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Mastery learning strategy and attitude towards chemistry among secondary school students in Rivers State

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Abstract
The study investigated the effect of mastery learning strategy on students' students' attitude towards chemistry in secondary schools in Rivers State, using the quasi-experimental study. Two research questions and one null hypothesis guided the study. Through random sampling, a sample size of 120 Senior Secondary Two (SS II) chemistry students was selected, which was subsequently split into experimental and control groups of 60 students each. The experimental group was taught by the mastery learning strategy while the control group was taught using the conventional instructional method. The research instruments were a 10-item observational checklist. The instruments were pilot tested and yielded a reliability coefficient of 0.81. Mean, frequency count and chi-square were used for data analyses. Results obtained showed that there was a significant difference between the students in the experimental group and those in the control group in their attitude towards chemistry. Also, student taught using mastery learning strategy had a significantly better attitude towards chemistry than those taught using the conventional method. Based on the results and in conformity with available research studies on MLS, it was concluded that MLS is an effective instructional method for improving students' attitude and therefore teachers should be provided adequate time in their instruction in order to adopt mastering learning strategy.

Keywords: mastery learning, chemistry curriculum, attitude

Introduction

The nature of chemistry as a subject requires that learners adopt a rational, practical and analytical mindset in approaching the subject. It is a subject that deals with the composition, structure and properties of matter, the interaction between different types of matter and the relationship between matter and energy. Ababio (2011) [1] defined chemistry as a science that deals with the composition, properties and uses of matter. He also stated that chemistry probes into the changes that matter undergoes. For Rannikmae (2002), chemistry is a body of knowledge and a way of thinking. This view clarifies the facts that chemistry knowledge is simultaneously reliable and tentative. The process of chemistry also utilizes the scientific method which captures the chemists demand naturalistic explanation supported by empirical evidence, scepticism, creativity and rational argument involving observation, problem-solving, hypothesis formulation, experimentation, data collection, analysis, inference, and the importance of being able to replicate work.

The importance of chemistry as a subject to individual and societal life cannot be overemphasized. Majority of the production companies and industries around the world, make use of the knowledge of chemistry in producing useful products such as petroleum products (kerosene, petrol, diesel, oil, grease, bitumen, etc) as well as simple products such as polythene, plastic etc. Chemistry teaching at the secondary school level helps to develop conceptual understanding in students and the appreciation of the way's scientists do things. Thus, Jones (2008) [13] offered some reasons why chemistry should be studied which include that: everything is chemistry, chemistry is fun, it helps us to think more logically and helps us to analyse until we are done, chemistry is a central science which involves a lot of practice in solving problems, it touches all we know, chemistry is chemical, it is our medicine, plastics, water and food, chemistry is all we see in the world of a modern man, chemistry helps us make decisions well and be confident inside.

Despite these seeming importance benefits of chemistry in our everyday life, too many secondary school students, the subject is drudgery and see it as irrelevant. In other words, many students hold a negative attitude towards chemistry as a subject in their educational curriculum. If this trend continues, it is difficult to achieve the objectives of the chemistry curriculum as stipulated by the Federal Government of Nigeria (FGN, 2007) [9] which includes:

- To facilitate a smooth transition in the use of scientific concepts and techniques acquired in integrated science and technology with chemistry.
- Provide students with the basic knowledge in chemical concepts and principles through an efficient selection of contents and sequencing.
- Show chemistry and its inter-relationship with other subjects.
- show chemistry and its links with industry, everyday life activities and hazards, and
- Provide a course which is complete for students not proceeding to higher education while at the same time provide a reasonably adequate foundation for a post-secondary school chemistry course.
- Chemistry curriculum is so rich that it covers the issue of globalization, information/communication technology and entrepreneurship. Since the desire of Nigeria is to be identified with contemporary development worldwide, the curriculum contents haven been organized into four major themes of (i) The Chemical World (ii) Chemistry and Environment (iii) Chemistry and Industry (iv)

Chemistry and Life. The contents of this curriculum, irrespective of their relevance will not be achieved if students' attitude towards the subject remains negative.

This assertion makes better meaning when it is realized that not all students hold negative attitude towards chemistry because while some students excel academically in the subject others perform abysmally poor. Available statistics have proved that there is an increase in the enrolment figure of chemistry students in West African School Certificate Examination but the percentage pass at the credit level is on the decrease, WAEC Report, (2010). This is indicated in Table 1 below.

Table 1: Senior Secondary School Certificate Results in Chemistry from 2000 – 2010

Year	Total number of candidates	Number of students with credit and above	% pass	% failure
2000	62,442	19912	31.89	68.11
2001	66604	20021	30.06	69.94
2002	90488	39289	43.42	56.58
2003	143839	73329	50.98	49.02
2004	105133	40970	38.97	61.03
2005	103211	41635	40.34	59.66
2006	112442	48923	43.51	56.49
2007	102466	38465	37.54	62.68
2008	112388	47562	42.32	57.28
2009	182,650	39085	43.64	52.28
2010	172,383	40652	43.87	56.11

Source: WASSCE Report (2000 – 2010)

On the basis of the statistics reported in Table 1, the enrolment figure in chemistry increased progressively on a yearly basis with the intermittent drop but the percentage of passes and failure seem to be wavering and discouraging. It is only in the year 2003 that the students recorded a 50.98 percentage pass. This is a disheartening situation and calls for a more proffer way of improving academic achievement and students' interest in chemistry. While effort has been directed at improving students' achievement through the provision of facilities and instructional materials, the aspect of students' attitude or interest has not been adequately explored. In recognition of students' negative attitude towards chemistry, researchers have identified different factors responsible for this disheartening trend, one of which is inappropriate teaching strategy used in teaching chemistry concepts Chinanson, Kurumeh & Obida, (2010) [6]. This study, therefore, seeks to investigate the effect of mastery learning strategy on students' attitude towards chemistry in Rivers State.

