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Enhancing Scientific Attitudes Through Activity-Based Approaches.

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Abstract

The purpose of this study was to assess the effects of activity-based approaches on scientific attitudes of SS II biology students, considering the influence of gender. The attitudes considered were critical - mindedness, positive approach to failure, objectivity and honesty. The population of the study comprised of the 810 SS II students in the fourteen secondary schools in Ogbia Educational zone of Bayelsa State. 86 SS II biology students of three intact classes which formed the sample were randomly selected from the target population. The data was analyzed using means, standard deviations, and Analysis of Covariance (ANCOVA). The result showed that activity-based approaches have significant effects on students' scientific attitudes with guided discovery approach being most facilitative. It was also shown that gender and the interaction between gender and activity-based approaches were not significant. This gave an indication that other factors play great role in enhancing students' scientific attitudes. Science teachers were therefore urged to adopt activity-based approaches to promote these scientific attitudes in students.

Introduction

The role science plays in the development of any nation cannot be over emphasized. Science is the foundation upon which the bulk of present technological breakthrough is built. According to Abdullahi (1982) in Babayi (2007), "the prestige and political power of any nation resides in its level of scientific activities". The World Summit on Sustainable Development (WSSD) in 2002 reported in Akpan (2008) affirmed the contribution of Science and Technology Education as an enabler for sustainable development.

The Nigerian Government in acknowledging the strategic role that science holds for national development, has directed universities as a matter of policy (National policy on Education 1981, revised 2004) to admit candidates on a ratio of 60:40 in favor of science amongst several other measures to promote

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science and technology. One of the indices for assessing scientific advancement through education is the performance of students.

According to Obemeata (1995) “the achievement of technological development through education depends largely on the performance of secondary pupils in Science and Mathematics”. If development in science is assessed by the performance of students in the sciences then, Nigerian is far from attaining that goal. Adeniyi (2005) has given a rundown of how Nigerian students have performed below expectation in scientific assessments.

The attitudes students have toward science may affect their performance. Attitude has been viewed as the predisposition to respond positively or negatively toward an object or phenomena. One of the important goals of science teaching is to promote positive attitudes toward science. Students with positive feelings toward science achieve more and also more likely to incorporate science into their daily lives when they appreciate its importance (Simpson and Anderson (1981)). Since positive attitudes have been found to correlate positively with achievement in sciences, teachers should strive to develop positive attitude towards science in their students. Perhaps, the reason why Nigerian students have not done creditably well in science is that they have not gotten the right attitudes.

Great achievement in both the cognitive and psychomotor domains, to a large extent, depends on the affective domain. Carin and Sund (1975) posited that the degree to which the scientific attitudes are manifested by the scientist as he carries out his investigations determines how well he will be able to utilize the

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processes to make significant discoveries. Scientific attitudes, according to Gauld and Aukins (2000), are a composite of a number of mental habits, or tendencies to react consistently in certain ways to a novel or problematic situation. These include: rationality, curiosity, open-mindedness, aversion to superstition, objectivity, intellectual honesty, humility and suspended judgment. These scientific attributes direct the behavior of the examination malpractice. This is because examination malpractice has been attributed to the lack of practical activities which make learning last longer. (Nwosu, 2008) . To develop scientific attitude in students, they should be provided with hands on experiences. This view has been held by (Simpson and Anderson, 1981: Nzewi, 2008 and Nwosu, 2008).

Activity-based approaches provide students with hands on experiences. According to Archibong (1997) any teaching strategy in which pupils are involved in activities, be it in exercise, laboratory work or let's find out' exercises/ activities, is activity-based approach.

Problem

The West Africa Examination Council (WAEC) Chief Examiners Reports (2002-2006) have showed consistent poor performances of students in the sciences. There has also been a public outcry in the moral decadence of students resulting to examination malpractice.

The table below shows students' involvement in examination malpractice in the University Matriculation Examinations (UME) from 2005-2009, as reflected by the results withheld for this reason.

Table 1: Showing results of candidates withheld due to examination malpractice.

Year	No of candidates that sat	No of result withheld	Percentage (%) withheld
2005	877408	95985	16.00
2006	806089	108789	14.00
2007	854439	21466	5.70
2008	998114	22398	2.24
2009	1182381	23819	7.07
Total	4718431	272457	45.01

Source: www.jambng.org.

The figures in the table showed that between 2005 to 2009, about 45% percent of candidates result were withheld due to examination misconduct. If this negative trend continues, then the educational system is in jeopardy and the much needed scientific and technological development will be a mirage. Hence, the need for this study to find ways of enhancing scientific attitudes in students through activity-based approaches.

Purpose of the Study

The purpose of this study was to assess the effect of activity-based approaches on the enhancement of scientific attitudes in secondary school students.

