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THE EFFECT OF MINDS-ON ACTIVITY TEACHING METHOD ON STUDENTS' ACHIEVEMENT AND ATTITUDES TOWARD PHYSICS AMONG SENIOR SECONDARY SCHOOL STUDENTS IN GOMBE SOUTH, GOMBE STATE

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Abstract
This paper explores the effect of the minds-on activity teaching method on students' achievement and attitudes towards physics among senior secondary school students in Gombe South, Gombe State. The research work was guided by three objectives, questions and hypotheses. The quasi-experimental research design was used on a population that comprised of 165 SS II Science Students (86 males and 79 females). Sixty (60) Physics students selected using the SRSM participated in the research. Two instruments tagged: the Physics Achievement Test (PAT) and the Physics Students Attitude Questionnaire (PSAQ) were used to collect data for the study. The research questions were answered using descriptive statistics while the hypotheses were tested using the t-test statistics at 0.05 level of significance. The results revealed a significant difference between the achievement of the experimental and control groups in favour of the former. The study concludes that the mind-on activity teaching method was found to be more effective than the conventional method at improving the achievement of students taught Physics.

Keywords: Minds-on, Achievement, Teaching, Method, Attitude and Students

Introduction
Physics, is an integral aspect of the natural science and technology curriculum. It plays an active role in contributing to the meaningful learning of science in secondary schools. The use of an adequate teaching method is therefore crucial to the realization of classroom objectives because meaningful learning is said to take place when there is a relative lifelong change in the attitudes of the learners (Bada & Jita, 2023).

Science has been regarded as the rudiments on which the present-day technological breakthrough is built. Countries all over the world, particularly developing countries such as Nigeria are striving hard to develop technologically and scientifically of which Physics is one of the crucial subjects that formed the basis of science and technology. As such, the teaching and learning of Physics at the secondary school level should be accorded the needed attention to boost academic achievements that will pave the way for technological and scientific advancement (Ayuba, *et al*, 2022). Physics is mathematical in nature and requires analytical and problem-solving skills, hence the search for the right method of instruction. There has been a great paradigm shift in the importance of science teaching and learning from teacher-centred to student-centred, activity-oriented such as the "mind-on activity teaching method" which requires reasoning and active participation during the learning process, focused more on understanding rather than rote-learning and simple recall of knowledge (Suresh & Suman-Rajest, 2019).

Education has been identified as a critical tool for attaining national development (Taiye, *et al*, 2022), yet it is never free from challenges. One major challenge that has persisted in the field of education is the continuous search for the best teaching method that can be used for instruction in schools. This situation is a repercussion of the cons that come with the already identified teaching method, which makes none of these methods perfect for instruction in secondary schools. This scenario is not different in the field of natural science, because the array of the different teaching methods used for instruction in secondary school physics has either revealed little or no significant difference over the conventional lecture method (Ugwuanyi, *et al*, 2020).

Nigeria will not realize its dream in the development of science and technology if its citizens do not have outstanding performance (achievements) in Physics and other science subjects. It's a known fact that no nation can survive economically and compete favorably if its future generation is performing poorly in scientific fields like Physics. Besides student's achievements or performance in Physics, it has also been observed that most students don't have an interest in studying Physics which is also among the major factors affecting their academic achievement or performance generally.

Statement of Problem

The lecture method, which is commonly used in teaching physics, is a method in which the teacher communicates his/her ideas to learners by direct verbal discussion while the students are engaged in critical thinking which would ultimately lead to little or no assimilation at all due to the fact that they are not actively involved in the learning process. This situation shows that the lecture method cannot sufficiently develop students' scientific thinking or reasoning and understanding of most concepts in physics. As such, it affects negatively their academic achievements. For this reason, it is essential to use a more effective teaching method which 'minds-on activity teaching method, which is an activity-oriented method' may serve as a better method or substitute for the lecture method, since the student participates actively in the learning process which will enhance better understanding of the physics concepts to improve on their achievements significantly**,** hence this development led to this research.

