

Improving Academic Achievement of Pupils in Basic Science and Technology: Differentiated Instruction as the Panacea

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Abstract: *The study investigated the effect of differentiated instruction on pupils' academic performance in Kwara State. The study made use of a pretest posttest control group quasi-experimental research design. Two (2) government primary schools were randomly selected to participate in the study. One validated and reliably tested research instrument titled 'Achievement Test Basic science and Technology (ATBST)' was used. Three (3) research hypotheses were tested with Analysis of Covariance (ANCOVA). The findings of the study revealed that treatment had significant effect on pupils' academic performance ($F_{(1; 84)} = 1795.319, P < 0.05$) in basic science and technology. However, gender ($F_{(1; 84)} = .002; P > 0.05$) did not have significant effect on pupils' academic performance. And Finally, The interaction of treatment and gender did not have any significant effect on pupils' academic performance ($F_{(1; 84)} = .541; P > 0.05$). It was concluded that differentiated instruction can improve academic performance of pupils. It was suggested that instructors be trained in the use of differentiated instruction.*

Keywords: Differentiated instruction, pupils' academic performance, Basic Science and Technology

Introduction

Basic Science and Technology Education is the process by which elementary school pupils attempt to learn about and comprehend their surroundings, as well as observe and explore the world around them. Science should be introduced to students prior to their entry into primary school in order for them to learn quickly in primary school. Children between the ages of one and eight learn quickly to take in sensations and perceive the world around them by using all of their senses and their entire body. During this point in their lives, children engage in play and spend the majority of their waking hours doing so. Their exploration spans aspects of development such as social, emotional, motor, language, and physical development through play activities.

Basic science and technology is one of the subjects through which the goal of education could be attained in the first six years. In Nigeria, one of the compulsory topics in primary and junior secondary schools is basic science and technology. Science and technology have been the focus of attention all around the world in order to achieve social, economic, and even political growth (Juliette, Sandra & Lieke, 2010). Nigeria isn't immune to this trend. This global ambition is reflected in the National Policy on Education (FRN 2013) and the Universal Basic Education (UBE) Act of 2004. Indeed, the UBE Act of 2004 stated that every learner who has completed nine years of basic education should possess numeracy, manipulation, community, and lifelong skills, as well as the ethical, moral, and civic values necessary for laying a solid foundation for lifelong learning, as well as the foundation for scientific and reflective thinking.

Technology is constantly linked to development, no matter what stage it is in, and technology develops as science progresses. Science, technology, and development are all proportional as a result. Developed and developing countries are currently separated into two categories. The two main sections are economics and the application of science and technology. When viewed attentively, it becomes evident that countries with a strong scientific and technology basis advanced more quickly. Russia, Japan, Brazil, China, India, and other countries are only a few examples. Science, technology, and engineering are the bedrocks of every successful economy, especially in today's knowledge-based economy. Countries that do not use science and technology have a low possibility of being developed, and may even be categorized as underdeveloped. Science and technology are intrinsically tied to modernity and are an essential tool for rapid development.

Despite the importance of basic science in our educational system and economic development, students' performance in this subject in school has been underwhelming. To ensure that this problem improves, all hands must be on deck. According to the Education Sector Analysis (ESA, 2000), students' performance in science subjects was poor. Isa, Mammam, Badar and Bala (2020) opined that improvement in the academic achievement of pupils is dependent on method of teaching. That is why the poor academic achievement of pupils in mathematics has been partly attributed to lecture method often used by some teachers. Hence, Ferrier (2007), Ruhan, and Sefik (2010), Olawole (2019) and obafemi (2022) recommended the use of differentiated instruction as a method of teaching to bring about improvement in the academic achievement of pupils.

Differentiated instruction, according to Tomlinson (2003), is an adapted instruction that enables children with a variety of academic demands and learning styles master the same difficult academic topic. While it is widely acknowledged that all children have a need

for acceptance, caring, and respect, paying attention to differences can help each kid achieve a sense of accomplishment by encouraging them to be the best they can be as individuals. One-size-fits-all curricula no longer suit the demands of the vast majority of students (McBride, 2004). Furthermore, addressing pupils' differences and interests helps to increase their drive to study while also encouraging them to stay dedicated and optimistic (Tomlinson, 2004).

A number of studies (Njagi, 2015; Ferrier, 2007; Karadag & Yasar, 2010; Osuafor & Okigbo, 2013; Obafemi, 2022) have been carried out on the effectiveness of differentiated instruction on the academic achievement of students in different school subjects other than basic science and technology. Aside that, studies on differentiated instruction at the primary level of education has not enjoyed deserved research attention and this is the research gap the study intended to fill.

Another variable of interest is gender. Gender is defined as the set of qualities that define femininity and masculinity and distinguishes them. These traits may include biological sex of been a male or female (Kevin, 2017). A number of studies (Pirmohamed, Debowska & Boduszek, 2017; Lori, Michelle, Glenda & Brian, 2019; Nnamani & Oyibe, 2016) have been conducted on the effect of gender on the academic achievement of students in different subject areas but the studies reported conflicting findings. Hence, this justifies the inclusion of the gender in this study.

Statement of the Problem

The low performance of pupils in basic science and technology particularly in the recent years has not been encouraging. This poor performance of pupils has been partly attributed to the pedagogical methods adopted by teachers. Claims have been made that the methods used by teachers do not respect diverse needs of individual learners. And one of the methods which pay attention to pupils' individual needs in the classroom is differentiated instructional method of teaching. Studies on differentiated instruction have been conducted but deserved research attention has not been given to the examination of the effect of differentiated instruction on the academic performance of pupils in basic science and technology particularly at the primary school level. Also, this kind of study has not been conducted in the Ilorin West Local Area of Kwara State where this study was carried out.

