 2006; STELLAR, 2013; Cruz-Jesus et al 2013; Khan et al, 2015 & Abdullahi, et al 2015) on the effect of ICT on learners achievement in Science have claimed that ICT has positive effect in the achievement of students' learning outcomes in Science. This informed the researchers' decision to compliment the instruction in Hausa with ICTeTD mode of instruction.

The aim of the study was to develop and evaluate the effect of an ICT enhanced Teacher development mode of Instruction in Hausa on the teaching and learning of concepts in Physics. The specific objectives of the study were to:

- develop an ICTeTD Instructional mode in Hausa
- use the instructional mode to teach some concepts in Physics
- compare the achievement of students who study Physics in their first language and those who study in English.
- evaluate the effects of ICTeTD instructional media on the cognitive learning outcomes of students in Physics.
- proffer suggestions for better conceptual instructional and understanding modes in Physics, with emphasis on the language factor.

To do this, the following research questions were addressed in the study:

(i) What is the level of academic achievement of students taught Physics concepts in English and those taught in Hausa Language?

(ii) What is the level of academic achievement of students taught Physics concepts in English and those taught in Hausa, with the aid of ICTeTD mode of instruction?

(iii) Is there any gender influence on the level of achievement of students taught Physics concepts in Hausa with the aid of ICTeTD mode of instruction?

In order to make valid inferences, the following hypotheses were tested:

(I) There is no significant difference in the academic achievement of students taught Physics in English and those taught in Hausa.

(ii) There is no significant difference in the academic achievement of students taught Physics in English and those taught in Hausa with the aid of ICTeTD mode of instruction.

(iii) There is no significant gender influence on the level of achievement of students taught Physics in Hausa with the aid of ICTeTD mode of instructional.

METHODOLOGY

Research Design

In this study, a quasi-experimental design which uses Pre-Post Test interventions study was employed. It is an empirical interventional study used to estimate the effects of Hausa as a medium of teaching Physics in schools. This design was employed, because it is not possible to randomize the subjects of the study without disrupting the school setting. The researchers also looked at the possible effects of using students' first language (L1) (in this case Hausa) as a medium of teaching concepts in Physics with the aid of ICT media, which is termed ICT enhanced Teacher development (ICTeTD) Medium of instruction. The ICTeTD media was web-based package developed where instructions in Hausa with animations and videos relating to the topics were presented to students by means of overhead transparencies.

Population and Sample size

The target population for the study constituted all public senior secondary schools students studying Sciences especially Physics, in Kontagora Schools. A purposive sampling technique was used to select three senior secondary schools from the target population. From each school, students were selected based on their proficiency (reading and writing skills) in their first language (L1), which is Hausa.

At least thirty (30) students comprising boys and girls, from Senior Secondary two (SSII) were sampled for the study. In total, ninety-eight (98) students were selected for the study. One of the three schools selected, was used as the control group, where the selected Physics concepts were taught in English (which is the conventional way of teaching Physics in Nigerian Secondary Schools). Hence, this mode of teaching was termed conventional instructional strategy.

The second group was the experimental group I. It was the first intervention group where Hausa was used as the medium of instruction. The third school was the second intervention group called experimental group II. In this intervention group, students were taught Physics in Hausa with the aid of ICT media termed ICT enhanced Teacher Development (ICTeTD) mode of instruction. The ICTeTD mode of instruction was a web-based instructional medium designed by the researchers for Physics instruction in Hausa with English interpretation. Grouping of the selected schools into groups was done by simple random sampling. The students were randomly grouped in the selected schools to avoid interaction during the treatment phase of the study.

Instrument for Data Collection

The researchers developed a Classical Physics Achievement Test (CPAT) which served as the main instrument for data collection. The test was drawn from the concepts of motion and matter of the senior secondary school (SSS) curriculum of Physics. The Classical Physics Achievement Test (CPAT) included a 20 multiple choice questions in English which were translated in Hausa Language (*See appendix A*). The items were subjected to face validation by experts in Physics and Educational Measurement and Evaluation after which a pilot test was conducted on twenty (20) non-participating students. Validity of a research instrument assesses the extent to which the instrument measures what it was designed to measure (Robson, 2011). To deduce whether the test items were construct effective, items were analyzed using factorial analysis, the communalities extraction for the 20 items ranged from 0.715 to 0.995. This implies that, the items of the questionnaire were well constructed.

The reliability of the instrument was also checked to ensure internal consistency. Answers to the 20-question achievement were transformed into a binary form of '0-fail', and'1-pass' for success and failure of a question respectively. The Cronbach's Alpha test yielded a Coefficient of 0.71. With Cronbach's statistic, a reliability index of 0.70 or higher is required for the use of an examination (El-Uri & Malas, 2013). Most items appeared to be worthy of retention, resulting in decrease in the coefficient if deleted by Inter-Item Correlation Matrix.(*See appendix C*)

Procedure for Data collection

Science Students of Senior secondary II category in the three selected schools were categorized into the control group, experimental group 1 and the experimental group 2. A Pre-Test of 20 items drawn in English from the concepts of motion and concept of matter in Classical Physics was administered to them. The scores obtained by each student in the Pre-Test were recorded for all groups. A six (6) weeks treatment was given to all groups in all the participating schools. The control group was taught the concepts of matter and motion using the conventional instructional Strategy. Students in Experimental group 1 were taught the same concepts in Hausa while the experimental group 2 were also taught the same concepts in Hausa with the aid of the ICTeTD mode of instruction (Web-based Package). The package was designed using html and JavaScript to gain access online through any device (computers, smart phones and Tablets). The web-based package can be accessed via https://www.phyhau.sciencesfcekg.sch.ng. After the treatment, the items on the Classical Physics Achievement Test (CPAT) were rearranged and given as the Post-Test to all the groups under study and their scores in the groups were recorded for each student. The results for the Pre-Test and Post-Test were subjected to statistical analysis.