Purpose of the Study

The paper examine the effect of the minds-on activity teaching method on students' achievement and attitudes towards physics among senior secondary school students in Gombe South, Gombe State. The specific objectives were to:

1. Determine the mean achievement score of students taught Physics using the minds-on activity method and those taught using lecture methods.
2. Examine the mean achievement scores of male and female students taught Physics using the minds-on activity method and those taught using lecture methods.
3. Find out the attitudes of students' taught Physics using minds-on activity method and those taught using lecture methods.

Research Questions:

The following research questions were raised to guide the study:

1. What is the difference in the mean achievement score of students taught Physics using minds-on activity method and those taught using the lecture method?
2. What is the difference in the mean achievement score of male and female students taught Physics using minds-on activity method and those taught using lecture method?
3. What is the difference in the attitudes of students taught Physics using minds-on activity method.

Research Hypotheses:

Ho_1: There is no significant difference between the mean achievement score of students taught physics using minds-on activity method and those taught using lecture method.

Ho_2: There is no significant difference between the mean achievement score of male and female students taught Physics using minds-on activity method and those taught using lecture method.

Ho_3: There is no significant difference in the attitudes of students taught Physics using minds-on activity method and those taught using lecture method.

Literature Review

Lecture Teaching Method

Traditional teaching methods like lectures, have long been in practice. However, this method is evaluated as poor and inappropriate in view of contemporary educational requirements (Kiyafat, 2017). This could be attributed to a number of reasons including but not limited to one-way transfer of knowledge that enhances memorization encourages surface rather than deep learning experience and encourages bulimic learning (Kiyafat, 2017). Though it is an effective method for transferring huge amounts of information to a large number of students this approach is characterized as primitive, outdated and traditional. Research studies have identified that the sole utilization of lecture teaching method generates an inactive and passive learning atmosphere. Lecturing, in lay terms, means 'to go on', usually at some length, about an issue to a willing or unwilling listener. But in educational terms, to lecture means a particular type of educational encounter in which a teacher transmits information to some students (Regmi, 2012). In this respect, one can argue that the interactive component between the students and the tutor is considered to be an effective means of teaching and learning (Regmi, 2012).

Minds-On Activity Teaching Method

Minds-on activity teaching method is defined as the teaching method in which students are engaged in the learning processes. In minds-on activity teaching method, students actively participate in the learning experience through critical reasoning and thinking about how to solve problems by themselves. Learning activities are based on real-life experience which helps learners to transform information or ideas received into personal knowledge which they can apply in different real-life situations (Bulus, 2021). Teaching method that engages learners in the class in higher order critical-thinking skills like analysis, synthesis, and evaluation, have been claimed to be highly effective in improving students' learning (Hackathorn *et al*., 2010). Minds-on activity teaching method, also known as active learning, is built on the theory of constructivism that has been used to clarify teaching-learning processes and is frequently stated as 'learner-centered instruction'. It has been supposed a paradigm shift from conventional to active learning teaching methods. Active learning according to Kiyafat (2017) is "anything that involves students in doing things and thinking about the things they are doing." The chief component of active learning is students' engagement in activities during the learning process''. It comprises any kind of technique that engages the learners in the learning process and makes them responsible for their own learning. In the research of Bulus (2021) on the effect of the minds-on activity learning method on achievement in physics among varied ability senior secondary students in Billiri Local Government area of Gombe State, revealed that the mind-on activity teaching method was more effective than the conventional method at improving the performance of students taught physics and was found to be gender friendly.

Students' Achievement in Physics Based on Gender

The studies of Stephen (2010) who investigated the effect of the technological attitude of students on academic achievement in Physics, showed significant effects on students' achievement. The research furthermore revealed that gender affects significantly physics students' achievement in favour of the male counterparts. This is because male students are proven through research to have higher manipulative skills than their female counterparts. Aina & Akintunde (2013) conducted research on the analysis of gender performance in Physics and found out that male students performed better than female counterparts. Odogwu and Babajide (2018) asserted that physics is believed to be a male subject such that, the male students are more eager and motivated to participate in physics class discussions, do assignments, create a physics personal learning environment and get more actively involved in physics activities and these reflect on their achievement in the subject compared to their female counterpart. However, the findings of Mari (2014) and Bulus (2021) showed that gender does not combine with teaching methods to affect students' achievement. Mkpanang (2016) showed that males performed better than females in physics, these are at variance with the findings of Ogunleye and Babajide (2011) who obtained a non-significant difference in the achievement of male and female students in physics.

