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SCIENCE-TEXT-CARDS' EFFECT ON INTEREST IN SCIENCE AMONG UPPER BASIC SCHOOL STUDENTS WITH VARIED CONCEPTUAL ABILITIES IN MAKURDI, NIGERIA

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Abstract

Science-Text-Cards' (STC) effect on interest in science among upper basic school students with varied conceptual abilities in Makurdi, Nigeria was studied using a pre-test-post-test quasi experimental research design. This was due to the prevalence of ineffective teaching methods which has contributed to a decline in students' interest in science at the upper basic school level. Two research questions and corresponding hypotheses guided the study. Out of the 2,007 upper Basic II students in all the Universal Basic Education Junior Secondary Schools (UBE-JSS) in Makurdi, a multistage sample of 56 students in two intact classes from two schools was drawn for the study. Interest Level in Basic Science Concepts Questionnaire (ILBSCQ) with a reliability coefficient of 0.94 determined by split-half method and Cronbach Alpha was used for data collection. Mean and standard deviation were used to answer research questions; whereas the null hypotheses were tested using Analysis of Covariance (ANCOVA). Findings of the study revealed a significant difference in the interest level of students taught Basic Science using STC and those taught using Recitation Teaching Method in favour of STC [F (1, 53) = 28.088, ρ (0.000) < 0.05]. However, no significant difference existed in the interest level among students with varied conceptual ability levels taught Basic Science using STC [F (1, 27) = .915, ρ (0.413) > 0.05]; implying a homogeneous increase in students' interest level in Basic Science across varied conceptual abilities. STC was therefore recommended among others for teaching Basic Science in upper basic schools.

Keywords: Science-Text-Cards (STC), Recitation Teaching Method (RTM), Basic Science, Interest, and Conceptual Ability.

Introduction

Typically, students who cultivate personal interest in a subject or possess intrinsic curiosity are more inclined to engage in comprehensive and meaningful processing of the material, produce additional observations, and retain a greater number of critical concepts necessary for adequate understanding. This consequently leads to excellence in tackling complex problems and applying acquired knowledge to real-world scenarios. Students' persistence, concentration, level of absorption, active participation in tasks, and

willingness to work are all influenced by their interest in the area of study (Ammar et al., 2024; Ayua & Eriba, 2014). This further implies that students who develop their individual interest in science or possess an inherent curiosity about scientific concepts and principles are likely to participate in more exhaustive and meaning-oriented processing of the subject.

Science could be seen as the factual knowledge obtained by methodical and experimental or Observational study of nature. It can also be referred to as the knowledge about the structure and behaviour of the natural and physical world based on proven or verifiable facts (Ayua et al., 2025). In other to meet the transformation challenges of the 21st century, there is need to improve the scientific knowledge of students, especially in Basic Science. This is because the subject is compulsory and fundamental in laying the solid foundation needed for successful science learning at the senior secondary school level as stated in the national policy on education by the Federal Republic of Nigeria (FRN, 2013). Since Basic Science is a fundamental subject, it is the responsibility of the teacher to carry the students along in order to reduce the level of abstraction.

Basic Science is a preliminary and a core subject offered at the upper 9-year Universal Basic Education (UBE) level in the Nigerian education system. The subject integrates all the different specialised areas in the scientific enterprise in order to make learners have a holistic view of science subjects (Ayua et al., 2021). This implies that that the subject aims to unify different scientific disciplines, providing a rounded view that fosters a broader understanding of science. By doing so, learners can develop a deeper understanding, think critically, and apply scientific knowledge to real-world problems in a more integrated way. Thus, the knowledge of Basic Science is necessary for an individual to be scientifically trained in different areas of endeavour leading to national development (Ayua et al., 2025; Oniya & Adefila, 2020). The subject was implemented in Nigerian secondary schools as a solution to many issues afflicting scientific education, particularly at the upper basic school level. The programme as stated in national policy on education (FRN, 2013) emphasizes acquisition of skills and development of the spirit of enquiry as opposed to rote learning. Omebe and Omiko (2015) observed that, although the proposed teaching approaches for Basic Science have been employed by educators for several years, students' motivation and interest in the subject have not been encouraging. The effective utilization of innovative teaching strategies like Science-Text-Cards is perceived as a gateway to help reduce the abstraction of science concepts and build learners' interest in the subject.

