

Fostering Secondary School Students' Interest in Biology Using Numbered Heads Together Cooperative Instructional Strategy

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ARTICLE INFO

Article History:

Received 27.02.2022

Received in revised form 10.08.2022

Tarih girmek için burayı tıklayın.

Available online 01.07.2023

ABSTRACT

The study investigated the effect of numbered heads together cooperative instructional strategy (NHT) on secondary school students' interest in biology in Awka Education Zone. Two research questions and three null hypotheses tested at 0.05 level of significance guided the study. The study is quasi-experimental research, adopting specifically the pretest posttest non-randomized control group of 2x2 factorial research design. 4755 senior secondary year two (SS2) students constituted the population. Multi-stage sampling procedure was employed to compose the sample size of 64 (21 males and 43 females) SS2 students. The sampled students who were in two intact classes were randomly assigned to experimental (23 girls and 10 boys) and control (20 girls and 11 boys) groups using a flip of a coin. A 20-item Biology students interest scale (BSIS), with five response options, developed by the researchers was used for data collection. The biology students interest scale was validated by three experts and with reliability index of 0.77 established using Cronbach alpha. Students in the experimental group was taught selected concepts in biology using NHT while those in the control group was taught the same concepts using Conventional Lecture Method (CLM). Mean and Standard deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 alpha level. The findings of the study revealed that NHT is more effective in fostering students' interest in biology than CLM. Gender had no significant influence on students' interest in biology. Also, there was no interaction effect of teaching methods and gender on students' interest in biology. The study therefore concluded that NHT is a gender friendly approach that fosters students' interest in biology as it involves the group working together and every member of the team taking accountability of the group. Based on the findings, recommendations were made among which include that NHT should be adopted by biology teachers in schools to foster students' interest in biology.

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Keywords:¹

Cooperative instructional strategy, Numbered Heads Together (NHT), Interest, Biology

INTRODUCTION

Intensive competition among countries in achieving scientific and technological advancements in the 21st century has caused a paradigm shift in Education, ushering in the revamping and restructuring of the education system. This revamping has caused a transformation from the normally used conventional methods of teaching to innovative methods of instructions, in order to meet up with the current trends of the 21st century. Innovative methods of instructions refer to approaches to teaching and learning that puts learners first and foremost and thrive to bring learning to the doorstep of the learners (Nwuba, Egwu & Osuafor, 2022). Okoli cited in Mbia and Nsungu (2019) defined them as instructional techniques that provide a hands-on-mind-on practical oriented activities that helps to de-emphasize rote memorization of science concepts and principles, encouraging learners' active participation in the learning process and acquisition of science process skills.

Supporting the above definitions, Puranik (2020) stressed that these innovative instructional approaches make connections between theory and practical applications that help students understand the content of a course, adapt to technological changes in the world as well as solve complex problems. Innovative instructional methods are vast and wide. According to Revathi, Elavarai and Sarawanan (2019), the innovative approaches employed in teaching and learning include all but not limited to: Computer assisted instruction (CAI), Flipped classrooms, Peer tutoring, Problem solving teaching, Use of digital tools and reusable learning objects, blended learning, Z to A approach, Mind-mapping approach, Activity-based approach, Cooperative teaching, Experiential based learning, Project based teaching learning and Research based teaching learning. In this study, a form of cooperative instructional approach was studied.

Cooperative instructional approaches are teaching strategies that involve small, heterogeneous teams, usually of four or five members, working together towards a group task, in which each member is individually accountable for part of an outcome, that cannot be completed unless the members work together (Sani, 2015). Usang and Okoli (2021) identified them as approaches to learning in which a selected group of students work together to achieve a stated goal. Since this approach involves members of a team working together to achieve a common goal, Onyiorah (2021) stated that cooperative instructional approaches increase self-confidence and communication skills of individuals, strengthens their power of problem solving and critical thinking and

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enables students to participate actively in the process of teaching and learning. Olaya and González-González (2020) identified that cooperative instructional approach exists in many forms including: Jigsaw, Think-Pair-Share approach, Numbered Heads Together, reciprocal teaching, quiz-quiz, STAD (Students Team Achievement Division), Prairie fire and group investigation. In this study therefore, numbered heads together, a form of cooperative instructional strategy was studied.

