ANDRAGOGICAL INSTRUCTIONAL METHOD AS A FACTOR ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BASIC SCIENCE: IMPLICATIONS FOR EDUCATION MANAGERS

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Abstract
This study investigated the effect of the andragogical instructional method on secondary school students' academic achievement in Basic Science, with specific emphasis on its implications for education managers. The quasi-experimental design, specifically the pretest-posttest non-equivalent control group design, was adopted. A sample size of 163 JSS II Basic Science students drawn from 4 intact classes using simple random sampling technique was used for the study. The experimental group was taught using the andragogical instructional method, while the control group received instruction through the conventional lecture method. Data were collected using a Basic Science Achievement Test (BSAT), which was validated by experts in science education and measurement and evaluated. The instrument yielded a reliability coefficient of 0.94 using the Kuder-Richardson formula (KR-20). Data obtained were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA) at 0.05 level of significance. The findings revealed that the andragogical instructional method significantly enhanced students' academic achievement in Basic Science compared to the conventional method. However, gender had no significant influence on stud ents' achievement, and there was no interaction effect between gender and instructional methods. The study recommends that Basic Science teachers should adopt andragogical instructional approaches in their teaching; government and school administrators should provide adequate instructional materials, laboratories, and technological tools that support the use of andragogical methods in teaching Basic Science among others.

Keywords: Andragogical Instructional Method, Basic Science, Academic Achievement, Gender, Education Managers

Introduction

The quest to improve the quality of science education in Nigeria has attracted enormous attention among researchers, policymakers, and education managers because of the strategic role science plays in technological and socio-economic development. Science subjects, particularly Basic Science at the junior secondary level, provide the foundational knowledge for students to

pursue advanced studies in Biology, Chemistry, Physics, and related fields. Unfortunately, reports of poor achievement in Basic Science at both internal and external examinations as revealed by Olatoye (2017) as well as the preliminary investigation conducted by researchers (2024) in the zone suggest that many students are unable to grasp fundamental concepts. This persistent underperformance has been attributed to several factors including the continued reliance on teacher-centered instructional methods that do not fully engage learners in the learning process (Prince, 2004; Okoye & Okecha, 2017). This situation raises critical questions about the suitability of existing teaching methods for engaging today's learners.

The conventional method of teaching, which still dominates Nigerian classrooms, is largely teacher-centered, focusing on information delivery and memorization. While this method allows coverage of the syllabus, it does little to promote inquiry, problem-solving, and active participation. Consequently, students become passive recipients of knowledge, limiting their ability to apply scientific concepts in real-life contexts (Okoli & Eze, 2018). In contrast, learner-centered instructional method that emphasizes exploration, self-direction, and peer interaction have consistently been linked to improved academic outcomes. One of such learner-centered instructional method is andragogical instructional method.

The andragogical instructional method, grounded in Malcolm Knowles' theory of adult learning, provides a promising alternative. Andragogy emphasizes principles such as self-concept, readiness to learn, orientation to learning, and motivation (Knowles, Holton, & Swanson, 2015). Although traditionally designed for adults, secondary school learners are not entirely dependent; many adolescents can take responsibility for their own learning when given the right opportunities (Ede & Okeke, 2020). By integrating andragogical principles into the teaching of Basic Science, students are encouraged to engage actively in discussions, draw from prior experiences, collaborate with peers, and solve real-life problems. This process enhances deeper understanding, retention, and transfer of knowledge. Moreover, the application of andragogy in Basic Science can bridge the gap between theory and practice. For instance, rather than memorizing definitions of energy or photosynthesis, students can investigate their applications in everyday life, design experiments, and analyze outcomes. This approaches foster curiosity while strengthening critical and creative thinking skills, which are vital in 21st-century learning (Trilling & Fadel, 2009).

Another dimension is the persistent debate on gender and science achievement. In many African contexts, cultural expectations and stereotypes often suggest that science is a male-dominated field (Okeke, 2019). Yet, empirical findings are inconsistent: some studies show male superiority in science achievement, while others report no significant gender differences (Omebe & Omiko, 2015). The non-significant gender differences found in similar studies suggest that effective teaching methods can mitigate gender-related disparities. Therefore, by adopting the andragogical method, which emphasizes inclusivity and learner autonomy, both male and female students may be given equal opportunities to participate actively in the learning process.