Interest refers to the feeling or emotion that makes students focus their attention on concepts in Basic Science. It is commonly considered as a motivational construct that directs an individual's attention and drives activities related to specific objects, stimuli, and events. Interest-driven activities are typically accompanied by positive emotions and increased cognitive functioning, and it serves as a fundamental driver in shaping the educational and career trajectories of students (Mouton et al., 2023; Renninger & Hidi, 2016). Students' interest in Basic Science refers to the feeling, curiosity, willingness, or persuasion of learners' wanting to know about science and their longing and readiness to be actively involved in its learning, principles and practice (Ammar, et al., 2024; Ayua, et al., 2025). Interest is an important aspect in the learning process. This is because it helps in sustaining concentration, purpose, commitment and cooperation with the teacher in the teaching and learning

processes. Interest is an important variable in learning, because if the learners are interested in learning Basic Science concepts, they will be more actively involved in the learning process and will be more eager to acquiring scientific skills and competencies (Ayua et al., 2021; Oviawe & Adeola,2017). Thus, interest is a pre-indication of attention. Once there is direct interest, attention is guaranteed and effective learning is assured. Ayua and Ode (2015) and Essiene et al. (2015), reported that interest most often is directly tied to the content or instruction, and it also directs and enhances learning. This means that students' interest in Basic Science could likely have the potential of positively affecting their engagement and academic performance in the subject. This could imply that, students who are more interested in Basic Science will perform better academically in the subject and in subsequent scientific courses at the post-basic education level. Nevertheless, this can hardly be achieved if Basic Science content or subject matter is taught using teacher-centred methods, which makes the concepts meaningless, boring, and uninteresting, and it makes students more likely to be passive learners (Ayua & Ode 2020; Ayua et al., 2021). This underscores the need to employ the constructivists' instructional strategies in presenting Basic Science lessons especially to the formative-age learners in basic schools.

Science-Text-Cards (STC) is an innovative teaching method to convey the science facts in an easy and organized way. This strategy involves the use of carefully designed cards that contain concise scientific explanations and visuals. According to Ayua et al. (2025), STC serve as a valuable educational tool for promoting engagement, understanding, and critical thinking skills in science classrooms. The visual and concise nature of STC captures students' attention and motivates them to explore scientific concepts further. The strategic use of specific scientific terminologies in the text cards helps students build their vocabulary around scientific concepts and frequent exposure to these terms enhances content retention, allowing students to remember critical information and apply it in various scientific contexts (Melvin, 2019). The use of innovative teaching strategies like Science-Text-Cards may help reduce the abstraction of science concepts which discourages learning by recitation. Empirically, Ayua et al. (2021) in their study on impact of creative-teaching on interest in basic science among varied-ability upper-basic students found a significant difference in the interest level among varied-ability students taught using creative teaching and those taught using conventional teaching in favour of those taught with creative teaching. Likewise, Obodo et al. (2021), Okechukwu et al. (2021), and Tofi et al. (2017) found that the interest level of students taught Basic Science was significantly enhanced as a result of their exposure to Student-centred teaching approaches.

Recitation Teaching Method (RTM) is a teacher-centred instructional strategy in which the teacher reads questions from the text material and the students recite answers which they find in the textbook or have memorized. Recitation involves rote answers and repetition of answers from the text which leads to students' lack of interest in the classroom (Ayua et al., 2025). According to Nurhayati (2016), Recitation Teaching Method is a structured instructional approach where students are expected to memorize and recite information or content. This traditional approach also insists that all the students should memorize the same materials at the same point, students that cannot memorize quickly enough are punished, rather than

being allowed to succeed at their natural speeds. The Recitation Teaching Method encourages rote memorization rather than comprehension, leading students, regardless of their conceptual ability, to forget the content of the material once through with the class lesson.