Data collection and Analysis

In order to quantitatively analyze the data obtained from the Pre and Post-Test, the mean values obtained were compared in the descriptive statistics. For inferential statistics, Analysis of Covariance (ANCOVA) was used to test the hypotheses. The Post-Test scores were used as the dependent variable; the Group (Control, Experimental group 1 and Experimental group 2) was the fixed factor or the independent variable and the pre-test served as the covariate. The purpose of using the pretest scores as a covariate in ANCOVA with a pretest-posttest design was to reduce the error variance and eliminate systematic bias. Another advantage of ANCOVA over other statistical approaches like ANOVA on gain scores is that when some assumptions do not hold, ANCOVA allows for modifications leading to appropriate analysis, whereas the gain score ANOVA does not (Dimiter, Dimitrov & Rumrill, 2003). In this study, the data met all the assumptions of ANCOVA. Analysis of covariance was performed using the Statistical Package for the Social Sciences (SPSS) IBM 23 version.

Ethical Consideration

The researchers maintained the core research ethics of anonymity and the data collected were used only for the purpose of the study.

RESULTS

Participant's Profile

The data collected were analysed. The demographic details are shown in Table 1

Table 1: Participant's Characteristics

Variable	Frequency	Percentage (%)
Group		
Experimental Group I	30	30.6
Experimental Group II	38	38.8
Control Group	30	30.6
Gender		
Male	47	48.0
Female	51	52.0
Total	**98**	**100.0**

The Sample constituted a grouping variable with 30 (30.6%) students each in the control group and the Experimental Group 1 while the experimental Group 2 had 38 (38.8%) students. 47(48.0%) were male students while the female had a percentage composition of 51(52.0%). Graphical representation of the variables is shown in figure. 2 and figure 3.

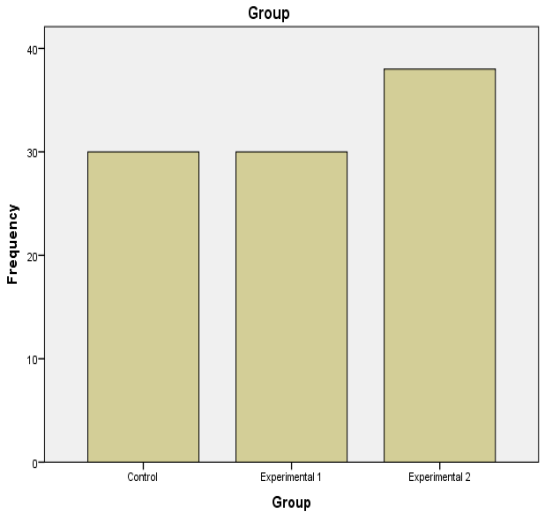
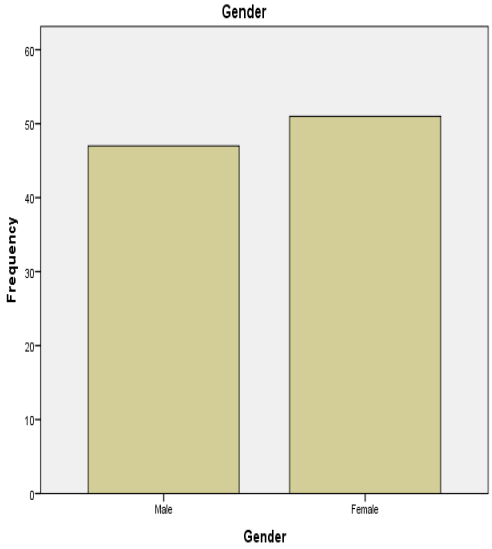


Fig2:



Composition of the grouping variable

Fig. 3: Gender composition

Achievement of Students Taught Physics in the Conventional Instruction mode and Hausa

In order to ascertain the level of achievement of students in the control and Experimental group 1, Scores obtained by students in the Pre-Test and Post-Test (*See Appendix B*) were subjected to statistical analysis using Analysis of Covariance (ANCOVA) where the dependent variable was the Post-Test, the group was the independent variable and the pre-test served as the Covariate. Descriptive and inferential statistics obtained were used to answer the research question1 and test hypothesis 1 respectively. Results obtained are shown in table 2 and table 3 below.

Table2: Descriptive Statistics
Dependent Variable: Post-Test

Group	Mean	Std. Deviation	N
Control	9.8333	2.54725	30
Experimental 1	12.1000	2.02314	30
Total	10.9667	2.55095	60

Table 3a: Levene's Test of Equality of Error Variances[a]
Dependent Variable: Post-Test

F	df1	df2	Sig.
.060	1	58	.807

Table3b:Tests of Between-Subjects Effects
Dependent Variable: Post-Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	108.425a	2	54.212	11.216	.000	.282
Intercept	268.888	1	268.888	55.630	.000	.494
Pretest	31.358	1	31.358	6.488	.014	.102
Group	76.171	1	76.171	15.759	.000	.217
Error	275.509	57	4.833			
Total	7600.000	60				
Corrected Total	383.933	59				

a. R Squared = .282 (Adjusted R Squared = .257)

From table 2, the participants in the two groups were subjected to treatment after the pre-test. The mean scores of those taught Physics in Hausa (Experimental Group 1) was 12.100 while those taught Physics Practical by conventional instructional medium (Control group) had a mean of 9.8333. These results show that the Experimental group 1 performed better than the control group after the treatment. This shows that those taught Physics in Hausa performed better than those taught using the conventional medium of instruction (English). To test whether the result was significant or not, the ANCOVA results shown in table 3a and b were considered. From table 3a, the result of the Levene's test shows that the data meets the homogeneity of variance assumption, since the p-value is greater than 0.05. In table 3b, the ANCOVA result yielded $F(1, 57) = 15.759$, $P = .000$, $\eta^2 = .217$. This implies that there is a statistical significant difference between the adjusted means ($p < .05$). The observed higher means of the experimental group 1 students over the control group in the descriptive statistics is significant. Therefore, the null hypothesis that '*There is no significant difference in the academic achievement of students taught Physics in English and those taught in Hausa'* was rejected as there exist strong statistical evidence that there is a significant difference in the mean scores of students at Post-Test. This is also supported by the 21.7% effect size observed based on partial eta squared estimates. Graph of estimated marginal means shown in figure 4 shows the experimental group 1 had higher marginal means than the control group.

