Improving the reading ability of science students through study groups and multiple intelligences

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Abstract: This study explored the effects of appropriate pedagogical skills (study groups and multiple intelligences) on students' efficiencies in reading skills. It employed a factorial design using three variables. A sample of 90 science students choosing from three intact classes were involved in the study. Data analyses were carried out using mean, standard deviation, analysis of covariance and multiple classification analysis. Findings revealed the significant difference in performance of the groups taught using study groups and multiple intelligences methods.

Key words: science; reading; studying groups; multiple intelligences

1. Introduction

Science teaching is to a large extent dependent on the use of textual materials despite the emphasis on inquiry-oriented activities and discovery learning. It is common knowledge that much of the information generated in science is disseminated in print and are acquired by students through reading of these textual materials. In order to read meaningfully, students need efficient reading skills.

Studies (Duruaku, 1987; Odusina, 1987; Aboderin, 1987; Okebukola, 2006) on reading comprehension in Nigeria have clearly shown that Nigerian students are not efficient readers. Olaofe (1987) observed that reading is not part of the Nigerian culture. Many factors have been advanced as being responsible for this reading inefficiency, these include: poor study habits (Onukaogu, 1987); difficulties in understanding the author's tone (Nzinga, 1983); inability to comprehend many ideas (Osisanwo, 1987); inability to read critically (Nzinga, 1983); and inability to summarize (Obilade, 1987). These consequently resulted in ineffective recall of what is read, inadequate reading interest, slow reading rate and poor processing of information.

The crippling effect of reading inefficiency seems to have manifested in the responses of science students to examination questions. West African Examination Council (WAEC, 2004) had noted that science students could not understand the demands of some questions and neither could they express themselves in clear and comprehensive language. This perhaps partly explains why students perform poorly in examinations.

Reading scholars (Emenyonu, 1987; Nduka, 1987; Aliyu, 1997; Omoniyi, 1997; Okebukola, 2000) are now agreed that the teacher must provide systematic and well-informed pedagogical skills that would stimulate students' interest and facilitate comprehension. Reading requires a stimulating environment to arouse and enhance

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interaction with the print, symbols and ideas presented rather than engaging students in the passive absorption of information encoded in the written stimuli. There is a causal link between the students' prior knowledge and the ability to recall efficiently (Adams & Bruce, 1982). Science teachers require the ability to ensure smooth border crossing from the sojourn of previous knowledge through the new knowledge to be acquired by the students.

It is therefore imperative to develop students reading ability through appropriate pedagogical skills that will link students' prior knowledge to the new scientific concept in discourse. With this goal in mind, this study was conceived to explore the effects of study groups and multiple intelligence approaches on students reading ability.

2. Methodology

The study employed a factorial design in which two teaching methods (independent variables) were manipulated simultaneously in order to study the independent effect of each method as well as their interaction effects. The teaching methods were study groups and multiple intelligences while the conventional method served as a moderator variable. Effects of these variables on the science students' achievements and reading efficiency were determined. A sample of 90 science students was drawn from intact Junior Secondary III classes of three schools selected by simple random sampling technique. A group was assigned to each of the schools, thereby having three schools.

Two instruments were used to gather data. Reading Ability Test (RAT) was a self-developed instrument designed to determine students' achievement on the concept "state of matter". It was premised on the causal link between efficient reading and high achievement. RAT was an objective test (fill in the gap). The choice was informed by the strength of the test in ascertaining students' actual knowledge and minimizing guesswork.

It elicited responses on the following aspects of matter: states, characteristics, citing of life experiences, familiar examples and experimental illustrations. It was made up of twenty items.

The second instrument titled Reading Efficiency Questionnaire (REQ) was developed to elicit information from the students about their reading ability after the treatment. It consisted of twenty items which bothered on the following areas: reading rate, reading habits, reading concentration, reading readiness, reading attitude, motivation for reading and reading interest. The questionnaire was developed using Likert 4-point scale of strongly agreed (SA), agreed (A), disagreed (D), strongly disagreed (SD).

The two instruments (RAT and REQ) were subjected to peer review and thereafter given to two experts who were specialists in science education and language education. Their comments and observations were duly effected and these improved the content validity of the instruments. Reliability coefficients of the instrument were established by using test-retest within three weeks interval for RAT (r=0.78) and split-half method for REQ (r=0.84). Data analyses were carried out using mean, standard deviation, analysis of covariance and multiple classification analysis.