Conceptual ability is the mental capacity of students to grasp and apply abstract ideas, concepts, and principles in problem-solving situations in Basic Science. According to Tan et al. (2020), and White (1971), conceptual ability involves using reasoning, analysis, and critical thinking skills to understand difficult or unfamiliar concepts and then apply them in practical ways. Thus, conceptual ability allows an individual to generalize from observations and experiences as well as develop abstract thought. It is seen as an antecedent of effective problem solving and social judgement skills and of sophisticated understanding of experiential knowledge (Corrigan et al., 2025; Mumford et al., 2000). Conceptual ability comprises of three main levels in order of lowest to highest; concrete, abstract and the metacognitive levels. The concrete level is the lowest, where students focus on specific details of concepts or ideas in Basic Science. Here students find it difficult to make connections between science concepts. The next level is the abstract level; in this level students are able to make connections and understand complex concepts. They have the ability to think in a theoretical way. The highest level is the metacognitive deals with the ability to reflect on one's own thinking. Students at this level are able to plan and organize their own learning.

In a study, “Students’ executive skills: Effects on students conceptual understanding and interest towards Physics during online learning, Suan eta al. (2023), found that students’ Conceptual Understanding was “very low,” proving that the new teaching and learning methods likely made it difficult to grasp Physics concepts; noting that more attention should be given to the methods and techniques to be applied to maintain high levels of interest while improving students’ conceptual understanding. This implies that, to boost interest and conceptual understanding in science, educators can develop engaging curricula, foster scientific creativity, and incorporate practical applications that make science relevant to students' lives. By doing so, they can create a more effective science education that promotes both understanding and interest in the subject. Relatedly, Ayua et al. (2021) in their study on impact of creative-teaching on interest in basic science among varied-ability upper-basic students found no significant difference in the interest level among varied-ability students taught using creative teaching. The study's findings suggest that creative teaching methods can significantly boost interest in science among students of varied abilities, potentially bridging the gap between students with different conceptual ability levels. By adopting creative approaches, educators can foster a more engaging learning environment that caters to diverse learning needs, ultimately promoting a deeper interest in science among students with varying conceptual abilities.

Statement of the Problem

The expansion of science education at the basic education level in Nigeria is hindered by substantial obstacles, notably low enrolment figures and diminished interest levels among students (Achor & Odaudu, 2018). Despite educators' and learners' intentions, various factors contribute to students' low interest in Basic Science, making it a pressing concern in science education research to investigate the causes and develop strategies to boost students' interest and motivation (Itodo, 2019). Research suggests that teachers'

instructional strategies play a crucial role in shaping students' learning experiences and interest in science (Itodo, 2019). Specifically, uninteresting content presentation and difficult course materials have been identified as significant contributors to declining interest in Basic Science (Adam, 2013). Furthermore, the prevalent use of teacher-centred methods, including recitation, has been linked to students' lack of interest in the subject (Achor & Odaudu, 2018). The consequences of this trend are far-reaching, with poor interest in Basic Science affecting enrolment rates in science at post-basic and tertiary levels. Alarmingly, between 2014 and 2019, the enrolment rate of students in sciences dropped from 21.92% to 13% (Ayua, 2020). If left unaddressed, this alteration may lead to inequity in national growth and future aspirations for science education in Nigeria, underscoring the need for innovative solutions to enhance students' interest in science, particularly among upper basic school students with varied conceptual abilities in Makurdi, Nigeria. It is against this backdrop that Science-Text-Cards' (STC) effect on interest in Basic Science among upper basic school students with varied conceptual abilities in Makurdi metropolis, Benue State, Nigeria was studied with the objectives to:

i. Ascertain the effect of Science-Text-Cards (STC) on students' interest level in Basic Science.
ii. Determine the effect of Science-Text-Cards (STC) on students' interest level in Basic Science based on conceptual ability.

Research Questions

The study had the following questions:

i. What is the mean difference in the interest level of students taught Basic Science using Science-Text-Cards (STC) and those taught using Recitation Teaching Method (RTM)?
ii. What is the mean difference in the interest level of students taught Basic Science using Science-Text-Cards (STC) based on conceptual ability?