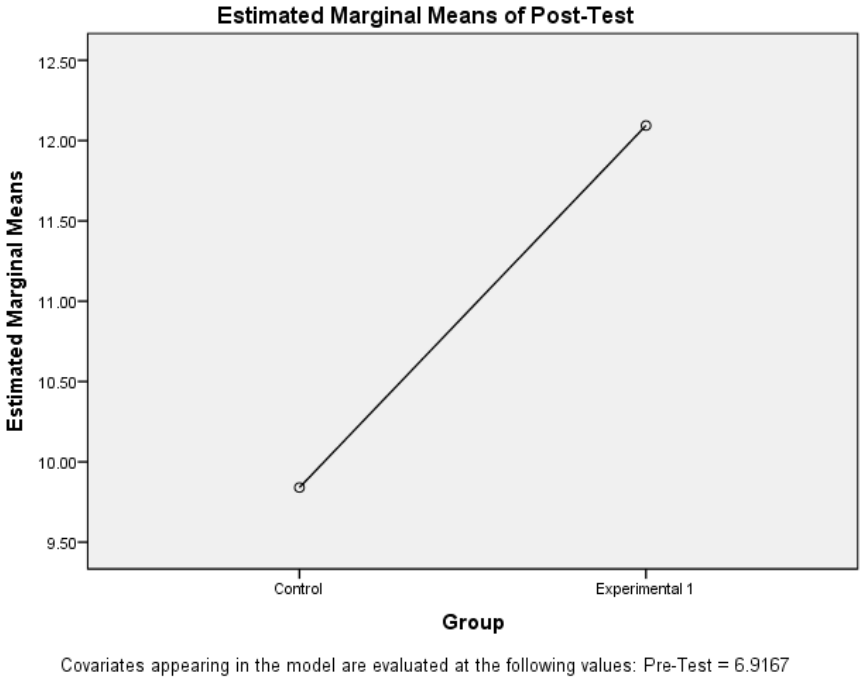


Figure 4: Estimated marginal Means of Post-Test Scores for Experimental 1 and control group

Level of achievement of students taught Physics in the conventional instructional Strategy and those taught in Hausa with the aid of ICTeTD mode of instruction

The level of achievement of students taught Physics in the conventional mode (control group) and the second intervention group, (those taught Physics using Hausa) with the aid of ICTeTD mode of instruction (Experimental group 2) was examined. The scores obtained by students in the Pre-Test and Post-Test (*See Appendix B*) were subjected to statistical analysis using univariate ANCOVA. The choice of univariate ANCOVA was to look at the specific differences between groups and the effect size of the interventions. Here, the dependent variable was the Post-Test. The grouping variable was the group and the covariate was the Pre-Test . Comparison of means and ANCOVA statistic were used to answer the research question2 and to test hypothesis 2, results of which are presented in table 4, and table 5 below.

Table 4: Comparison of Means between Control and Experimental group 2

Dependent Variable: Post-Test

Group	Mean	Std. Deviation	N
Control	9.8333	2.54725	30
Experimental 2	12.0789	2.18572	38
Total	11.0882	2.59008	68

Table 5a: Levene's Test of Equality of Error Variances[a]

Dependent Variable: Post-Test

F	df1	df2	Sig.
.204	1	66	.653

Table 5b: Tests of Between-Subjects Effects
Dependent Variable: Post-Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	140.106[a]	2	70.053	14.719	.000	.312
Intercept	324.925	1	324.925	68.269	.000	.512
Pretest	55.565	1	55.565	11.675	.001	.152
Group	115.450	1	115.450	24.257	.000	.272
Error	309.365	65	4.759			
Total	8810.000	68				
Corrected Total	449.471	67				

a. R Squared = .312 (Adjusted R Squared = .291)

From table 4, the participants in the Experimental Group 2 had a mean score of 12.070 while those in the Control group had a mean of 9.8333. These results show that the Experimental group 2 performed better than the control group after treatment. This implies that those taught Physics in Hausa with the aid of ICTeTD mode of instruction achieved better than those taught in the conventional mode of instruction (English).

Analysis of Covariance (ANCOVA) performed to check the statistical significance of the results obtained in the descriptive is shown in table 5a and b. From table 5a, the result of the Levene's test shows that the data meets the homogeneity of variance assumption, since the p-value (P=.653) is greater than 0.05. In table 5b, the ANCOVA result shows that $F\ (1, 65) = 24.257,\ P = .000,\ \eta^2 = .272$. This implies that there is a statistical significant difference between the adjusted means of the groups since ($p < .05$). The observed higher means of the experimental group 2 over the control group in the descriptive statistics is significant. Therefore, the null hypothesis that says '*There is no significant difference in the academic achievement of students taught Physics in English and those taught in Hausa with the aid of ICTeTD mode of instruction'* was rejected as strong statistical evidence that there is a significant difference in the mean scores of students at Post-Test exist. This is also supported by the 27.2% effect size observed based on partial eta squared estimates. Graph of estimated marginal means shown in figure 5 presents experimental group 2 with higher marginal means than the control group.

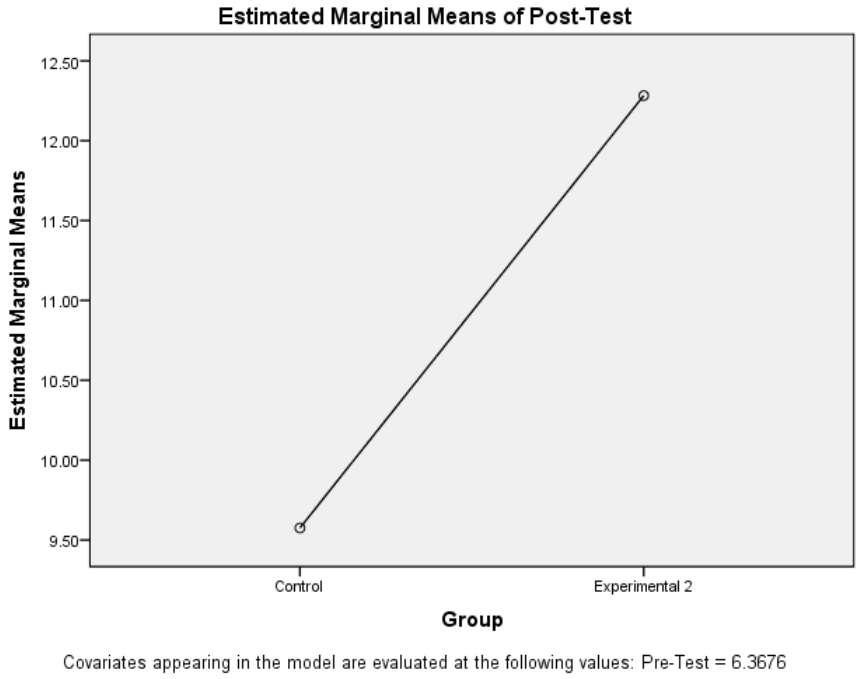


Figure 5: Estimated marginal Means of Post-Test Scores for Experimental 2 and control group