Research Hypotheses

Ho1: There is no significant effect of differentiated instruction on the academic performance of pupils.

Ho2: There is no significant effect of gender on the academic performance of pupils.

Ho3: There is no significant interaction effect of treatment and gender on the academic performance.

Methodology

The study adopted a pretest posttest control group quasi-experimental research design with a factorial design of 2X2. The target population was all primary four (4) pupils in Ilorin west Local Government Area of Kwara State. Simple random sampling technique was used to select four (2) public primary schools. One of the two schools was experimental group while the other was the control group. Only primary four pupils in each of the selected schools were involved in the study. The research instrument used in the study was researchers' designed achievement test titled 'Achievement Test on Basic Science and Technology (ATBST). The ATBST were drawn from the basic science and technology scheme of work for primary four, and it consisted of twenty (20) multiple choice questions. The drafted questions for the Basic Science and Technology achievement test, differentiated instructional guide, and conventional instructional guide were given to lecturers in Early Childhood and Primary Education Department, Kwara State University who validated the instrument. To establish the reliability of the BSTAT, test retest method was used. The test was administered twice, in an interval of two weeks, to 25 pupils in primary four who were not part of the study. Data from the two administrations were correlated using Pearson Product Moment Correlation (PPMC) and the reliability coefficient was established at 0.79. The study lasted for 6 weeks and data collected were analyzed using Analysis of Covariance (ANCOVA).

Results

Research Hypothesis One: There is no significant main effect of treatment on the academic performance of pupils

Table 1: Summary of Analysis of Covariance (ANCOVA) showing the Main Effect of Treatment in Pupils Academic performance in Basic Science and Technology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1435.081 ^a	4	358.770	453.388	.000
Intercept	10.000	1	10.000	12.638	.001
Pretest	.021	1	.021	.026	.871
Treatment	1420.654	1	1420.654	1795.319	.000
Gender	.002	1	.002	.002	.964
Treatment * Gender	.428	1	.428	.541	.464
Error	66.470	84	.791		
Total	15023.000	89			
Corrected Total	1501.551	88			

Table 1 shows the effect of treatment on pupils' academic performance. There was significant effect of treatment on pupils' academic performance ($F_{(1, 84)} = 1795.319$, $P < 0.05$). The hypothesis is therefore rejected in the light of the result since the significant value (.000) is less than 0.05. This implies that treatment had significant effect on pupils' academic performance. The source of the significant difference is presented in table 2 below.

Table 2: Summary of Bonferroni's Poc Hoc Pairwise Comparison of the scores between the two groups

Treatment	Mean Difference	Experimental	Control Group
Differentiated Instruction	16.88	*	
Conventional Method	8.77		*

Table 2 revealed that the significant effect exposed by table 1 is as a result the significant difference between differentiated instruction and conventional method. Differentiated instruction refers to experimental group, while conventional method is known as control group. This implies that those exposed to differentiated instruction (16.88) performed significantly better than those exposed to conventional method (8.77).

Research Hypothesis Two: There is no significant effect of gender on pupils' academic performance.

Table 1 also revealed the effect of gender on pupils' academic performance. There was no significant effect of gender on pupils' academic performance ($F_{(1, 84)} = .002$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.964) is greater than 0.05. This implies that gender had no significant effect on pupils' academic achievement.

Research Hypothesis Three: There is no significant interaction effect of treatment and gender on pupils' academic

Table 2 also revealed the interaction effect of treatment and gender on pupils' academic performance. There was no significant interaction effect of treatment and gender on pupils' academic performance ($F_{(1, 84)} = .541$; $P > 0.05$). The hypothesis is therefore not rejected in the light of the result since the significant value (.464) is greater than 0.05. This implies that interaction of treatment and gender had no significant effect on pupils' academic achievement.

Discussion of Findings

The findings of the study revealed that there was significant main effect of differentiated instruction on pupils' academic performance. This implies that pupils taught Basic Science and Technology using differentiated instructions performed significantly higher than their counterparts taught with lecture method. This finding is in tandem with the earlier study by (Bailey & Williams-Black, 2008). Educators have found that to increase academic performance for struggling pupils, differentiated instruction is the most reliable way to give pupils what they need (Bailey & Williams-Black, 2008). This gave support to the study by McAdmin (2001) who reported significant improvement in the test scores of low-scoring pupils in the Rockwood School District (Missouri), following the use of differentiated instruction. When teachers demonstrate a love for what they are teaching and are able to convince pupils' of its relevance, pupils may achieve more.

Another finding of the study revealed that gender had no significant effect on the academic performance of pupils. This finding corroborated with the finding of Tijani (2017) which discovered that there was a significant main effect of gender on the academic performance of pupils in Mathematics in Moro Local Government Area of Kwara State. Similarly, the finding supported the finding of Rafiu (2018) which unfolded that gender had no significant effect on the academic performance of pupils in numeracy in Ilorin West Local Government Area of Kwara State.

The findings of the study further revealed that there was no significant interaction effect of treatment and gender on the academic performance. This finding supported the finding of Tijani (2017) discovered that the interaction of treatment and gender had no significant effect on academic achievement in mathematics. Yusuf (2019) also reported that there was no significant interaction effect of treatment and gender on the academic achievement of pupils.

Conclusion and Recommendations

Based on the findings of the study, it is evident that differentiated instruction has effect on the academic performance of pupils in Basic science and Technology regardless of gender. Based on the above conclusion, the following recommendations were made:

- Basic Science and Technology teachers should adopt the use of differentiated instruction in their classroom interaction.
- Seminars, workshops and conferences should be organized for teachers on how to use Differentiated Instruction.
- Differentiated instruction should be incorporated in teacher training programme courses
- Differentiated instruction should be included in the curriculum of Basic Science and Technology

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