Hypotheses

Two null hypotheses were formulated for the study as follows:

i. There is no significant difference in the mean interest level of students taught Basic Science using Science-Text-Cards (STC) and those taught using Recitation Teaching Method (RTM)
ii. There is no significant difference in the mean interest level of students taught Basic Science using Science-Text-Cards (STC) based on conceptual ability.

Methodology

A pre-test post-test quasi-experimental - control group research design was used for the study. The population of the study comprised 2,007 upper basic II students in all the Universal Basic Education Junior Secondary School (UBE-JSS) in Makurdi Metropolis, Benue State. A sample of 56 (31 Experimental & 25 Control) students from two intact classes in two schools from the population was drawn and used for the study. The sample was drawn by a multistage (including stratified, purposive and random) sampling technique. Thus, the schools were first stratified by location (North and South Bank). Then, only schools which are co-educational with one-arm standard class-size and at least one Basic Science teacher with first degree were purposively selected from each location. Thereafter, one school with intact classes was drawn from each stratum and placed into experimental and control groups at random. The instrument used for

data collection was Interest Level in Basic Science Concepts Questionnaire (ILBSCQ). The researcher-made ILBSCQ was validated and trial tested on 20 students who are part of the population but not part of the sample for the study using Split-half method and Cronbach Alpha statistic with a reliability index of 0.94. the conceptual ability levels of students were determined using the Conceptual Ability Quiz (CAQ) which consisted of five questions with three options labelled A, B and C; each representing a conceptual ability level (concrete, abstract and metacognitive) with corresponding qualities, respectively. The majority of the conceptual ability items a student ticks were considered their conceptual ability level. Pre-test was given to both groups so as to determine the interest level of Students in Basic Science before administration of treatment. After pre-test administration, both groups were taught the concept of work, energy and power. Science-Text-Cards (STC) was used for the experimental group and Recitation Teaching Method (RTM) was used for the control group. The lesson plans for both groups were guided by the 9-year basic education curriculum and upper basic two text books and lasted for 80 munities. For the experimental group, the lessons were planned to capture and maintain students' interest and also to involve them in the class teaching and learning activities. The teacher supplied the students with Text cards based on the topics (work, energy and power), and on each card, the concepts were pin pointed for the students to study in groups and discuss amongst themselves their understanding on the topic and thereafter a total class discussion facilitated by the teacher. This treatment lasted for four weeks before post-test. The collated data was analysed to ascertain the interest level of students in Basic Science. The research questions were answered using mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the null hypothesis at $P \leq 0.05$ level of significance.

Results

The results of the study were presented in order of the research questions and hypotheses as follows:

Research Question One: What is the mean difference between the interest level of students taught Basic Science using Science-Text-Card (STC) and those taught using Recitation Teaching Method (RTM)?

Table 1: Interest Level of Students Based on Teaching Method

Teaching Method	Sample (n)	Pre-I		Post- I		$\bar{x}$ Gain	$\bar{x}$ Gain Difference
		$\bar{x}$	SD	$\bar{x}$	SD		
STC	31	48.45	10.698	60.00	0.000	11.55	8.19
RTM	25	47.24	11.526	50.60	12.602	3.36	

$\bar{x}$ (Mean), SD (Standard Deviation), I (Interest)

The result in Table 1 shows similarity in the pre-interest level among students taught Basic Science using Science-Text-Card and those taught Basic Science using Recitation Teaching Method with means of 48.45 and 47.24 in the pre-interest, also, the table shows the post-interest means of 60.00 and 50.60 for STC and RTM respectively. The Table further reveals a post-interest mean gain difference of 8.19 in favour of students taught Basic Science using Science-Text-Cards.

Research Question Two: What is the mean difference between the interest level of

students taught Basic Science using Science-Text-Card based on conceptual ability?

Table 2: Interest Level of Conceptual Ability Students Taught using Science-Text-Card.