Effect of Gender on the level of achievement of Students

The results in table 6 shows that the mean scores of male participants in post-test which is 11.9149 is higher than that of their female counterparts which had a mean score of 10.9216. This implies that there was achievement for both male and female students taught in Hausa with the aid of ICTeTD mode of instruction. However, the male students performed better than their female counterparts.

Table 6: Comparison of means on gender effect

Dependent Variable: Post-Test

Gender	Mean	Std. Deviation	N
Male	11.9149	2.07291	47
Female	10.9216	2.71178	51
Total	11.3980	2.46518	98

Table 7a: Levene's Test of Equality of Error Variances[a]

Dependent Variable: Post-Test

F	df1	df2	Sig.
1.096	1	96	.298

Table 7b: Tests of Between-Subjects Effects

Dependent Variable: Post-Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	55.244[a]	2	27.622	4.912	.009	.094
Intercept	720.273	1	720.273	128.082	.000	.574
Pretest	31.110	1	31.110	5.532	.021	.055
Gender	20.396	1	20.396	3.627	.060	.037
Error	534.236	95	5.624			
Total	13321.000	98				
Corrected Total	589.480	97				

a. R Squared = .094 (Adjusted R Squared = .075)

Analysis of Covariance (ANCOVA) was used to test the null hypothesis 3. The mean post-test score was the dependent variable while gender was the fixed factor and the Pre-Test was used as the Covariate. From Table 7a, the result of the Levene's test shows that homogeneity of variances assumption was not violated, since the p-value (P=.298) is greater than 0.05. The test of between-subjects Effects yielded F (1, 95) = 3.627, P = .060 (>.05). This implies that the observed higher mean scores of the male students over their female counterparts is not statistically significant since the p value is >.05; Therefore, the null hypothesis is retained as there was no evidence that there is a significant difference in the mean scores of male and female students taught Physics concepts in Hausa with the aid of ICTeTD mode of instruction.

DISCUSSION OF FINDINGS

The aim of this research was to develop and evaluate the effect of an ICT enhanced Teacher development Instructional Media in Hausa on students learning outcomes in Physics. From the results obtained in research hypothesis 1 in this study, students who were taught Physics concepts in their first Language (L1) achieved better than those who were taught in the conventional medium of Instruction (English). This result agrees with Kocakulah, Ustunluoglu and Kocakulah's (2005) work which revealed that students taught science in native languages performed better than students taught science in foreign languages.

Results obtained for research hypotheses 1 of this study are also in line with the assertions of Johnstone and Selepeng (2001) that students who learn science in a second language lose at least 20 percent of their capacity to give thought to and understand the concepts learnt. (Kocakulah *et al.*, 2005). The findings of this research are consistent with the other researches that have shown that the use of first language or mother tongue in teaching science and mathematics yields better results (Fafunwa & Fasokun, 2000; Alidou, 2004; Dutcher, 2004; Heugh et al., 2007; Smits et al, 2008).

Many researches have been carried out to check the effect of ICT media instructional materials on the academic achievement of students in sciences. The STELLAR, (2013) project showed that ICT impact positively on the academic performance of students. Cruz-Jesus et al. (2013) analyzed several studies related to the impact that ICT had made on educational institutions in Europe. Their findings indicated that there was a limited and incomparable evidence of impact of ICT adoption on students' performance
On the effects of ICT on students' academic performance, Khan et al (2015: 88) opined that:

> The positive impact of ICT use in education has not been proven. In general, and despite thousands of impact studies, the impact of ICT use on student achievement remains difficult to measure and open to much reasonable debate. Positive impact is more likely when linked to pedagogy. It is believed that specific uses of ICT can have positive effects on student achievement when ICTs are used appropriately to complement a teacher's existing pedagogical philosophies. Also Computer Aided Instruction has been seen to slightly improve student performance on multiple choice, standardized testing. In some areas Computer Aided (Assisted) Instruction (CAI), which refers generally to student self-study or tutorials on PCs, has been shown to slightly improve student test scores on some reading and Mathematics skills, although whether such improvement correlates to real improvement in student learning is debatable.

In this study, it was observed that students who were taught the concepts of motion and matter in Hausa with the aid of ICTeTD media achieved significantly better that those taught in Hausa only. Comparing the effect size by partial eta squared estimates, students taught in Hausa with the aid of ICT had a higher effect size of 27.2% as against the 21.7% gained by students who were taught in Hausa only over the control

group. This result is consistent with the analysis done by Hogarth, Bennett, Lubben, Campbell, and Robinson (2006). Several works done on ICT were reviewed and they came out with a conclusion that ICT had a positive effect on the learning of Science education.

Results of research hypothesis 3 in this study revealed that there was no statistical significant difference in the performance of Male and Female students taught Physics concepts in Hausa based ICTeTD instructional media. This finding of the study is consistent with the findings of Abdullahi, et al (2015), Adigun, et al (2015), Akano, et al (2018) and Ekemezie (2019) who found that there was no significant difference in the performance of male and female students. According to Brewer (2003), providing opportunities to interact with course materials through the use of computers and information technology tends to change the course from competitive endeavor to one that is more collaborative, student-centered and focused on the cognitive development and construction of knowledge in the students irrespective of their gender. The obvious implication is that any male or female student selected from the group has similar performance; hence, the instructional strategy used is not gender biased.