Objectives of the Study

Specifically the objectives of the study were as follows.

1. To determine the effects of activity-based approaches on students' scientific attitude.

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2. To assess the relative effects of demonstration, project, and guided discovery methods on students' scientific attitudes such as objectivity, critical mindedness, honesty and positive approach to failure.
3. To find out the influence of gender on students enhancement of scientific attitude.
4. To determine the joint effect of gender and activity based approaches on students' scientific attitude.

Scope of the Study

This study was delimited to three activity-based approaches namely:

Demonstration, project and guided discovery in teaching SS2 Biology Students. It is also restricted to four scientific attitudes namely; objectivity, critical-mindedness, honest, and positive approach to failure.

Research Hypotheses.

The following null (H_0) hypotheses were stated and tested in the study.

H_{01} : There is no significant difference among students taught using demonstration, project, and guided discovery approaches in their objectivity, critical mindedness, honesty and a positive approach to failure.

H_{02} : There is no significant influence of gender on students' scientific attitudes when taught with activity-based approaches.

Research Method

A quasi-experimental design was used with pre-test posttest and a 3x2 factorial arrangement. All the SS2 students in the fourteen (14) Secondary schools in the Ogbia Educational zone of Bayelsa State formed the population.

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Three schools which met the following criteria represented the sample.

1. The schools must have been founded within the same period.
2. They must have a functioning laboratory
3. They must have at least one graduate biology teacher with at least five years of teaching experience.

The experimental treatments (activity-based approaches) were randomly assigned to the three schools. A total of eighty six (86) SSII biology students formed the sample represented as follows

Demonstration approach-28 students

Project approach-28 students

Guided discovery approach -30 students

In order not to disrupt the schools' activities, intact classes were used.

Instrumentation

The instrument for data collection was a scale tagged "Scientific Attitude Enhancement Scale (SAES)" developed by the researcher and validated by a team of experts in Science Education. The instrument consisted of twenty eight items which were expected to measure the level of enhancement of four scientific attitudes namely honesty, objectivity, critical mindedness and a positive approach to failure. Each of the scientific attitudes contained seven statements in which there were five categories of responses with a weight value of one (1) through five (5) depending on the intensity of agreement and disagreement with statements that are favourable and unfavourable to the objects, respectively.

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A reliability index of 0.72 was obtained using test re-test method.

Scoring

The items in the scale (SAES) consisted of positively, and negatively structured statements. For positively structured items,

For positively structured items, the marks were assigned as follows: Strongly Agree (SA)-5; Agree (A)-4; Undecided (U) -3; Disagree (D) -2 and Strongly Disagree (SD).

In the case of negatively structured items, the marks were reversed as follows: strongly Agree-1; Agree-2; Undecided-3; Disagree -2 and Agree -1. The maximum score on all the 28 items on the scale was 140 while the minimum was 28.

Research Procedure

The three groups were pre tested to ensure that they were equivalent in initial attitudes. In order to control for researcher's bias, research assistants (biology teachers) in each of the schools were trained on the use of the teaching packages (lesson plan) prepared by the researcher. The three groups were exposed to the same content covering germination, osmosis and diffusion taken from the SSII 1st term scheme of work. These concepts were selected because they were activity oriented considering the study under investigation. The study lasted for four weeks. One week was used in training the teachers, while the remaining four weeks were used for the actual teaching. At the expiration of the four weeks, a post-test was administered to the three groups.

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Data Analysis

The null hypotheses were analyzed using analysis of variance (ANOVA) and factorial analysis of covariance (ANCOVA).

Results

The analyses are presented in presented in tables to enhance the interpretation of the hypotheses.

H_{01} : There is no significant difference among students taught using demonstration, project and guided discovery approaches in their objectivity critical-mindedness, honesty and positive approach to failure.

TABLE 2: A summary of analysis of variance (ANOVA) on students' enhancement of scientific attitudes using activity's based approaches.

Scientific attitude	Source of variance	Df	Sum of squares	Mean squares	f-ratio	Sig.
Critical Mindedness	Between group	2	23.24	11.62	.18	.84 Ns
	within group	83	5512.63	66.42		
	Total	85	5535.87			
Positive Approach to failure	Between “	2	1563.36	781.68	9.71	.000 *
	Within “	83	6684.13	80.53		
	Total	85	8247.49			
Objectivity	Between “	2	564.95	282.48		
	Within “	83	7152.63	86.18	3.28	.04*
	Total “	85	7717.58			
Honesty	Between	2	5065.44	2532.72		
	Within “	83	8742.56	105.33	24.05	.000*
	Total “	85	13080.00			

NS: Not Significant at $P < .05$

*: Significant at $P < .05$

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The result in table 2 indicates that the three approaches: demonstration, project and guided discovery, significantly enhanced the cultivation of positive approach to failure, objectivity and honesty in the subjects. There was no significant enhancement of critical-mindedness as shown in the table.