Conceptual Ability	Sample (n)	Pre-I		Post-I		$\bar{x}$ Gain	$\bar{x}$ Gain Difference
		$\bar{x}$	SD	$\bar{x}$	SD		
Concrete (C)	7	50.29	12.148	59.29	3.190	9.00	1.43 (C & A)
Abstract (A)	14	48.93	10.637	56.50	9.280	7.57	2.63 (A & M)
Metacognitive (M)	10	49.50	7.292	59.70	0.949	10.20	1.20 (C & M)

$\bar{x}$ (Mean), SD (Standard Deviation), I (Interest)

The result in Table 2 shows sameness in the interest level among conceptual ability students taught Basic Science using Science-Text-Card in the pre-interest with means of concrete = 50.29. Abstract = 48.93 and Metacognitive = 49.50. The table also shows that the interest scores in the post-interest homogenously improved across the conceptual ability levels with means of Concrete = 59.29, Abstract = 56.50, and Metacognitive = 59.70. The table further reveals the post-interest mean gains of: Concrete = 9.0, Abstract = 7.57, and Metacognitive = 10.70. The minimal mean gain differences of 1.43, 2.63, and 1.20 between concrete and abstract, abstract and metacognitive, and concrete and metacognitive respectively, across the conceptual ability levels indicates that STC homogenously enhances students' interest in science irrespective of their conceptual abilities.

Hypotheses One: There is no significant difference between the interest level of students taught Basic Science using Science-Text-Cards (STC) and those taught using Recitation Teaching Method (RTM).

Table 3: Summary of Two-Way ANCOVA Analysis on interest level Between Teaching Methods.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3034.182[a]	2	1517.091	40.190	.000	.603
Intercept	2520.095	1	2520.095	66.761	.000	.557
Pretest	1811.342	1	1811.342	47.985	.000	.475
Teaching Method	**1060.277**	**1**	**1060.277**	**28.088**	**.000**	**.346**
Error	2000.658	53	37.748			
Total	179421.000	56				
Corrected Total	5034.839	55				

a. R Squared = .603 (Adjusted R Squared = .588

Table 3 shows a significant difference in the interest level between students taught Basic Science using STC and those taught using RTM, F (1, 53) = 28.088, ρ (0.000) < 0.05. The null hypothesis which states that there is no significant difference between the interest level of students taught Basic Science using Science-Text-Cards (STC) and those taught using Recitation Teaching Method (RTM) was therefore rejected. This implies that Science-Text-Cards (STC) significantly enhances the interest of students in Basic Science better than Recitation Teaching Method (RTM)

Hypotheses Two: There is no significant difference in the mean interest level of students taught Basic Science using Science-Text-Cards (STC) based on conceptual ability

Table 4: Summary of Two-Way ANCOVA Analysis on Interest Level Based on Conceptual Ability

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	334.754[a]	3	111.585	3.403	.032	.274
Intercept	2086.819	1	2086.819	63.634	.000	.702
Pretest	263.589	1	263.589	8.038	.009	.229
Conceptual Ability	**59.997**	**2**	**29.998**	**.915**	**.413**	**.063**
Error	885.440	27	32.794			
Total	106085.000	31				
Corrected Total	1220.194	30				

a. R Squared = .274 (Adjusted R Squared = .194)

Table 4 shows no significant difference in the interest level among students with varied conceptual abilities taught Basic Science using STC, F (1, 27) = .915, ρ (0.413) > 0.05. The null hypothesis which states that there is no significant difference between the interest level of students taught Basic Science using Science-Text-Cards (STC) based on conceptual abilities was therefore not rejected. This confirms that STC significantly and homogenously enhances students' interest in Basic Science irrespective of their conceptual abilities.

Discussion of Findings

Regarding students' interest level based on their exposure to Teaching Methods, it was found that a significant difference existed in the interest level between students taught Basic Science using Recitation Method and those taught using Science-Text-Cards in support of those taught using Science-Text-Cards. Following field experience, the finding is not strange. This is because during the teaching and learning process using STC, the students were given tasks to perform in groups based on the text-cards provided with information of concepts on each card following class demonstration, discussion and interaction. This stimulated curiosity and interest in the subject due to the interaction among students and with the text cards. This finding agrees with that of Ayua et al. (2021), who found a significant difference in the interest level among varied-ability students taught Basic Science using creative-teaching and those taught using lecture method in favour of creative-teaching. Likewise, the

finding is in agreement with those of Obodo et al. (2021), Okechukwu et al. (2021), and Tofi et al. (2017) who found that the interest level of students taught Basic Science using student-centred methods significantly increased as compared to their counterparts who were taught using teacher-centred methods. This implies that STC as a Student-centred approach is effective in increasing the interest level of students in Basic Science.