For educational managers, the implications of adopting andragogical methods are far-reaching. Managers must ensure that teachers are adequately trained to apply learner-centered strategies, provide resources that support collaborative and inquiry-based learning, and integrate

policies that encourage innovative pedagogical practices. Successful implementation could lead to improved student achievement, reduced gender gaps, and enhanced scientific literacy among secondary school students (Bybee, 2013; Okebukola, 2015; UNESCO, 2017). In light of these issues, this study investigated the effect of the andragogical instructional method on secondary school students' academic achievement in Basic Science. The study also explored whether gender interacts with the teaching method to influence achievement. The outcome of this research is expected to provide useful insights for teachers, curriculum developers, and educational managers on effective instructional strategies that can enhance achievement and bridge possible gender gaps in science education.

Materials and Method

The study adopted a quasi-experimental design, specifically the non-equivalent control group design. This design was considered appropriate because intact classes in secondary schools were used rather than random assignment of students to groups. The study was carried out in selected secondary schools in Enugu North Educational Zone in Enugu State. The zone comprised 31 public secondary schools. This zone includes the Local Government Areas (LGAs) of Enugu North, Enugu East, and Isi-Uzo, and these 31 schools are managed by the Post Primary Schools Management Board (PPSMB). A sample size of 163 JSS II Basic Science students was used for the study using simple random sampling technique. This sample was drawn from the population of JSS II Basic Science students in the zone. The instrument for data collection was Basic Science Achievement Test (BSAT) developed by the researchers. The BSAT consist of 50 multiple-choice objective questions covering the topics taught during the study. The instrument was validated by three experts in Science Education (Biology Education, Chemistry Education and Measurement and Evaluation Units). This was done to ensure face validity of the instrument. To ensure the content validity, the instrument was constructed using table of specification. The reliability of the instrument was determined after trial tested using Kuder-Richardson formula 20 (KR-20). An internal consistency reliability coefficient of 0.94 was determined for the instrument.

Experimental Procedure

The Basic Science teachers who served as research assistants were trained by the researchers on the use of the instructional. The experimental group was exposed to andragogical instructional method based on principles of self-direction, collaboration, and problem-solving. The control group on the other hand was taught using the conventional lecture method. Both groups were taught the same Basic Science topics for a period of six weeks. Before the commencement of the actual treatment, pretest was administered and posttest after treatment.

Method of Data Analysis

Data collected was analyzed using both descriptive and inferential statistics. Specifically, mean and standard deviation was used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The pretest scores served as covariates to control for initial group differences.

Purpose of the Study

The general purpose of the study was to determine the effect of andragogical instructional method on secondary school students' academic achievement in Basic Science; implications for education managers. Specifically, the study sought to determine the;

1. mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional (lecture) method;
2. influence of gender on students' mean achievement score in Basic Science;
3. interaction effect of teaching methods and gender on students' mean achievement score in Basic Science.

Research Questions

The study was guided by the following research questions;

1. What are the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional (lecture) method?
2. What is the influence of gender on students' mean achievement scores in Basic Science?
3. What is the interaction effect of teaching methods and gender on students' mean achievement score in Basic Science?

Hypotheses

The study formulated and tested the following hypotheses at a 0.05 significance level:

1. There is no significant difference in the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional (lecture) method;
2. There is no significant difference in the mean achievement score of male and female students in Basic Science.
3. There is no significant interaction effect of teaching methods and gender on students' mean achievement score in Basic Science.

Result

Research Question One

What are the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional (lecture) method?