3. Procedure and treatment

The three schools involved in the study were arbitrarily assigned to the groups. The two groups were handled separately by the researchers (a group per person). The integrated science teacher of the school who was requested to teach in the usual conventional method handled the third group.

The data gathering process lasted for 6 weeks. The first week was used to conduct a pre-test for the groups. Treatment was thereafter administered on the subjects and this lasted for another 4 weeks. The last week was used

to administer the post-test and the Reading Efficiency Questionnaire (REQ).

The following were the treatment given to the groups.

3.1 Group one

This group was taught with the use of study group method. This is a teaching method organized among class members who are divided into different groups consisting of five members. It ensures that each group member takes active part in the discussion. Group members actively listen without interrupting to one another. Other group members work collaboratively to resolve any concern raised by a group member. Group member feels free to criticize each other but keep their criticisms constructive. The following group activities were undertaken:

(1) Group activity one: Students were asked to read the class note on the concept “states of matter”.

(2) Group activity two: Students were given opportunity to discuss on the concept. In doing this, they were to listen to points raised by other group members and jot down notes.

(3) Group activity three: Specific questions or activities to involve each student on an individual basis were introduced along side some other practical considerations of the issues raised.

The teacher plays the role of a moderator. He is to prevent the study group from being distracted from the discussion. This method relies on the strength that students often listen and discuss information and concepts, learn new study habits easily from one other.

3.2 Group two

Multiple intelligences method was employed for this group. Multiple intelligences presuppose that an array of different kinds of intelligence exists in human beings. Howard Gardner, the inventor, opined that all human beings possess nine intelligences but in varying amounts. The nine intelligences as observed by Okebukola (2002) are:

(1) Verbal-Linguistic Intelligence: Well-developed verbal skills and sensitivity to the sounds, meanings and rhythms of words.

(2) Mathematical-Logical Intelligence: Ability to think conceptually and abstractly, and capacity to discern logical or numerical patterns.

(3) Musical Intelligence: Ability to produce and appreciate rhythm, pitch and timber.

(4) Visual-Spatial Intelligence: Capacity to think in images and pictures, to visualize accurately and abstractly.

(5) Bodily-Kinesthetic Intelligence: Ability to control one’s body movements and to handle objects skillfully.

(6) Interpersonal Intelligence: Capacity to detect and respond appropriately to the moods, motivations and desires of others.

(7) Interpersonal Intelligence: Capacity to be self-aware and in tune with inner feelings, values, beliefs and thinking processes.

(8) Naturalist Intelligence: Ability to recognize and categorize plants, animals and other objects in nature.

(9) Existential Intelligence: Sensitivity and capacity to tackle deep questions about human existence, such as the meaning of life, why do we die, and how did we get here.

In using this method the teacher relies on the individual innate intellectual endowment of students. The students are requested to revise the concept “states of matter” earlier taught. The class as a whole is now engaged in various forms of learning experiences ranging from discussions, demonstration, practical activity and questioning. The role of the teacher is to act as a facilitator in which he selects a student who signifies intention to lead or perform the activity in contention. He interjects occasionally to guide or prevent the student from derailing.

The various learning experiences are handled and controlled by students. This is different from the guided discovery approach because the students are in full control of proceedings. This method allows students to exhibit their latent talent and reduce boredom during lessons.

It should be noted that the two approaches are best fit in situations where students have prior knowledge of subject matter however faint it may be.

3.3 Group three

The third group was taught in the usual conventional method in which the teacher talks while the students listen, copy notes and rarely ask questions. Flurry of studies (Ogunleye, 2000; Okebukola, 2002; Owolabi, 2006) had revealed that science classroom in Nigeria is teacher dominated and the students are passive listeners.

4. Results

Table 1 shows that the main effect is significant at $p<0.05$. The calculated F value of 84.562 is greater than the critical F value of 3.15. It implies therefore that significant difference exists among the groups.

Consequent upon the existence of significant difference in main effects, Multiple Classification Analysis (MCA) is considered to determine the specific contribution of the levels of the treatments to the gain in students' achievement.

Table 1 One-Way Analysis of Covariance (ANCOVA) of the post-test scores on reading ability

Source of variation	Sum of square	Mean square	df	F	Sig.
Pretest	736.364	736.364	1	8.25	.000
Main effects	2230.214	1875.36	2	84.562	.000
Explained	2541.005	1703.09	3	54.313	.000
Residual	1337.098	8.421	87		
Total	5347.83		90		

Table 2 shows a multiple regression index of R=0.84 with a multiple regression squared index of R^2=0.72. This implies that 72% of the total variance in the achievement of students in the groups is attributable to the influence of the treatments administered.