To determine which approach was more facilitative in enhancing students' scientific attitudes, a post hoc test was carried out.

TABLE 4: Summary of analysis of covariance (ANCOVA) on scientific attitudes scores of students taught using activity - based approaches with pretest scores as covariates.

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Critical mindedness

Variables	Ss	Df	Ms	F-ratio	Sig
Covariates	709.59	1	709.50	12.20	.001
Main effect	900.16	4	225.04	3.87	.006
Approach	25.82	2	12.91	.22	.80Ns
Gender	279.68	1	279.68	4.81	.031*
Appr. X gender	42.08	2	21.04	.36	.70Ns
Model	942.23	6	157.04	2.70	.02
Residual	4593.64	79	58.15		
Total	5535.87	85	65.13		
Positive approach					
Covariate	418.27	1	418.27	6.16	.015
Main effect	1998.89	4	499.72	7.36	.000
Approach	1603.10	2	801.55	11.80	.000*
Gender	94.02	1	94.02	1.38	.243Ns
Appr. X gender	301.74	2	150.87	2.22	.115Ns
Model	2300.63	6	383.44	5.65	.000
Residual	5365.70	79	67.92		
Total	7666.33	85	90.19		
objectivity					
Covariate	535.41	1	535.41	6.64	.012
Main effect	1019.11	4	254.79	3.16	.018
Approach	394.06	2	197.04	2.44	.093Ns
Gender	0.20	1	0.20	.00	.987Ns
Appro x Gender	45.97	2	22.99	.29	.752Ns
Model	1065.09	6	177.51	2.20	.051
Residual	6370.14	79	80.64		
Total	7435.22	85	87.47		
Honesty					
Covariate	1603.32	1	1603.32	19.01	.000
Main effect	6709.20	4	1677.30	19.89	.000
Approach	2850.42	2	1425.21	16.90	.000*
Gender	31.61	1	31.61	.38	.452Ns
Appr. X gender	436.53	2	218.27	2.59	.082Ns
Model	7145.74	6	1190.96	14.12	.000
Residual	6662.27	79	84.33		
Total	13808.00	85	162.44		

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Table 4 showed that activity-based approaches significantly enhanced a positive approach to failure and honesty in the students. There was however no significant enhancement of critical mindedness and objectivity in the students. The table also revealed that gender has a significant effect in enhancing only critical mindedness in students. The interaction of activity-based approaches and gender have no significant effect in enhancing students' scientific attitudes.

TABLE 5: Summary of analysis of covariance (ANCOVA) on total scientific attitudes scores of students taught using activity-based approaches with pre-test as covariates.

Variables	SS	DF	MS	F-ratio	SIG
Covariates	6355.13	1	6355.13	77.31	.000
Main effect	10141.90	4	2536.48	30.85	.000
Approach	3412.74	2	1706.37	20.76	.000*
Gender	292.59	1	292.59	3.56	.060Ns
Appr x Gender	37.84	2	18.92	.23	.795Ns
Model	10179.74	6	1696.62	20.64	.000
Residual	27701.60	331	82.20		
Total	37881.34	343	110.44		

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The analysis of covariance (ANCOVA) on total scientific attitudes from table 5 showed that activity based approaches have significant impact on students' enhancement of scientific attitudes. Gender was not found to be significant. The interaction between gender and activity-based approaches was not also found to be significant.

Discussion

The findings of this work as shown in table 2 revealed that the guided discovery approach is most facilitative in enhancing students' scientific attitude. This might be due to the instructional advantages inherent in this approach as students are led by the teacher on a step by step procedure to discover things for themselves. This supports Carin and Sund (1975) opinions that the discovery approach makes learning last longer and make children to think like scientist. The weakness in the project approach may be attributed to the fact that most of the work was done by the group leaders. Supporting this view is Baribor (2003), who opined that one of the instructional disadvantages of the project approach is that some students may become overactive while others are passive. To make the approach more effective, he advocated that the project approach should be used in combination with other approaches. In the case of demonstration, probably, many students may not have paid attention to the teacher as the demonstration was going on. Buseri (1996) had earlier affirmed that in demonstration, students mainly observe and their participation is limited to mental activities. Schafersman (1991) had suggested that for children to cultivate critical thinking-one of the scientific attitudes, they must be actively involved.

The results in table 4 show that that there was no significant effect of gender on enhancing students' scientific attitudes. This findings supports that of Osuafor (2008) who found out that demonstration which is an activity-based approach could be used to

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eliminate gender differences amongst students. The findings also revealed that activity-based approaches and gender have no significant joint effect on students' enhancement of scientific attitudes. This is an indication that two factors will only interact significantly when the effect of one factor on the other is not the same at all levels of the other factor. This implies that the effect of activity-based approaches on students' enhancement of scientific attitudes is different from that of gender.