Table 1: Mean and standard deviation of students' academic achievement in Basic Science when taught using andragogical instructional method and those taught using conventional (lecture) method

Groups		Pre-test		Post-test		Mean Gain Scores	Mean Gain Difference
	N	Mean	SD	Mean	SD		
Experimental Group	84	23.76	5.33	47.68	5.61	23.92	13.67
Control Group	79	21.75	6.18	32.00	7.27	10.25	

Result in Table 1 shows the mean achievement scores of students who were taught Basic Science using andragogical instructional method (experimental group) and those taught using the conventional (lecture) method (control group). The experimental group had mean achievement score of 23.76 with standard deviation of 3.33 at pre-test and 47.68 with standard deviation of 5.61 at post-test. The mean gain score of students exposed to andragogical instructional method

was 23.92. On the other hand, students who were exposed to conventional (lecture) method had mean achievement score of 21.75 with standard deviation of 6.75 at pre-test and 32.00 with standard deviation of 7.27 at post-test. The mean gain scores of the students exposed to conventional method was 10.25. The mean gain difference of 13.67 was recorded for the two groups in favour of andragogical instructional method. However, the obtained standard deviation from students in both the experimental and control groups were relatively small; indicating that the variation from the mean was small. The result indicated that teaching Basic Science with the use of andragogical instructional method enhances students' achievement compared to conventional (lecture) method. This can be seen from the gain score of 13.67 in favour of andragogical instructional method.

Research Question Two

What is the influence of gender on students' mean achievement scores in Basic Science?

Table 2: Mean and standard deviation of male and female students' achievement in Basic Science

Gender	Pre-test		Post-test		Mean Gain Scores	Mean Gain Difference
	N	Mean	SD	Mean	SD		
Male	76	22.77	5.61	44.74	8.52	21.97	1.92
Female	87	22.56	4.08	42.61	7.02	20.05	

Result in Table 2 revealed that at the pre-test, male students had mean achievement score of 22.77 with a standard deviation of 5.61 while their female counterpart had mean achievement score of 22.56 with standard deviation of 4.08. At the post-test, male students had mean achievement score of 44.74 and standard deviation of 8.52 while female students had mean achievement score of 43.61 with standard deviation of 7.02. The mean gain score of the males was 21.97 while the mean gain score of the female students was 20.05. The results therefore, show that male students had a slight higher mean achievement score compared to their female counterpart. This can be seen from a very slight mean gain score difference of 1.92 in favour of the male students.

Research Question Three

What is the interaction effect of teaching methods and gender on students' mean achievement score in Basic Science?

Table 3: Mean and standard deviation of interaction effect of teaching methods and gender on students' achievement in Basic Science

Groups	Gender	N	Mean	Std. Dev.
Experimental Group	Male	41	47.67	5.88
	Female	45	46.20	5.09
Control Group	Male	35	34.05	7.92
	Female	42	31.38	4.96

Result of the analysis in Table 3 revealed that male students exposed to experimental group (andragogical instructional method) had a higher mean achievement score of 47.67 and a

standard deviation of 5.88 as against their male counterparts in the conventional (lecture) method that had a mean achievement score of 34.05 with standard deviation of 7.92. On the other hand, female students exposed to experimental group (andragogical instructional method) had a higher mean achievement score of 46.20 and a standard deviation of 5.09 while their female counterparts in the conventional (lecture) method had a mean achievement score of 31.38 with standard deviation of 4.96. The results do not suggest ordinal interaction effect between methods of teaching and gender on students' achievement in Basic Science. This was because at all the levels of gender, the mean achievement scores were higher for students in the experimental group than those in the conventional method.

Hypothesis One

There is no significant difference in the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional method.

Table 4: Summary of Analysis of covariance (ANCOVA) of students' achievement in Basic Science when exposed to andragogical instructional method and those not exposed

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3454.906[a]	4	863.727	16.675	.000
Intercept	7058.886	1	7058.886	136.277	.000
PretestInt	5.832	1	5.832	.113	.739
Method	2972.348	1	2972.348	57.384	.000
Gender	6.013	1	6.013	.116	.735
Method * Gender	.121	1	.121	.002	.962
Error	2486.301	158	51.798		
Total	115528.000	163			
Corrected Total	5941.208	162			

Result of the analysis in Table 4 shows that teaching method is a significant factor on students' achievement in Basic Science; F (1,158) = 57.384, P = .000. Thus, the null hypothesis of no significant difference in the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional method was rejected. This is because the exact probability value (.000) is less than level of significance set at 0.05. Therefore, the researchers conclude that there is a significant difference in the mean achievement scores of students taught Basic Science using andragogical instructional method and those taught using conventional method.