Numbered heads together Instructional strategy (NHT) is a cooperative instructional strategy developed by Spencer Kagan and associates in 1994 (Kagan and Kagan, 2009). Adhini (2017) defined it as a cooperative learning strategy in which students work together to ensure that each member of a group knows the correct answer to a problem or question asked by the teacher. It is a learning technique that provides justice in groups because all students are active together in preparing answers and questions to understand the materials being studied (Etik, Lustyantje & Emzir, 2021). Hence, Numbered heads together instructional strategy can be defined as a cooperative instructional approach in which members of a team work on a task together with each member ensuring he/she knows the answer(s) to the task or learned material, since the group is not informed in advance who the representative of the group will be.

In line with above definitions, Barker (2013) emphasized that NHT creates room for positive interdependence, individual accountability, face to face communication as well as active engagement and interaction of group members, since each individual student is potentially responsible for the success of both the group and the individual student. To effectively implement NHT in the classroom, Ellena and Suminar (2018) summarized the five-phase structure the teacher must adopt: Phase 1. Numbering: in this phase, the teacher divides the student into small heterogenous groups, with 4 to 5 persons in a group and each member of the groups given number from 1 to 4 or 5 (depending on number of team members in the group). Phase 2. Asking/Posing a question or presenting a problem: in this phase, the teacher may ask a question, give a learning material or presents a problem to the class and give the groups time to think and work together to complete the task. Phase 3. "Heads Together": the students put their heads together, and discuss, to decide on one appropriate answer making sure that every group member knows the agreed upon answer. Phase 4. Answering the Question: the teacher calls a number at random and only members in the groups with the number respond to the question. 5. Feedback: the teacher asks if there are other students who want to refute or add an answer and finally, provides feedback to the answer.

In effectively implementing the phases above, Isjoni and Ismail cited in Nursyamsi and Corebima (2016) asserted that NHT instructional approach improves students' achievement, curiosity, self-confidence, teamwork, communication skills as well as courtesy and respect of members. Supporting the premise, Etik, Lustyantje and Emzir (2021) stated that NHT instructional strategy increases students' participation, academic results, and positive behavior in learning when effectively utilized. In this light, the study sought to determine the effect of NHT on students' interest in biology.

Biology is one of the science subjects studied in Nigerian secondary schools. Onu, Anyaegbumam and Uzoigwe (2020) defined it as a natural science which studies the existence (evolution, morphology and physiology) of living things, as well as their interactions with non-living components of the earth. Hence, it is that branch of science that studies living things and their interactions with the environment. Nwuba, Egwu and Osuafor (2022) stressed that the importance of biology cannot be overemphasized as it provides the knowledge applied in every sphere of life today ranging from food production, environmental protection, conservation of resources, bioengineering, and agriculture.

Despite biology's importance and popularity among students, the recorded performance of students in the subject in external examinations has remained unsatisfactory and inconsistent as seen in the statistic report of West African Examinations Council (WAEC) from 2015-2019. In 2015, for aggregate of A₁-C₆, a percentage pass of 57.42 was recorded, 61.68% in 2016, 55.57% in 2017, 55.10% in 2018 and 55.63% in 2019 showing that students' performance in the subject over the years has remained slightly above average. This continued unsatisfactory performance in biology is an indication that either biology teachers do not utilize innovative strategies effectively to teach, or that there are other student personal factors which possibly impact achievement. Hence, the study sought to find out if using numbered head together cooperative instructional strategy will foster students' interest in biology and help them achieve better in the long run.