In this research however, there were challenges faced by the researchers, first of all, translation of Physics content into Hausa needed a Professional in Hausa and a validation of the translated materials to ensure that the original English meaning of the concepts were not lost. Secondary, movement of ICT gadgets to the intervention school since the school lacked such ICT facilities. Also, the researchers had challenges with internet connection services.

CONCLUSION

Development and evaluation of L1 (Mother Tongue) Hausa Based ICT Enhanced Teacher Development (ICTeTD) Mode of Instruction in Physics has been carried out. From the result of the study, it can be inferred that the medium of instruction affects students learning outcomes in Physics. The Hausa based ICTeTD instructional media is seen to have enhanced the performance of students in Physics significantly. This implies that using Hausa to teach Physics has a significant positive effect on the academic achievement of students in Physics. The results also show that teaching in students' first languages (L1) with the aid of ICTeTD Media has significant influence on students' academic achievement in Physics. The implication of this is that ICT is an instructional media that aids the teaching of new Pedagogies and make teaching and learning more flexible. It contributes to the academic achievement of students in the teaching and learning of Physics. This study along with others reviewed shows that there is no significant difference in the academic achievement of students from gender perspective.

The educational implication of this research is that if instructions in Physics are carried out in students' first languages (L1) or mother tongues along with ICT media technologies, Learning will become real and student will able to create knowledge for themselves based on their experiences in their environment. There will be good interaction and communication of ideas between Science students and local technicians in their immediate communities. There are far reaching benefits to the learning outcomes of students, since this knowledge will be transferred to local technology in Hausa in which the students have created thoughts as they learn. Many nations that have developed technologically have had their Physics instructions in their mother tongues. It should be noted that if first languages in different geopolitical zones of Nigeria is used as a medium for teaching Physics, meaningful learning would take place and this would translate into sustainable national technological development in Nigeria.

Recommendations

Based on the findings of this research the following recommendations are made:

- Hausa Based ICTeTD mode of instruction should be introduced into the Nigerian school system to enhance cognitive learning outcomes in Physics.
- There is need for professionals to translate Physics content to Hausa and other languages in Nigeria that would want to harness the opportunities in learning through L1.
- ICT facilities are paramount in modern day learning and should be provided by government, administrators and all stake holders in the educational sector in Nigeria.
- Nigeria should look forward to developing Physics and Science content in L1 in different geopolitical zones.
- Institutions of higher learning and research institutes should conduct more researches on the teaching and learning of Science in different L1 of students in Nigeria.
- There is need for all stakeholders in the educational sector in Nigeria to provide adequate in-service training for their teachers across the geo-political zones in other to educate them on the effect of L1 on learning outcomes of students in Sciences.

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REFERENCES

Abdullahi, M., Dania, C.M., Daniel, T.A. & Lasisi, A.R. (2015). *The Effects of Virtual Laboratory Experiments on Students' Conceptualization and Academic Achievement in Physics Practical*. An Institutional Based Research (IBR). 2011 TETFUND Research and Publication Grant. Kontagora, Unique Press.

Adigun, J., Onihunwa, J., Irunokhai, E., Sada, Y.& Adesina, O. (2015). Effect of Gender on Students' Academic Performance in Computer Studies in Secondary Schools in New Bussa, Borgu Local Government of Niger State. *Journal of Education and Practice* www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) 6(33).

Akano B.U, Kinta M, Nma A.H, & Temaugee S.T. (2018). Assessment of knowledge and understanding of laboratory Health practices among secondary school students in North-Central, Nigeria. *International Journal of Education, Learning and Development.* 6,(12),.38-51, December 2018

Alidou, H. (2004). Medium of instruction in post-colonial Africa. Medium of Instruction Policies: Which Agenda? Whose Agenda? *In J. Tollefson and A. Tsui (Eds.*). 195 214. Mahwah and London: Lawrence Erlbaum.

Banerjee A.C.& Yager R.E. (1995). Changes in student perceptions about science classes and the study of science following science-technology-society instruction. *Sci. Educ*., 4: 18-24.

Bird, E. & Welford, G. (1995). The effect of language on the performance of second-language students in science examinations, International Journal of Science Education, 17:3, 389-397, DOI: 10.1080/0950069950170309

Cole, M., & Wertsch, J. V. (2002). Beyond the Individual-Social Antimony in Discussions of Piaget and Vygotsky. www.massey.ac.nz/~alock/virtual/colevyg.htm.

Cruz-Jesus, F., Vicente, M. R. Bacao, F. & Oliveira, T. (2016). "The education-related digital divide: an analysis for the EU-28," *Computers in Human Behavior*, 56, 72–82, 2016.

De-Lisi, R. (1979). *The Educational implication of Piaget's theory and assessment technique*. Eric clearinghouse on Test, Measurement and evaluation, Princeton, New Jersey. USA

Dimiter M. Dimitrov and Phillip D. Rumrill, Jr.(2003).*Pretest-posttest designs and measurement of change.* Work 20 (2003) 159–165, IOS Press. https://www.researchgate.net/publication/10826237

Dutcher, N. (2004). *Expanding educational opportunity in linguistically diverse societies.*
(2nd ed.). Washington, DC: Center for Applied Linguistics. <www.cal.org>.BarcelonaTalkFinal 5/10/04.

Ekemezie, B.U. (2019). *Effects of ICT mode of instruction on the academic Achievement of students in modern Physics in Private secondary schools of Kontagora, Niger state*. An unpublished B.Sc.Ed research Project submitted to the department of Physics FCE Kontagora in Affiliation with Ahmadu Bello University Zaria.

El-Uri, F.I. & Malas, N. (2013). Analysis of use of a single best answer format in an undergraduate medical examination. *Qatar Med J. ;* 2013(1): 3–6. Published online 2013 Nov 1. doi: 10.5339/qmj.2013.

Enderby, J (2008). *Knowledge, validation and Transfer: Science, communication and Economic development. Science and Technology and the Future development of societies*. International workshop proceedings The National Academic Press. Open book. Washington D.C 20001.Retrieved from www.nap.edu/openbook.php.