Regarding students' interest level based on Conceptual Ability, findings reveal no significant difference in the interest level among concrete, abstract and metacognitive ability students taught Basic Science using STC. This finding is not strange because during the field experience, all students, regardless of their conceptual ability, were captivated by the text cards and were eager to interact with the material to promote active learning of scientific concepts and principles. The finding implies that, students' interest in Basic Science is impacted and determined by how scientific concepts and principles are taught to them rather than by their conceptual ability level. the finding of this study is related to that of Ayua et al. (2021) who found no significant difference in the interest level among varied-ability students taught using creative teaching. The study's findings suggest that creative teaching methods can significantly boost interest in science among students of varied abilities, potentially bridging the gap between students with different conceptual ability levels. By adopting creative approaches, educators can foster a more engaging learning environment that caters to diverse learning needs, ultimately promoting a deeper interest in science among students with varying conceptual abilities. This finding however differs from that of Suan eta al. (2023) who found students' Conceptual Understanding was "very low," proving that the new teaching and learning methods likely made it difficult to grasp Physics concepts; noting that more attention should be given to the methods and techniques to be applied to maintain high levels of interest while improving students' conceptual understanding.

Conclusion

Based on the study's findings, it was concluded that: Science-Text-Cards (STC) homogenously enhances students' interest in Basic Science irrespective of their varied conceptual abilities.

Recommendations

To this end, the following recommendations were made:

1. Basic Science should be taught using Science-Text-Cards.
2. Teacher training institutions in Nigeria should include constructivists teaching strategies such as Science-Text-Cards in the teacher training programmes.

References

Achor, E. E., Ejeh, E. E., & Odaudu, R. E. (2018). Training needs of basic science teachers in Benue State, Nigeria. *Journal of Research in Curriculum and Teaching, 10*(2), 110 - 117.

Adam, H. D. (2013). Effects of socio-scientific issues-based teaching on interest: Students' resources as moderator. *Journal of Educational Research, 17* (4), 117-130.

Ammar, M., Siby, N., Khalili, S., Al-Thani, A. N., Sellami, A., Touati, F., Bhadra, J., Al-Thani, N. J., & Ahmad, Z. (2024). Investigating the individual interests of undergraduate students in STEM disciplines. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1285809

Ayua, G. A., & Eriba, J. O. (2014). Influence of teachers' creative behaviours on development of interest in Basic Science and Technology among pupils in Benue State. *National Association of Science, Humanities and Education Research Journal*, *12* (2), 1 - 11. https://www.researchgate.net/publication/337167103

Ayua, G. A., & Ode, G. O. (2015). Environmental exploration and its influence on development of pupils' interest in Basic Science and Technology in primary schools in Oju, Benue State. *Africa Journal of Sustainable Professional Development*, *2* (1), 94 - 103. https://www.researchgate.net/publication/337167429

Ayua, G. A., & Ode, J. O. (2020). Science-technology-society strategy's effect on students' interest in Basic Science at upper-basic school level. *Africa Journal of Sustainable Professional Development*, *4* (1), 5-11. https://www.researchgate.net/publication/354817666

Ayua, G. A., Agbidye, A., Tofi, M., Iorpenda, N. P., & Kucha, O. S. (2025). Effect of science-text-cards on students' gender-based interest in science at upper basic schools in Makurdi, Nigeria. *Journal of Ethnoscience and Educational Studies*, *1*(2), 1-7. https://elyquests.com/index.php/JEES/article/view/13

Ayua, G. A., Bichi, S. S., Usman, I. A., & Lawal, F. K. (2021). Impact of creative-teaching on interest in Basic Science among varied-ability upper-basic students in Makurdi, Nigeria. *Umaru Musa Yaradua University Journal of Education*, *11*(1), 15-22. https://www.researchgate.net/publication/357163399