Students' Attitude Towards Physics

Joseph and Alabi (2014) recognized attitude as a major factor in a subject choice and also considered attitude as a mental and natural state of readiness, organized through experiences exerting a directive influence upon the individual's responses to all objects and situations with which it is related. However, the attitude does not stay the same. It changes in a couple of times and gradually. Physics was believed to be difficult and less appealing and a majority of students didn't take physics electives as a choice (Xavier & Croux, 2016) which resulted in

a lack of personal interest in learning physics that impacted their attitudes and grades (Villa & Candeias, 2020) so they usually viewed the subject as difficult. The pieces of literature reviewed showed a mixture of positive and negative attitudes towards learning physics while gender difference was significant in some studies, it was insignificant in others. Physics was considered to be a difficult subject and was not attractive to students because of its mathematical nature (Odogwu & Babajide, 2018). Also, research reports showed that males are found in physics than females but some females are found in Biology than males.

Research Methodology

Design of the Study

The design of the study was a Quasi-experimental research design. Pre-test was administered to both groups at first, to determine their achievement after which they were placed equally into two arms (A & B) before administering the two pedagogical methods concurrently. After the teaching, the same Physics Achievement Test (PAT) & Physics Students Attitudes Questionnaire (PSAQ) were administered as the Post-test. The experimental group were taught using the Mind-On Activity Method while the control group were taught using the Lecture Method. A lesson plan of about 80 minutes was already prepared for teaching the foregoing concept (Optics). The mind-on-activity teaching method (MATM) was based on the theory of constructivism which capitalizes on learning by reasoning it out, thinking-does it makes sense. And at some stage, uses the hands learning by doing (Activity-based Method). The researchers adopted the 5E model of (MATM) developed by Mbonyiryiwuze *et al* (2021).

Gombe South is one of the three Senatorial Zones of Gombe State, comprised of four local governments namely: Billiri, Balanga, Kaltungo and Shongom respectively, in North-Eastern Nigeria. It is located at longitude 17 N and latitude 10 E. The inhabitants of Gombe South were predominantly farmers and civil servants. It is one of the most civilized zones in the state due to the influence of the early missionaries who brought Western education and settled down in the area.

The population for the study comprised 165 SS II Science Students which included both male and female students (86 and 79) in the 2022/2023 academic session. The sample for the study was selected using the stratified random sampling method (SRSM) from Government Day Secondary School Ibinola in the central educational zone of Gombe South. The class was divided into A and B and were maintained as experimental and control groups respectively.

The instrument used for data collection was: the Physics Achievement Test (PAT), which was used as pre-test and post-tests to determine both the ability level and academic achievement. It comprised of 30-item Multiple choice questions with four response options and 2-Essay Questions; and Physics Students Attitude Questionnaire (PSAQ) were used to determine any attitudinal change in both the experimental and control group adopted from Mbonyiryiwuze *et al* (2021). The PSAQ items were used to determine the students' attitudes towards the concept of optics. The items were designed to be rated on a 5-options Likert type response format (absolutely agree, disagree, neutral, agree and absolutely agree). The instruments were subjected to content and face validation by experts in the Department of Educational Foundation, Federal University of Kashere, Gombe, Gombe State. The reliability was determined through test-re-test method. The Pearson Product Moment Correlation Coefficient (PPMCC) was used to obtain 0.70 as the reliability index of PAT and PSAQ. The

instrument was found to be reliable since a reliability index ≥ 0.5 was considered well enough for the study (Ugodulunwa, 2008).

The experimental group were taught using minds-on activity teaching while the control group were taught using the lecture method. Both groups were taught the same concept (optics) for 8 weeks. Data collected from PAT and PSAQ were analyzed and used to answer the research questions and hypotheses**.** The research questions were answered using mean, standard deviation and mean deviation while the hypotheses were tested using t-test at $P \leq 0.05$ level of significance.

Results

Research Question 1: What is the difference in the mean achievement of students taught Physics using minds-on activity method and those taught using the lecture method?