Engida, T. (2011). *ICT-enhanced Teacher Development Model.* UNESCO-IICBA P.O.Box 2305, Addis Ababa, Ethiopia Layout and Graphic Design: Daniel Ergetachew.

Fafunwa, B.A & Fasikun, O.T. (2000). Prospects: the quarterly review of comparative education. UNESCO: International Bureau of Education, 2000.

Haque, M. N., Nasrin, S., Yesmin, M. N. & Biswas, M. H. A. (2013). Universal Pre-Primary Education: A Comparative Study *American Journal of Educational Research*, 1(1), 31-36. DOI:10.12691/education-1-1-7

Hanemann, U. & Scarpino, C (2016). Literacy in multilingual and multicultural contexts: effective approaches to adult learning and education. UNESCO Digital Library. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000245513

Heugh, K., Benson, C., Bogale, B. & Gebre Yohannes, M. A. (2007). Final Report: Study on Medium of Instruction in Primary Schools in Ethiopia. Research report commissioned by the Ministry of Education, Addis Ababa, September to December 2006. Retrieved from http://www.hsrc.ac.za/research/output/outputDocuments/4379_Heugh_Studyonmediumofinstruction.pdf.

Hogarth, S., Bennett, J., Lubben, F., Campbell, B. & Robinson, A. (2006) . *ICT in science teaching. Technical report. In: Research Evidence in Education Library.* London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London. Report 1412T.

Johnstone, A. and Selepeng, D. (2001). A language problem revisited. Chemistry Education: *Research and Practice in Europe*, 2(1), 19-29.

Kaufman, D. (2004).Constructivist issues in language learning and teaching. *Annual Review of Applied Linguistics* 24:303 – 319. DOI: 10.1017/S0267190504000121

Khan, M.S., Khan, I., Din, S., Ismail, H.M., Khattak, R., & Jan, R. (2015). The impacts of ICT on the students' Performance:A Review of Access to Information. *Research on Humanities and Social Sciences www.iiste.org.*. 5(1), 85-94.

Kocakulah, Ustunluoglu & Kocakulah (2005). The effect of teaching in native and foreign language on students' conceptual. understanding in science courses. *Asia-Pacific Forum on Science Learning and Teaching*, 6(2), p.1 (Dec., 2005).

London, C. (1988). A Piagetian constructivist perspective on curriculum development. *Reading Improvement*, 27, 82-95.

Mkwinda-Nyasulu, B. (2014). Role of language in socio-economic development: the semiotics are right. *Journal of Humanities (Zomba)*. 23, 213-230 .https://www.ajol.info/index.php/jh/article/viewFile/151922/141518.

Nigeria begins moves to teach maths, science subjects in indigenous languages. (2017, May 31). Premium Times. Retrieved from http://www.premiumtimesng.com/news/232659-nigeria-begins-moves-to-teach-maths-science-subjects-in-indigenous-languages.html.

Olaniran, O.H. (2019). *Effect of Computer-Based Multimedia Instructional strategy on senior Secondary School students' Academic performance in Physics Practical in Kontagora Niger State*. An Unpublished B.Sc.Ed research Project submitted to the department of Physics FCE Kontagora in Affiliation with Ahmadu Bello University Zaria.

Osoba, J.B. (2014). Language, education and manpower development in the Present-day Nigeria. *Journal of Education and Practice.* 5(7) 86-96. www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online).

Rashid, S. M., Ghose, K., & Cohen, D. A. (2015). Brand Identity: Introducing Renewed Concept For Coffee Shops. PEOPLE: *International Journal of Social Sciences*, 1(1), 82-90.

Robson, C. (2011). *Real World Research:* A Resource for Users of Social Research Methods.

STELLAR, (2013). Project Rationale. American University of Nigeria. Retrieved from http://www.aun.edu.ng/about/dev/stellar/104-project-rationale.

Sener, S. & Sarıdoğan, E. (2011). The Effects of Science-Technology-Innovation on Competitiveness and Economic Growth. *Procedia Social and Behavioral Sciences* 24 (2011) 815–828. Published by Elsevier Ltd. Selection and/or peer-review under responsibility of 7th International Strategic Management Conference.doi:10.1016/j.sbspro.2011.09.127

Smits, J. Huisman, J.& Kruijff, K. (2008). *Home language and education in developing world*. UNESCO background paper prepared for the education for all Global Monitoring report 2009. 2009/ED/EFA/MRT/PI/21.

Snow, C.E. (2010). Academic Language and the Challenge of Reading for Learning About Science. *Science* 328 (5977):450-2. DOI: 10.1126/science.1182597

Temaugee, S.T. & Oladipo, E.O. (2014). Computer Aided Analysis of Experimental Results in Physics At Post Basic And Tertiary Institutions in Kontagora North Central Nigeria. *Proceedings of the 37th National Conference of the Nigerian Institute of Physics (NIP)*. Held at Oduduwa University Ipetomodu, Ife, Osun state. 26-31 October, 2014.

Wolff, H. E. (2013). *Hausa language. Encyclopædia Britannica*.https://www.britannica.com/topic/Hausa-language. October 05, 2020

Yurdabakan, I (2011).The influence of peer and self-assessment on learnin and metacognitive knowledge: consequential validity. *International Journal on New Trends in Education and Their Implications.* 2 (4). Article: 6 ISSN 1309-6249

Ziglari L., Birjandi P. (2012) Meaning Development in Child Language: A Constructivist Approach. In: Seel N.M. (eds) *Encyclopedia of the Sciences of Learning*. Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-1428-6_902

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Appendices
Appendix A: Classical Physics Achievement Test
CPAT (English)