Hypothesis Two

There is no significant difference in the mean achievement score of male and female students in Basic Science.

Result of the analysis in Table 4 was also used to test hypothesis two. The Table shows that gender is not a significant factor on students' achievement in Basic Science; F (1, 158) = .116, P = .735. Therefore, the null hypothesis of no significant difference in the mean achievement score of male and female students in Basic Science was accepted because the exact probability level is greater than level of significance set at 0.05. The researchers therefore,

conclude that there is no significant difference in the mean achievement scores of male and female students in Basic Science. The result indicated that gender is not a significant factor in the mean achievement scores of students in Basic Science.

Hypothesis Three

There is no significant interaction effect of teaching methods and gender on students' achievement in Basic Science.

The result of the analysis in Table 4 was also used to test hypothesis three. The Table shows that the exact probability value of .962 associated with method and gender is greater than 0.05 level of significance; (F (1, 158) = .002, P =.962). Thus, the null hypothesis of no significant interaction effect of teaching methods and gender on students' mean achievement scores in Basic Science is upheld. The researchers therefore, conclude that the interaction effect of teaching methods and gender on students' achievement in Basic Science is not significant.

Discussion of Findings

Effect of Andragogical Instructional Method on Students' Achievement in Basic Science

The finding of this study revealed that the andragogical instructional method significantly enhances students' academic achievement in Basic Science compared to the conventional method. This outcome suggests that when teachers adopt learner-centered strategies that encourage active participation, self-direction, and problem-solving, students are more likely to construct meaningful understanding of scientific concepts. Andragogical approaches, which emphasize dialogue, collaboration, and contextual learning, appear to align with constructivist principles of teaching and learning, thereby promoting deeper comprehension of Basic Science topics. The higher mean achievement score recorded for students taught Basic Science with andragogical instructional method may be as a result of the fact that andragogical instructional method contributes to the understanding of how students learn, in what context, and the process of learning. Moreover, andragogy is a rallying point for separating adult education from other areas of education. This supports the view of Zmeyov as cited in Chan (2010) that andragogical principles of learning are widely needed now, and not only in adult education.

The findings of the study is in agreement with the findings of Horner (2001) who examined the effectiveness of andragogical teaching methodologies within a community college environment and reported that teaching with the use of andragogical instructional method produced higher post-course achievement scores as determined by a multiple-choice test and an increased positive course attitude. Also in agreement were the findings of Wilson (2005) who scrutinize the impact of teachers' andragogical orientation on students' cognitive (learning) and student affective (satisfaction) outcomes in a non-traditional post-secondary graduate context and found that andragogy impacts student satisfaction in a non-traditional education setting.

This finding is also consistent with the work of Ugwu and Okoro (2019) found that interactive, student-centered methods improve learners' academic performance more than teacher-dominated conventional approaches. By engaging students in active inquiry and critical thinking, andragogical methods reduce rote learning and enhance knowledge retention, a major challenge in the teaching of Basic Science in Nigerian secondary schools. The result also corroborates findings by Olatoye and Adekoya (2016), who reported that instructional methods

that promote learners' participation and responsibility significantly boost achievement in science subjects. The implication is that when Basic Science is taught using strategies that treat learners as active participants in the learning process, they not only acquire factual knowledge but also develop higher-order skills such as analysis, application, and evaluation.

Influence of Gender on Students' Achievement in Basic Science

The result of the findings revealed that gender does not significantly influence students' achievement in Basic Science; though male students had a slight higher mean achievement score than their female counterparts. The finding that gender does not significantly influence students' achievement in Basic Science, despite male students having a slightly higher mean score than their female counterparts, suggests that both male and female students have comparable abilities when exposed to similar instructional environments. The slight differences in mean scores may reflect contextual factors such as classroom participation styles, teacher expectations, or socio-cultural perceptions of science, rather than inherent differences in ability (Eddy & Brownell, 2016).