Table 1: Post-Test Mean Achievement of Students Taught Physics Using Minds-On Activity Method and Those Taught Using the Lecture Method

GROUPS	N	M	SD	Mean Difference
Experimental	28	42.07	14.95	6.79
Control	32	35.28	15.27	

The data in table 1 above shows that the mean score of the experimental group taught physics is 42.07 with a standard deviation of 14.95 while the mean score of a control group is 35.28 with a standard deviation of 15.27. This depicts that, the difference exists between post-test mean scores of experimental and control groups in favour of the experimental; that is those taught using the minds-on activity method.

Research Question 2: What is the difference in the mean achievement of male and female students taught Physics using minds-on activity method and that taught using the lecture method?

Table 2: Post-test Mean Achievement of Male and Female Students Taught Physics using Minds-on Activity Method and Those Taught using Lecture Method

GROUPS	N	M	SD	Mean Difference
Male	24	43.04	15.53	7.65
Female	36	35.39	14.69	

To answer the above research question, the data collected was calculated and analyzed as shown in table 3. The post-test mean achievement of a male is 43.03 while that of female is 35.39 with standard deviations of 15.53 and 14.69 respectively. The mean difference between

the male and female achievement of students taught physics using minds-on activity method and those taught using lecture method is 7.65. The result indicated that difference exists between the two genders in favour of male students taught physics using minds-on activity method.

Research Question 3: What is the difference in the attitudes of students taught Physics using minds-on activity method and that taught using lecture method?

Table 3: Post-Test Mean Attitude of Students Taught Physics Using Minds-On Activity Method and Those Taught Using Lecture Method

GROUPS	N	M	SD	Mean Difference
Experimental	28	2.65	1.80	0.68
Control	32	1.97	1.01	

The data in table 3 above indicated the post-test mean attitude of students taught physics. The experimental group had a mean of 2.65 with standard deviation of 1.80 as against the control group with 1.97 and 1.01 as mean and standard deviation respectively. The mean difference of 0.68 exists between the experimental group taught physics using minds-on activity method and the control group taught physics using lecture method in favour of the experimental group.

Hypotheses Testing

Hypothesis 1: There is no significant difference between the mean achievement of those taught using minds-on activity method and those taught using lecture method**.**

Table 4: Independent sample t-Test Analysis on the Mean Achievement of Students Taught Physics Using Minds-on Activity Teaching Method and Those Taught Using Lecture Method

GROUPS	N	M	SD	Df	t-value	p-value	Remark
Experimental	28	42.07	14.95	58	1.74	0.04	Rejected
Control	32	35.28	15.27				

N = 60, Significant at P ≤ 0.05 *alpha levels*

Table 4 shows the independent t-Test analysis on the mean achievement of students taught physics using minds-on activity teaching method and those taught using lecture. The t-value was found to be 1.74 against p-value of 0.043 with degree of freedom (df) 58. Conclusively, the result reveals that there is a significance difference between students taught physics using minds-on activity teaching method and those taught using lecture method in terms of academic achievement in favour of the experimental group (those taught using minds-on

activity teaching method). Hence, the null hypothesis which states that, there is no significant difference between the mean achievement of those taught using minds-on activity method and those taught using lecture method, thus was rejected.

Hypothesis 2: There is no significant difference between the mean achievement of male and female students taught Physics using minds-on activity method and those taught using lecture method.

Table 5: Independent sample t-Test Analysis on the Mean Achievement of Male Students and Female Students Taught Physics Using Minds-on Activity Teaching Method and Those Taught Using Lecture Method

GROUPS	N	M	SD	Df	t-value	p-value	Remark
Male	24	43.04	15.53	58	1.93	0.029	Rejected
Female	36	35.39	14.69				

N = 60, Significant at P ≤ 0.05 alpha levels

The results presented in table 5 above shows the independent sample t-Test analysis on the mean achievement of male and female students taught physics using minds-on activity teaching method and those taught using lecture method. The analysis indicated that the t-value was 1.93 against p-value of 0.029 with degree of freedom (df) 58. Conclusively, the results proved that, there is significant difference in the mean achievement of male and female students taught physics using minds-on activity teaching method and those taught using lecture method in favour of the male who was taught using minds-on activity method. Therefore, the null hypothesis which stated that, there is no significant difference between the mean achievement of male and female students taught Physics using minds-on activity method and those taught using lecture method was rejected.