Name of Student: _____

Age: _____ **Gender** **Male** ☐ **Female** ☐
Class_____

1. Matter is a general term that applies to anything that has_____ and occupies space (a) direction (b) distance (c) position (d) mass
2. All matter is acted upon by a force called _____ (a) friction (b) Gravity (c) nuclear (d) electromagnetic.
3. A state of matter in which the molecules are closely together and they vibrate about a fixed position and have a fixed shape is known as _____ (a) Liquid (b) gas (c) solid (d) evaporation
4. Brownian motion was first observed in 1827, by _____(a) Isaac Newton (b) Robert Brown (c) Albert (d) Michael Faraday
5. Robert Brown found out that particles were in continual and _____motion
(a) Linear (b) Circular (c) Haphazard or random (d) Oscillatory
6. A type of motion that occurs when an object moves in a fixed position is called (a) Periodic motion (b)Oscillatory motion (c) translational motion (d) Vibratory motion
7. A state of matter in which molecules are also in constant motion but are comparatively far apart and have no fixed shape due to their distance in the molecules is known as (a) Liquid (b) Melting (c) Gas (d) Solid
8. Brownian concludes that; (a) Molecules exist and are static (b) Molecules does not exist (c) molecules exist and are at rest (d) Molecule exist and continually in motion
9. A type of motion in which a body moves to-and-fro with uniform speed is known as (a) random motion (b) relative motion (c) periodic or oscillatory motion (d) rotational motion
10. A body which is moving has energy called_____ (a) Potential energy (b) Chemical energy (c) Light energy (d) Kinetic energy
11. The faster a body moves the greater its_____
(a) Kinetic energy (b) Heat energy (c) Electrical energy (d) Potential energy
12. _____ is a type of motion where objects move irregularly or disorderly without specific direction (a) Rotational motion (b) Translational motion (c) oscillatory motion (d) Random motion
13. A change of position of a body with time is called_____
(a) Friction (b) Energy (c) Motion (d) reflection
14. The study of motion of a body without involving the forces which causes the motion is called_____ (a) Dynamic (b) Vibration (c) Kinematics (d) Potential
15. The rate of change distance with time is known as_____ (a) Speed (b)Acceleration (c) Amplitude (d) Displacement
16. Given that acceleration, a = $\frac{v-u}{t}$ obtain the equation of motion by making v, the subject of formula (a) v = u – at (b) v = $\frac{u}{at}$ (c) v = u + at (d) v = $\frac{a+u}{t}$
17. All substances are made up of _____ (a) energy (b) temperature (c) Matter (d) Gravity
18. The smallest particle of a substance which exist independently is known as _____ (a) Molecule (b) matter (c) Atom (d) Element
19. A type of motion that involves the movement of a body in a circle about an axis is called (a) Random Motion (b) Relative Motion (c) Rotational motion (d) Periodic motion

20. A state of matter in which the molecules move about in a constant random motion, and also occupies the shape of the container is called (a) Gas (b) Liquid (c) Diffusion(d) Solid
CPAT (Hausa)

Sunan : _____

Shekara: ___Sex ☐ **Maza** ☐ **Mata**

1. Makunshi wanzuwa shi ne _____wani abu (a)al-qiblan (b) Nisan (c) wurin zaman (d) nauyin
2. Tasirin wani abu mai karfi ko nauyi akan makunshi wanzuwa shi ake kira _____ (a) sabanin tafiyan abu (b) gravity (nauyi ko karfi wani abu) (c) nuclear (d) electromagnetic
3. Daya daga cikin rabe-raben Al'amarin makunshi wanzuwa wanda molekulai din sa suna tattara ne a guri guda, kuma basu iya motsi, shi ake kira____ (a)abu mai ruwa (b) abu daskararre (c) abu na irin iska ko na hayyaki (d) wani nauyi na iska.
4. Wanda ya samo ko kirkiro motsi Brownian a shekara 1827, shi ake kira (a) Isaac Newton (b) Robert Brown (c)Albert Brown (d) Michael Faraday
5. Robert Brown, ya gano cewa abubuwa suna cikin tafiya tare da _____ (a) motsi na mikekken hanya (b) motsi na zagaya (c) motsi na barkatai (d) motsi na kayyadadden lokaci
6. Irin motsi da abu ke yi a kayyadadden layi, shi ake kira _____ (a) motsi nakayyadadden lokaci (b) motsi na mikkaken hanya ko layi (c) motsi girgiza (d)motsi na barkatai
7. Daya daga cikin al'amaarin makunshi wanzuwa da molekulai suna cikn tafiya amma suna nisa-nisa da juna, su ake kira _____ (a) abu mai ruwa-ruwa (b) Narkewa (c) abu mai iska (d) daskararren abu
8. Brownian ya yanke shawara cewa; (a) molekulai suna wanzuwa, kuma basu tafiya (b) molekulai basu wanzuwa (c)molekulai suna wanzuwa, kuma basu motsi (d) molekulai suna wanzuwa, kuma suna cikin tafiya
9. Motsi da yake mai-maita kansa bayan wani lokaci kayadadden, shi ake kira _____ (a) motsi na barkatai (b) motsi relative (c)motsi na kayyadadden lokaci (d) motsi a kewaye
10. Duk wani abu mai tafiya yana da _____ (a) kuzarin potential (b) kuzarin chemical (c) kuzarin haske (d) kuzarin kinetic
11. Gudu abu na karuwa ne, da karuwan _____(a) kuzarin kinetic (b) kuzarin potential (c) kuzarin zafi (d) kuzarin lantarki
12. Irin motsi da abubuwan suke tafiya ba tare da tsari ba shi ake kira_____ (a) motsi na juyawa (b) motsi na mikakken hanya ko layi (c) motsi na barkatai (d) motsi kayyadadden lokaci
13. Canji wuri zama abu tare da lura da lokaci, shi ake kira _____ (a) sabanin tafiyan wani abu (b) Kuzarin (c) motsi (d) mayarwa da haske
14. Nazarin karatun motsi ba tare da lura da abubuwan da ke kawo ko jawo motsi ba, shi ake kira_____ (a) dynamics (b) girgiza (c) kinematics (d) potential
15. Canji nisan guri tareda lura da lokaci, shi ake kira_____ (a) gudun abu (b) zabaran abu (c) zagaya abu (d) Mikakken abu
16. An ba da zabura haka, a = $\frac{v-u}{t}$ samu lissafi na motsi in aka mai da v, ya tsiya shi kadai (a) v = u – at (b) v = $\frac{u}{at}$ (c) v = u + at (d) v = $\frac{a+u}{t}$
17. Dukabubuwa sun kunshi _____(a) kuzara (b)yawan zafi ko sanyin abu (c) makunshi wanzuwa (d) nauyi ko karfin wani abu
18. Shi mafi kakanta abu, da zai iya rayuwa shi kadai, shi ake kira ___ (a)molekul (b) makunshi wanzuwa (c)Al-zara (d) Elaimeti