Corrigan, M. W., Wong, J. T., Grove, D., Andersen, S., & Hughes, B. S. (2025). Enhancing elementary students' conceptual understandings of scientific phenomena: The impact of STEAM-first and STEM-first approaches. *Science Education*, *109* (5), 1147-1505. https://onlinelibrary.wiley.com/doi/full/10.1002/sce.21942

Essien, E. E., Okon, A., & Imo, M. O. (2015). Students' interest in Social Studies and academic achievement in tertiary institutions in Cross River State, Nigeria. *European Journal of Training and Development Studies, 2*(2), 35-4.

Federal Republic of Nigeria (FRN). (2013). *National policy on education*. Nigeria Educational Research and Development Council (NERDC) Printing Press.

Itodo, M. (2019). Investigating prospective teachers perceived problem-solving abilities in relation to gender, major, place lived, and locus of control. *Universal Journal of Educational Research*, *5*(6), 1030-1038.

Melvin, M. (2019). Conception of innovative teaching methodologies among lecturers at selected polytechnics in Malaysia. *Creative Education*, *10*, 874-881

Mouton, D., Hartmann, F. G., & Ertl, B. (2023). Career profiles of university students: How STEM students distinguish regarding interests, prestige and sex type. *Education Sciences*, *13*(3), 324.

Mumford, M. D., Baughman, W. A., Costanza, D. P., Uhlman, C. E., & Connelly, M. S. (2000). Developing creative capacities: Implications of

cognitive processing models. *A Journal on Gifted Education*, *16*(1), 16-21.

Nurhayati, D. A. W. (2016). Using local drama in writing and Speaking: EFL learners' creative expression. *Journal of English Language Teaching and Linguistics*, *1*(1), 51. https://doi.org/10. 21462/jeltl.v1i1.13

Obodo, A. C., Animercy, I., & Okolo, P. C. (2021). Effect of digital technology on students' achievement and interest in Basic Science and Technology. *Educational Psychologist*, *14*(1) 203-213

Okechukwu, O. R. (2021). Team teaching strategy and students' interest in Basic Science in Anambra State. *International Journal of Trend in Scientific Research and Development*, *5*(6), 940-945.

Omebe, C. A., & Omiko, O. (2015). A review of teaching methods for Basic Science in junior secondary schools. *Journal of Research in Curriculum and Teaching*, *10*(2), 110-117.

Oniya, T., & Adefila, O. (2020). Effect of computer assisted instructional software on senior secondary school students' learning outcomes in volumetric analysis in Ekiti State, Nigeria. *International Journal of Science and Research*, *10*(7), 7-30.

Oviawe, J., & Adeola, P. S. (2017). Improving students' academic achievement and interest in geometry through audio-visual resources as instructional strategy. *International Journal of Multidisciplinary and Current Educational Research*, *2*(4), 4-20.

Renninger, K. A., & Hidi, S. (2016). *The Power of Interest for Motivation and Learning*. Routledge.

Suan, F. G., Flores, D., Ybañez, R., Jumarito, E., Alim, N. R., & Vallespin, M. R. (2023). Students' executive skills: Effects on students conceptual understanding and interest towards Physics during online learning. *Journal of Harbin Engineering University*, *44*(12) https://ssrn.com/abstract=4793228

Tan, R. M., Yangco, R. T., & Que, E. N. (2020). Students' conceptual understanding and science process skills in an inquiry-based flipped classroom environment. *Malaysian Journal of Learning & Instruction*, *17* (1), 159-184. https://doi.org/10. 32890/mjli2020.17.1.7

Tofi, M., Adejoh, M. J. & Ochu, A. N. O. (2017). Effect of problem-solving instructional method on upper basic II students' interest in Basic Science in Makurdi Metropolis, Benue State. *ATBU Journal of Science, Technology and Education*, *5*(3), 162-170.

White, R. (1971), *Mastery Achievement of Intellectual skills*. St Martin's Press.