The (ANCOVA) results on table 5 showed that not all the scientific attitudes were significantly enhanced. Perhaps the few lessons had do not impact so much on the enhancement of critical- mindedness. This Corroborates Carin and Sund (1975) views that not all the scientific attitudes need the same emphasis in their development; some may take longer duration spanning a whole course of study. One of the goals of science teaching is to produce individuals with critical thinking, to do this, the method adopted is very crucial.

According to Okebukola (2002), the best method to change attitudes is by persuasion and that this method succeeds depending on the personality involved. Similarly schafersman (1991) asserted that critical thinking is a learned ability that must be taught and that trained and knowledgeable instructors are necessary to impart the proper information and skills. Carin and Sund (1975) also asserts that in developing critical thinking in students, the teacher may combine several investigative strategies to attain the goal. They further maintained that it takes

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time for children to be critical thinkers and that an in-depth study of some topics is a prerequisite. Perhaps, the short duration of the study might have accounted for the non-significance in the enhancement of critical mindedness. Other methods through which critical thinking could be taught had been suggested by Schafersman. These include:

1. Lecture with good questioning techniques;
2. Laboratory activities;
3. Home work through quantitative exercises, term papers, examinations, and
4. Good writing

Conclusion

From the findings in this study, it can be concluded that:

1. Guided discovery approach is the most facilitative in enhancing students' scientific attitudes.
2. Gender had no significant effect on enhancing students' scientific attitude. It was only significant for enhancing critical -mindedness.
3. The interaction between gender and activity-based approaches do not yield any significant effect.

Recommendation

1. Teachers should be encouraged to adopt guided discovery approach so that students' scientific attitudes could be improved.
2. Workshop and conferences should be organized to expose teachers on how best to use activity-based approaches in fostering scientific attitudes in students
3. Activity-based approaches should be adopted to eliminate gender differences.

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References

Abdulahi, A. (1982). An investigation *into the status of primary science teaching in Nigeria*. Journal of Science Teachers Association of Nigeria, 4 (2), 10 16.

Archibong, A.U. (1997). *The relative effectiveness of Activity-based approach and lecture method on the cognitive achievement of Integrated Science students*. Journal of Science Teachers Association of Nigeria, 32 (1&2), 30 37

Akpan, B.B. (2008). *Nigeria and the future of Science Education*. Ibadan: Oluseyi press Ltd.

Babayi, A.A. (2007). *Achieving national economic empowerment and development strategy (NEEDS) through Chemistry*. Proceedings of the 50th anniversary conference of Science Teacher Association of Nigeria. HEBN Publisher Ltd.

Carin, A.A & Sund, R.B. (1975). *Teaching Modern Science*. Ohio: Charles E. Merrill Publishing Co.

Gauld, C.F.& Hukins, A.A. (2002). What is Scientific attitude. [http://en. Wikipedia. Org/wiki/Science education](http://en.Wikipedia.Org/wiki/Science_education).

Nzewi, U.M (2008). *Practical approach to effective teaching of ecological concepts for sustainable development: A keynote address presented at the opening ceremony of the biology panel of the Science Teachers Association of Nigeria workshop at Enugu*.

Nwosu, A.A (2008). *Practical approach to the teaching of ecological concepts for sustainable development: Science Teachers Association of Nigeria. Biology Panel Series 20 29*.

Obemeata, J.O. (1995). *Education: An unprofitable industry in Nigerian. A paper delivered at the postgraduate interdisciplinary research discourse. University of Ibadan. Pp. 24*

Akporehwe & Onwioduokit: Enhancing Scientific Attitudes through Activity-based Approaches. NJSSE, Vol. 8, No 2, Sept., 2010, pp 87-102

Okebukola, P.A. (2002). *Beyond the stereotype to new trajectories in science*. A lecture presented at the 43rd annual conference of Science Teachers Association of Nigeria.

Osuafor, A.M. (2008). *Extent of involvement of secondary school science, Technology and Mathematics (STM) Teachers in conduct of research and participation in Science Teacher Association of Nigeria activities: Implications for (STM) development in Nigeria*.

Simpson, R.D. & Andersdon, N.D. (1981). *Science Students and Schools: A guide for the middle and secondary school teachers*. New York: John Willy and Sons.

Schafersman, S.D. (1991). *Introduction to critical thinking*. [http://www.freeinquiry.com/critical thinking. Html](http://www.freeinquiry.com/criticalthinking.html)

West African Examination Council, WAEC (2002-2006). Chief Examiners Report, Senior Secondary School Certificate Examination.