Interest simply entails willingness to acquire skills, knowledge, attitude, and values. It is the eagerness to learn a set out task or activity for positive and near mastery of the skills and knowledge related to the activity (Unachukwu & Okoli, 2020). Similarly, Okekeokosisi and Okigbo (2021) defined interest as an

emotionally oriented behavioral trait that determines a students' urge and vigor to tackle educational programs or other activities. Hence, interest, in the context of this study, may be defined as a personal attribute of a student towards a learning situation usually expressed as like or dislike.

From the above definitions, it can be deduced that interest is an important factor that needs to be considered for effective learning to take place. Supporting the above assertion, Gessel cited in Okonkwo (2012) stressed that a child is willing to learn when he/she has an interest and matured thinking in the teaching-learning process. Similarly, Udoh (2019) stated that meaningful learning depends on interest and how motivated learners are during the teaching and learning scenarios as when students feel passionate about a lesson content and its method of instruction, the student's interest is aroused, and this fosters achievement and retention. In this light, the study sought to determine the effect of numbered heads together (NHT) instructional strategy on secondary school students' interest in biology irrespective of gender.

Gender, as a concept, has captured the interest of science educators in Nigeria, especially now that gender equity is being emphasized in many quotas. Filgona and Sababa (2017) defined it as a range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between the feminine and masculine (female and male) population. Hence, gender in the context of this study may simply be defined as an attribute ascribed to male and female based on biological features. In recent times, gender related issues in science education have generated serious concerns for science educators judging by the number of studies done to that effect. Still, there is no consensus as to whether it affects students' interest in science or not.

While some researchers (Onu, Anyaegbumam & Uzoigwe, 2020; Usang & Okoli, 2021) reported that female students had higher interest in biology and chemistry respectively than their male counterparts, others (Okekeokosisi & Okigbo, 2021; Yunusa, Abdulwahid & Adullahi, 2014) reported that there is no significant difference in the mean interest scores of male and female students in science subjects. This inconclusive results on gender calls for further investigation to find out if gender influences students' interest in biology or not. Hence, this study also intends to examine gender differences in interest among secondary school students' taught biology using NHT. It is against this backdrop that the researchers sought to find out if secondary school students' interest in biology can be fostered using numbered heads together cooperative instructional strategy irrespective of gender.

The role of biology in scientific and technological advancements cannot be overemphasized. This is probably why there has been consistent search of variables that could be influenced to foster and promote students understanding of the subject. Despite this importance, students' performance in the subject in external examination such as West African Secondary School Certificate Examinations (WASSCE) has remained unsatisfactory. To curtail this ugly trend, several research has been carried out on both environmental (teaching methods and strategies, learning environment, instructional materials and facilities for practical teaching) and students personal (psychological) variables such as self-efficacy, locus of control, interest, creativity, communication skills, critical thinking ability prompting provision of resources as well as organization of workshops, seminars, conferences and symposia by education stakeholders and professional bodies such as Science Teachers Association of Nigeria (STAN), but still students' performance in biology has not improved significantly to the expectations of education stakeholders. In this light, the research sought to find out if using Numbered Heads together cooperative instructional strategy can foster students' interest in the biology. As when students' interest is fostered and sustained in any learning process, their understanding of any concepts is enhanced and in the long run their academic achievement.

1. What is the difference in the pretest posttest mean interest scores of secondary school students taught biology using NHT and those taught using Conventional Lecture Method (CLM)
2. What is the difference in the pretest posttest mean interest scores of male and female secondary school students taught biology using NHT?

Hypotheses

1. No significant difference exists between the mean interest scores of secondary school students taught biology using NHT and those taught using Conventional Lecture Method (CLM).
2. There is no significant difference between the mean interest scores of male and female secondary school students taught biology using NHT?
3. There is no interaction effect of gender and teaching methods on secondary school students' interest in biology.

METHOD

The study is a quasi-experimental research, adopting a pretest posttest non-randomized control group of 2x2 factorial research design.