The result of the study is in agreement with the findings of Jennifer, Anna, and Hayal (2010) who reported no significant difference in the science achievement of high school female and male students. The finding that gender did not significantly influence Basic Science achievement is consistent with extensive evidence that males and females perform similarly across many academic domains. Comprehensive reviews and meta-analyses conclude that gender differences in science and mathematics achievement are generally small and context dependent (Hyde, 2005; Hyde & Linn, 2006). Afuwape and Oludipe (2012) and Godpower-Echiei (2019) have likewise reported non-significant gender effects in Basic/Integrated Science when instructional opportunities are equitable. These findings suggest that the slight mean advantage observed for males in the present study is unlikely to reflect a true gender gap in ability, but rather minor contextual or sampling variation reinforcing the need to focus on instructional quality and resource equity rather than gender as a primary explanatory factor. Achor and Amadu (2015) also found that although male students recorded slightly higher mean scores in science, the differences were not statistically significant.

Interaction Effect of Teaching Strategies and Gender on Students' Achievement in Basic Science

The findings of the study revealed no significant interaction effect of teaching method and gender on students' achievement in Basic Science. This indicates that the effectiveness of the instructional strategy employed was not dependent on whether the students were male or female. In other words, both male and female students benefited relatively equally from the teaching methods applied, showing that the instructional strategy had a general effect that cut across gender differences. The finding is also consistent with result of Afuwape and Oludipe (2008) who reported no significant interaction between teaching strategy and gender on students' achievement in Integrated Science. Likewise, Udo and Udoh (2011) reported that gender did not interact with instructional method to influence students' achievement in Integrated Science, suggesting that males and females responded equally to innovative teaching approaches. The study is in agreement with findings of Ikeh, et al (2015) who reported no significant effect of interaction between treatment and gender on students' achievement in Economics. The result however disagrees with the findings of Eraikhuemen (2003) that reported significant interaction effect of gender and school location on the academic achievement of students.

Conclusion

The findings of this study lead to the conclusion that the andragogical instructional method is more effective than the conventional method in enhancing students' academic achievement in Basic Science. This suggests that active, learner-centered, and participatory strategies associated with andragogy better promote students' understanding and achievement than teacher-dominated, traditional approaches. Furthermore, the absence of significant gender differences indicates that both male and female students benefit equally from the andragogical approach. This underscores the fact that effective instructional methods, rather than gender, are the critical determinants of students' academic achievement in Basic Science.

Recommendation

Drawing from the outcomes of the research, the study recommends the following:

1. Basic Science teachers should adopt andragogical instructional approaches in their teaching. This is because methods encourage active participation, critical thinking, and self-directed learning, which can enhance students' achievement irrespective of gender.
2. Ministries of Education and school management boards should organize regular workshops, seminars, and professional development programs to equip teachers with the skills and strategies needed to effectively implement andragogical methods in Basic Science classrooms.
3. Curriculum developers should integrate andragogical principles into the Basic Science curriculum to ensure that learning activities are more learner-centered and interactive.
4. Government and school administrators should provide adequate instructional materials, laboratories, and technological tools that support the use of andragogical methods in teaching Basic Science.

Implications for Education Managers

Based on the findings of the study, the following implications were drawn for educational managers;

1. Policy Development and Implementation: Educational managers should recognize the effectiveness of andragogical instructional strategies and incorporate them into school policies and instructional guidelines. This can encourage schools to adopt more student-centered approaches that foster deeper understanding and achievement.
2. Teacher Recruitment and Training**:** The findings imply that educational managers need to prioritize the recruitment of teachers who are not only knowledgeable in subject matter but also skilled in modern learner-centered methodologies. Regular professional development programs should be organized to retrain teachers in andragogical practices.
3. Resource Allocation and Support**:** Since andragogical methods often require interactive materials and flexible classroom arrangements, educational managers must ensure the provision of adequate resources, such as laboratories, ICT facilities, and instructional materials that support participatory learning.
4. Monitoring and Supervision**:** School heads and supervisors should adjust their supervisory practices to ensure that teachers implement innovative instructional strategies

like andragogy. Monitoring should emphasize learner engagement and achievement rather than rote teaching.

5. Equity in Learning Opportunities**:** The finding of no significant gender difference implies that educational managers can focus more on improving the overall quality of teaching and learning rather than on gender-based interventions. Efforts should be geared toward creating inclusive learning environments that benefit all students equally.

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