Table 2 Multiple Classification Analysis (MCA) of post-test scores of students in the reading ability test

Multiple R	Grand mean	N	Unadjusted		Adjusted		Multiple R squared
			Dev'n	Eta	Dev'n	Beta	
	Variable+Category			0.84			
0.84	Study group	30	4.61		4.56	0.81	0.72
	Multiple intelligence	30	5.11		4.98		
	Conventional	30	-6.34		-6.31		

To find the order of effectiveness of treatments and direction of significance under investigation, the post-test scores were subjected to Scheffe multiple comparison test for a post hoc analysis in Table 3.

As shown in Table 3, the mean difference between SG and MI was 1.47, between SG and CM was 8.1211, and between MI and CM was 11.821. This implies that multiple intelligences was the most effective method in facilitating students' achievement in science. This was then followed by study group method while the conventional method was seen to be least effective in facilitating students' achievement in science.

Table 3 Results of Scheffe's Post Hoc Test for multiple comparison of treatments on students achievement in dependent variable: Post-test scores

Treatment		Mean difference	Std. error	Sig.	95% confidence level	
					Lower bond	Upper bond
SG	MI	1.4781*	.556	.006	.4344	.3847
	CM	8.1211*	.543	.000	.9146	.1101
MI	SG	-1.4781*	.556	.006	.3667	.4343
	CM	11.821*	.521	.000	10.124	11.0710
CM	SG	-11.821*	.543	.000	-13.672	-9.2341
	MI	-8.1211*	.521	.000	-11.434	-10.2218

Notes: Where SG=study group; MI=multiple intelligence; CM=conventional method.

Table 4 shows that study group and multiple intelligence methods both possess high mean score which are nearly equal for all reading efficiency indices. It implies that both methods influence science students' reading efficiency.

Table 4 Mean and standard deviation of students responses on their reading efficiency after treatment

Reading efficiency indices	N=30		N=30	
	Study group		Multiple intelligence	
	Mean score	SD	Mean score	SD
Reading rate	39.74	6.29	37.45	5.72
Reading habits	35.45	6.57	36.34*	5.43
Reading concentration	38.84	5.56	39.74*	6.34
Reading readiness	39.47	6.31	38.86	6.43
Reading attitude	35.52	6.58	37.44	5.28
Motivation for reading	39.22	6.34	35.47	5.23
Reading interest	38.86	6.12	38.74	6.14

5. Discussions of findings

The analysis of this study (Table 1 refers) show a significant difference in the achievement of students due to methods of teaching employed. This corroborated Shulman's (1986) view that students tend to learn more from one another than from the teacher. Perhaps the influence of both methods on students' freedom of expressions was partly responsible for this observation.

As revealed in Table 3, multiple intelligences was a more effective method in facilitating students' achievement in science. This method provided opportunity for students to express their innate potentials and talents, and varying methods of eliciting the innate potentials and talents. Also the variation of teaching techniques as exemplified by multiple intelligences will enliven the learning atmosphere thereby making the lesson interesting and rewarding.

The two methods of teaching (study group and multiple intelligence) employed in the study are learning tasks-oriented and both influence science students reading ability (refer to Table 4). This implies that reading ability is dependent on students' involvement in a learning task. This is in agreement with Driver (1985) assertion that students' involvement in the lesson go along way in determining whether they will be interested, motivated and reinforced to seek further knowledge. It could also develop students' inquisitiveness and scientific attitude (Ogunleye, 2000). No doubt, students are timid in the presence of a teacher but express themselves more freely while discussing with their peers.

6. Recommendations

The following recommendations are proffered to improve students reading ability:

(1) Science teachers should play the role of a moderator by initiating, directing and organizing learning activities.

(2) Science teachers should promote and encourage individual and/or group learning activities among students.

(3) Science teachers should endeavour to give hand-on learning activities to students as assignment or homework.

7. Conclusion

The methods used by teachers to a greater extent determine students' levels of achievement in learning. Science is an activity-oriented discipline, it is imperative to involve students more in doing through student-student interactions and student—material interactions. The zeal and interest will be re-awakened and quest to learn more will be stimulated.

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