Study Group

4755 senior secondary year two (SS2) students constituted the population of the study. Multi-stage sampling procedure was employed to compose the sample size of 64 (21 males and 43 females) SS2 students sampled from two government owned co-educational schools in Awka Education Zone of Anambra State. The sampled students who were in two intact classes were randomly assigned to experimental (23 girls and 10 boys) and control (21 girls and 11 boys) groups using a flip of a coin.

Material

The instrument used for data collection was a 20-item Biology Students Interest Scale (BSIS), with five response options of Strongly Agree (SA), Agree (A), Undecided (UN), Disagree (D) and Strongly Disagree (SD), developed by the researchers, and validated by three experts (Two from the Department of Science Education and one from the Department of Measurement and Evaluation, all from Nnamdi Azikiwe University, Awka). The reliability of the instrument was that of internal consistency established using Cronbach Alpha. The reliability coefficient of the BSIS was found to be 0.77.

Experimental Procedure

The experiment was conducted in two phases. Phase one and Phase two. Phase one was the briefing of the research assistants who were the regular biology teachers of the two sampled schools. In the experimental group, the research assistant was briefed on how to implement NHT in the classroom using the lesson plans developed by the researchers while the research assistant of the control group was given the lesson plans on CLM and then asked to teach as usual. In Phase two, the treatment process commenced with the administering of the pretest (BSIS) to both the experimental and control groups. The teaching process in both groups lasted for four weeks in which for each new week a selected concept (Nutrition and Excretion) in biology was taught to the two groups. In the last week of the teaching, a posttest (reshuffled BSIS) was administered again to the research participants of the two groups. The two administered questionnaires (pretest and posttest) were collected, scored, and recorded by the researchers.

Data Analyses

Data from the questionnaires were analyzed using Mean and Standard deviation in answering the research questions and Analysis of Covariance (ANCOVA) in testing the null hypotheses at 0.05 alpha levels. In taking decisions, null hypothesis was rejected if the Probability (P) value is less than or equal to the level of significance (0.05), if otherwise, the null hypothesis was not rejected.

Findings

Research Question 1: What is the difference in the pretest and posttest mean interest scores of students taught biology using Numbered Heads Together Cooperative Learning Strategy (NHT) and that of those taught using Conventional Lecture Method (CLM)?

Table 1: Mean interest and Standard Deviation Scores of students taught biology using NHT and those taught with CLM

Method	N	Pretest		Posttest		Gain in mean
		Mean	Std. Dev.	Mean	Std. Dev.	
NHT	33	57.58	1.87	77.52	1.84	19.94
CLM	31	55.06	2.12	59.00	1.68	3.94
Mean Difference		2.52		18.52		16.00

From table 1 above, the experimental group, taught with NHT, had mean interest scores of 57.58 and 77.52 in the pretest and posttest respectively while their counterparts taught with CLM had mean interest scores of 55.06 in the pretest and 59.00 in the posttest. The mean difference of the gains in mean for NHT and CLM, revealed that students in the experimental group had increased interest in biology more than those in the control group with a mean difference of 16.00. The result indicated that using number heads together cooperative instructional strategy enhanced students' interest in learning biology as it provided a learning environment that involved every member of a team taking charge of the learning process and making contributions when necessary.

Research Question two: What is the difference in the mean interest scores of male and female students taught Biology using Numbered Heads Together Cooperative Instructional Strategy?

Table 2: Mean Interest and Standard Deviation Scores of male and female students taught biology using NHT

Gender	N	Pretest		Posttest		Gain in mean
		Mean	Std. Dev.	Mean	Std. Dev.	
Male	10	56.00	3.17	74.77	3.61	18.77
Female	23	58.60	2.34	79.70	1.89	21.10
Mean Difference		2.00		5.07		2.23

Table 2 above shows that for the experimental group, the male students had mean interest scores of 56.00 and 74.77 in their pretest and posttest respectively while their female counterparts had 58.60 in the pretest and 79.70 in the posttest. The mean difference in the gains in mean for the male and female students taught biology using NHT is 2.23. From the gains in means, it can be deduced that the female students had increased interest than their male counterparts when both are taught selected concepts in biology using numbered heads together cooperative instructional strategy.