Hypothesis 3: There is no significant difference in the attitudes of students taught Physics using minds-on activity method and that taught using lecture method.

Table 6: Independent Sample t-Test Analysis on the Mean Attitudes of Students Taught Physics Using Minds-on Activity Teaching Method and Those Taught Using Lecture Method

GROUPS	N	M	SD	Df	t-value	p-value	Remark
Experimental	28	2.65	1.80	58	1.84	0.035	Rejected
Control	32	1.97	1.01				

N = 60, Significant at P ≤ 0.05 alpha levels

The result seen in table 6 shows that the t-Test analysis on the mean attitudes of students taught physics using minds-on activity teaching method and those taught using the lecture

method. From the analysis, t-value was found to be 1.84 against p-value of 0.035 with degrees of freedom (df) 58. In conclusion, the result indicated that there is a significant difference in the mean attitudes of students taught Physics using minds-on activity method and that taught using lecture method in favour of the experimental group (those taught using the minds-on activity teaching method). Based on the results presented in the table, the null hypothesis was hereby rejected.

Discussion of findings

The data collected from the post-test administered were analyzed employing t-test statistics at $P \leq 0.05$ levels of significance. In Table 4, the result of the tested hypothesis shows that there was a statistically significant difference in the mean achievement of students exposed to the minds-on activity method than those taught with the lecture method. The significant difference found between the two groups was likely to be due to the use of minds-on activity method (an activity-oriented method) in the experimental group. If the treatment administered has no effect, the two groups would be expected to perform equally the same. Since the experimental group performed significantly better, it then implies that using minds-on activity method has improved their achievement or performance in the subject. Minds-on activity teaching method creates an ideal situation for teaching science subjects such as Physics. The result confirmed the earlier finding of Bulus (2021) who investigated the effect of minds-on activity teaching method on academic achievement in physics among varied ability of senior secondary school students in some selected senior secondary schools in Billiri Local Government of Gombe State.

On the issue of gender in relation to academic achievement when exposed to minds-on activity and lecture method, the results in Table 5 showed that there is a significant difference in the mean achievement of male and female students taught physics in favour of the male counterparts who were taught using minds-on activity method. This finding was contrary to the results obtained by Mari (2014) and Bulus (2021) who showed that gender does not combine with teaching method to affect students' achievement.

The result seen in Table 6 shows the t-Test analysis on the mean attitudes of students taught physics using minds-on activity teaching method and those taught using the lecture method. From the analysis, t-value was found to be 1.84 against p-value of 0.035 with degrees of freedom (df) 58. The result indicated that there is a significant difference in the mean attitudes of students taught Physics in favour of the experimental group (male counterpart). The result of this finding was in disagreement with the results obtained by Mbonyiryiwuze *et al* (2021) who found a gender difference in the attitude of students with females possessing better learning attitudes than male students.

Conclusion

This study investigated the effect of minds-on activity teaching method on students' achievement and attitudes towards physics among senior secondary school students in Gombe South, Gombe State. The results revealed a significant statistical difference between the performance of the experimental and control groups in favour of the former. On gender and attitudes, the results also showed that there is a significant difference in favour of the male counterparts who were taught physics using minds-on activity teaching method. The study concludes that the mind-on activity teaching method was found to be more effective than the conventional method at improving the achievement of students taught Physics.

Recommendations

Based on the results of this paper, the following recommendations were made:

1. Physics teachers should use the minds-on activity teaching method in teaching physics for improved achievement.
2. Curriculum planners should incorporate minds-on activity teaching into the main stream of pedagogy in the teaching of physics at the senior secondary school level.
3. Also, seminars and workshops should be organized by the government and other relevant stakeholders, for physics teachers on the use of minds-on activity teaching method.
4. Science teachers should ensure that all students; male and female are given equal opportunity during lessons by giving them equal attention, and fair tasks and inspiring them through mixed group works and projects. This will help close the gap between male and female students concerning their performances or achievements in the sciences.

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