19. Daya daga cikin ire-iren motsi dake taraya da motsi a kewayen, shi ake kira _____ (a) motsi barkatai (b) motsi relative (c) motsi juyawa ko zagaya (d) motsi na kayyadadden lokaci

20. Daya daga cikin al'amarin makunshi wanzuwa wanda abubuwa ke tafiya barkatai, kuma suna shigo duk inda suke so, shine (a) abu na irin iska ko hayaki (b) abu mai ruwa-ruwa (c) difusion (d) abu mai kauri

Appendix B: Pre-Test and Post-Test Scores

Case Summaries[a]

				Case Number	Pre-Test	Post-Test
Group	Control	1		1	5.00	9.00
		2		2	4.00	10.00
		3		3	8.00	14.00
		4		4	6.00	8.00
		5		5	8.00	12.00
		6		6	7.00	10.00
		7		7	7.00	11.00
		8		8	5.00	11.00
		9		9	8.00	11.00
		10		10	6.00	5.00
		11		11	5.00	10.00
		12		12	7.00	9.00
		13		13	8.00	12.00
		14		14	7.00	10.00
		15		15	8.00	6.00
		16		16	6.00	10.00
		17		17	4.00	11.00
		18		18	9.00	11.00
		19		19	7.00	6.00
		20		20	9.00	11.00
		21		21	8.00	11.00
		22		22	7.00	10.00
		23		23	7.00	12.00
		24		24	3.00	6.00
		25		25	9.00	12.00
		26		26	9.00	15.00
		27		27	4.00	4.00
		28		28	8.00	11.00
		29		29	9.00	7.00
		30		30	9.00	10.00
		Total	N		30	30
	Experimental 1	1		31	4.00	12.00
		2		32	3.00	11.00
		3		33	2.00	10.00
		4		34	8.00	14.00
		5		35	6.00	9.00
		6		36	7.00	8.00
		7		37	8.00	14.00
		8		38	8.00	10.00
		9		39	8.00	13.00
		10		40	9.00	16.00
		11		41	9.00	14.00
		12		42	3.00	13.00

	13		43	8.00	10.00
	14		44	7.00	13.00
	15		45	7.00	12.00
	16		46	7.00	12.00
	17		47	7.00	10.00
	18		48	9.00	10.00
	19		49	8.00	15.00
	20		50	10.00	12.00
	21		51	6.00	12.00
	22		52	9.00	12.00
	23		53	7.00	10.00
	24		54	5.00	12.00
	25		55	5.00	13.00
	26		56	8.00	10.00
	27		57	6.00	14.00
	28		58	8.00	16.00
	29		59	9.00	12.00
	30		60	7.00	14.00
	Total	N		30	30
Experimental 2	1		61	5.00	13.00
	2		62	2.00	12.00
	3		63	7.00	15.00
	4		64	2.00	11.00
	5		65	5.00	10.00
	6		66	4.00	12.00
	7		67	5.00	10.00
	8		68	5.00	11.00
	9		69	8.00	14.00
	10		70	7.00	12.00
	11		71	7.00	10.00
	12		72	8.00	12.00
	13		73	4.00	10.00
	14		74	8.00	13.00
	15		75	7.00	12.00
	16		76	7.00	14.00
	17		77	8.00	18.00
	18		78	9.00	12.00
	19		79	5.00	12.00
	20		80	6.00	14.00
	21		81	6.00	6.00
	22		82	10.00	11.00
	23		83	8.00	9.00
	24		84	2.00	10.00
	25		85	5.00	11.00
	26		86	6.00	14.00
	27		87	10.00	15.00
	28		88	5.00	10.00
	29		89	4.00	12.00
	30		90	6.00	14.00
	31		91	6.00	11.00
	32		92	6.00	14.00
	33		93	4.00	13.00

		34	94	7.00	15.00
		35	95	3.00	9.00
		36	96	6.00	12.00
		37	97	6.00	12.00
		38	98	7.00	14.00
		Total N		38	38
	Total	N		98	98

a. Limited to first 100 cases.

IX C: Validity and Reliability of Instrument
ility

Scale: ALL VARIABLES

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.717	.726	20

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1	15.2000	9.011	.365	.	.701
Q2	15.4500	8.261	.455	.	.687
Q3	15.3500	9.187	.147	.	.720
Q4	15.3000	8.747	.356	.	.699
Q5	15.2000	8.695	.545	.	.688
Q6	15.2000	9.011	.365	.	.701
Q7	15.4500	8.261	.455	.	.687
Q8	15.3500	9.187	.147	.	.720
Q9	15.3000	8.747	.356	.	.699
Q10	15.2000	8.695	.545	.	.688
Q11	15.2500	9.882	-.103	.	.736
Q12	15.2000	9.011	.365	.	.701
Q13	15.4500	8.261	.455	.	.687
Q14	15.3500	9.187	.147	.	.720
Q15	15.3000	8.747	.356	.	.699
Q16	15.2000	8.695	.545	.	.688
Q17	15.2500	8.724	.426	.	.694
Q18	15.3500	8.976	.227	.	.712
Q19	15.4000	9.726	-.057	.	.741
Q20	15.1500	10.134	-.285	.	.736

Factor Analysis

Communalities

	Initial	Extraction
Q1	1.000	.971
Q2	1.000	.939
Q3	1.000	.995
Q4	1.000	.967
Q5	1.000	.963
Q6	1.000	.971
Q7	1.000	.939
Q8	1.000	.995
Q9	1.000	.967
Q10	1.000	.963
Q11	1.000	.521
Q12	1.000	.971
Q13	1.000	.939
Q14	1.000	.995
Q15	1.000	.967
Q16	1.000	.963
Q17	1.000	.696
Q18	1.000	.879
Q19	1.000	.715
Q20	1.000	.835

Extraction Method: Principal Component Analysis.