Hypothesis one: There is no significant difference between the mean interest scores of students taught biology using NHT and that of those taught with CLM.

Table 3: ANCOVA Test of Significant Difference between the Mean Interest Scores of Students Taught Biology Using NHT and those Taught Using CLM

Dependent Variable: pretest						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	
Corrected Model	3312.981 ^a	4	828.245	10.411	.000	
Intercept	58.492	1	58.492	.735	.395	
Posttest	3082.483	1	3082.483	39.746	.000	
METHOD	989.416	1	989.416	12.437	.001	
METHOD * gender	4.321	1	4.321	0.54	.817	
Error	4693.753	59	79.555			
Total	211295.000	64				
Corrected Total	8006.734	63				

a. R Squared = .414 (Adjusted R Squared = .374)

The result of the ANCOVA test from table 3 above shows that the F-value is 12.437 and P-value is .001. Since the P-value is less than 0.05 level of significance at df 1 and 59, the null hypothesis is rejected. Hence, there is a significant difference between the mean interest scores of students taught biology with NHT (experimental group) and that of those taught with CLM (control group) in favour of those in the experimental group. This reveals that using numbered heads together cooperative instructional strategy in teaching biology provides an activity-based learning environment where students being motivated by teamwork, take charge of the learning process, and are actively involved in making contributions.

Hypothesis two: No significant difference exists between the mean interest scores of male and female students taught biology using NHT.

Table 4: ANCOVA Test of Significant Difference between the Mean Interest Scores of Male and Female Students Taught Biology Using NHT

Dependent Variable: pretest						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	
Corrected Model	1494.684 ^a	2	747.342	10.075	.000	
Intercept	27.689	1	27.689	.373	.546	
Posttest	1441.423	1	1441.423	19.432	.000	
Gender	2.769	1	2.769	.037	.848	
Error	2225.377	30	74.179			
Total	113114.000	33				
Corrected Total	3720.061	32				

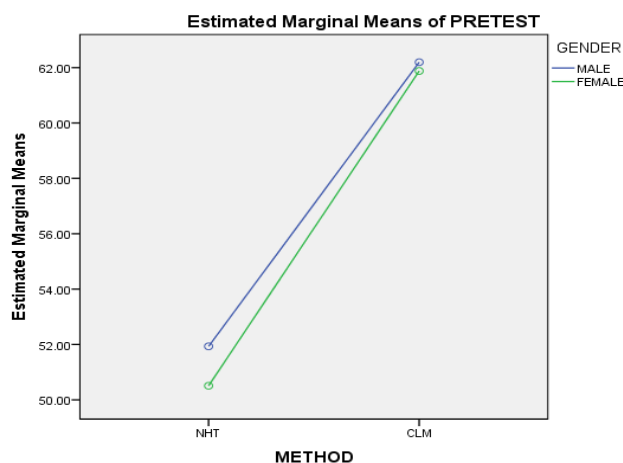
a. R Squared = .402 (Adjusted R Squared = .362)

The result of the ANCOVA test from table 4 above shows that the F-value is 0.37 and P-value is 0.848. Since the P-value is greater than 0.05 level of significance at df 1 and 30, the null hypothesis is not rejected.

Thus, there is no significant difference in the mean interest scores of male and female students taught biology using numbered heads together cooperative instructional strategy. This insignificant difference in gender can be attributed to the nature of NHT as it involves heterogenous team members working together as each individual student is potentially responsible for the success for both the group and the individual student irrespective of gender.

Hypothesis three: There is no interaction effect of gender and teaching methods on students' interest in biology

The result of the ANCOVA test from table 3 above shows that F-value is 0.54 and P-value is 0.817. Since the P-value is greater than 0.05 alpha levels at df 1 and 59, the null hypothesis is not rejected. Showing that there is no interaction effect of gender and methods of teaching on interest of students in biology. This implies that the two-way interaction (methods*gender) is not a significant factor on students' interest in biology.



Covariates appearing in the model are evaluated at the following values: POSTTEST = 68.5469

Figure 1: Profile Plot of Interaction Effect of Teaching Methods and Gender on the Interest of Students in Biology

Discussion

The finding of the study revealed that students taught biology using Number Heads Together Cooperative Instructional Strategy (NHT) showed increased interest in biology more than their counterparts taught with the Conventional Lecture Method (CLM). This increase in interest was proved statistically significant by the test of null hypothesis one in table 4. This significant increase in students' interest in learning biology can be attributed to the unique nature of the approach, of every member potentially responsible for the success or failure of the group, hence encouraging positive interaction among small group members with different learning abilities with the aim to achieve the classroom stated objectives. The findings of the study concur with the findings of Hikmawandini and Kurniawati (2017), Al.harir (2019) and Pamungkas (2019) who reported in their three different studies that numbered heads together technique improved students' interest in English language, attitude towards English language and attitude towards Mathematics respectively. Similarly, the finding of this study also lends credence to the findings of Yunusa, Abdulwahid and Adullahi (2014), Onu, Anyaegbumam and Uzoigwe (2020) and Usang and Okoli (2021) who asserted in their studies that students taught with cooperative instructional strategies similar to NHT showed increased interest in biology and chemistry respectively.

On influence of gender, the study revealed that although female secondary school students had more improved interest in biology than their male counterparts, the difference is not statistically significant. The findings of this study agree with the findings of Onu, Anyaegbumam and Uzoigwe (2020) and Usang and Okoli (2021) who revealed in their respective studies in biology and chemistry that cooperative instructional strategies fosters students' interest in learning irrespective of gender. Since NHT involves heterogenous members of a group working together and exchanging information, their interests are fostered irrespective of gender. Hence, the study asserted that numbered heads together instructional strategy is not gender biased.

On interaction effect of teaching methods and gender on students' interest in biology, the finding of the study revealed that there was no interaction effect of teaching methods and gender on students' interest in biology. From the findings, it can be deduced that numbered heads together cooperative instructional

strategy is a gender friendly instructional approach that fosters students' interest in learning biology. Hence, if teachers will incorporate numbered heads together cooperative instructional strategy in teaching biology at secondary schools in Nigeria, students will develop interest in the subject and thus, achieve better when examinations come.

Limitations of the Study

The major limitation of the study was that the study was carried out using only two selected topics in biology (Nutrition and Excretion). Also, the study was carried out in one out of the five local government areas in the chosen education zone in Anambra State, Nigeria.

Conclusion

Based on the findings, the study concluded that Numbered Heads together cooperative instructional strategy (NHT) is an innovative instructional approach that fosters students' interest in learning biology, irrespective of gender, as it provides a learning environment that promotes teamwork (as every member of the team is held accountable for the success or failure of the group) prompting active engagement and interaction among students during the teaching and learning process.

Recommendations

In the light of the findings of the study, the following recommendations were made:

1. Biology teachers in secondary schools should adopt the use of NHT to foster students' interest in biology.
2. Seminars, symposia, workshops, and conferences should be organized for biology teachers by the government, education stakeholders and professional bodies (STAN) to familiarize teachers with innovative instructional approaches such as NHT.
3. Teacher training colleges and institutions should emphasize the use of NHT in training pre-service biology teachers.

Acknowledgement

The authors are immensely grateful to the principals, research assistants (biology classroom teachers) and research participants (biology students) of the two sampled school used in the study. On a similar note, they also appreciate the validators of the instrument and all the researchers whose works were used as resource materials in the study.

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