Aim and Objectives of the Study

The study is an investigation into the effect of mastery learning strategy on students' attitude towards chemistry in secondary schools in Rivers State. In specific terms, the objectives of the study are to:

1. Find out the attitude of the students towards chemistry in the mastery learning strategy group (experimental group), and those in the conventional instructional method group (control group).
2. Find out whether mastery learning strategy has more positive effect on the attitude of the students towards chemistry than the conventional instructional method.

Research Questions

1. Do the students in the experimental group have more positive attitude towards chemistry than those in the control group?
2. Does mastery learning strategy influence the students' attitude positively towards chemistry than conventional instructional method?

Hypothesis

1. There is no significant difference between the effect of mastery learning strategy and the conventional instructional method on the attitude of the students towards chemistry**.**

Literature Review

Concept of Attitude

Attitude is the characteristic way of thinking, feeling or behaviour towards an object, person or group of persons James (2010) [12]. It is also the judgement of the opinion of one towards another, thing or subject situation, one's attitude towards any entity in the world consisting of one's belief about it, one's positive or negative feelings towards it and a person's behaviour tendencies regarding it. In the context of this study, attitude is seen as the students' behaviour, thinking and feelings towards chemistry concepts in relation to mastery learning and aptitude.

The greatest attitude change of all will be when the communicator or the facilitator can get the audience to role-play the attitude, he/she wants them to acquire James, (2010) [12]. This further explains the role of science teachers and chemistry teachers in particular to their students. The source of the message plays a big role in attitude change, especially when people are not highly motivated to process information and do much thinking, (Davidoff, 2007). Thus, the source must be attractive and likeable with motives beyond suspicion. For a student to develop a positive or negative attitude to any particular subject, the student must first of all like or dislike the subject teacher.

Although the nature of the subject might affect the student's attitude towards the subject, the attitude of the teacher is a major contributing factor. One of the greatest problems of science teaching (chemistry in particular) is the teachers themselves. Bethe (2004) [3] opined that teachers' attitudes towards science subjects are not encouraging. Most of them do not know the subject very well and teaching what one does not know or has no mastery of, is dangerous. This, in turn, makes the students feel that the subject is difficult which influences their attitude towards the subject.

According to Okoli (1989) [15], teachers who continuously tell students that chemistry is the most difficult subject among other subjects offered in secondary schools are selling their birthright in the teaching profession. Teachers are the life wire of an educational system. The success or failure of the system depends on their number, quality, devotion and effectiveness, Enenalo, (1982) [8]. In effect, chemistry teachers must map out a good teaching strategy and have an in-depth knowledge of the concept in other to motivate the students' interest in chemistry. Every teacher wants his/her students to go away from the class with a more positive attitude towards the subject, the teacher and others. It is, therefore, necessary that chemistry teachers should develop a mastery approach in teaching chemistry concepts.

Concept of Mastery Learning Strategy

In mastery learning, students are helped to master each learning unit before proceeding to a more "advanced learning task", Bloom, (1985) [5] in contrast to "conventional instruction". MLS is based on the principles that all students can learn a set of reasonable objectives with appropriate instruction and sufficient time to learn. According to Bloom (1968) [4], the mastery learning theory is based on the idea that cognitive introduction behaviours (i.e., pre-learning which is assumed to be necessary for learning a unit) which are the students' characteristics, emotional introduction features (the level of motivation to learn the unit) and the quality of teaching activity are the basic indicators of learning output. If the students' characteristics (e.g. attitude) and the teaching activities are positive, the learning output will reach a high level and the gap between the high and low achievement students will be bridged.

Available researches have shown the positive effects of mastery learning. Therefore, it will be necessary to consider the school systems that have implemented mastery learning programs. School administrators, classroom teachers, curriculum developers and others involved in educational decision-making must utilize the research findings. The information obtained from research and implementation studies can be used to develop restructuring plans in school systems willing to meet the changing world climate.

Patterson (1993) discussed the restructuring efforts at a high school in Colorado based on demands for higher standards and higher student achievement. The school discarded old policies and practices and adapted mastery learning standards. The implemented changes yielded 75% achievement on each unit and retakes for those who did not meet 75% requirement. The change in mastery level led to an eight-period schedule with four 90-minute period per day in order to meet students' needs. One of the periods was designated as the Encore period in which students could seek assistance in the area of decreased mastery or work.

Hill and Hounshell (1991) [10] discussed an innovative approach to a summer school Biology course in North Carolina. The school system implemented six teaching strategies including mastery learning in an attempt to increase student achievement, student attitudes, parents' attitudes and students' attendance. Mastery learning recorded a successful achievement among other methods. Others that have recorded positive effects in the implementation programs of mastery learning include Chicago Board of Education which developed Chicago Mastery Learning Reading Program (CMLR) and Arredondo and Block (1990) [2] who made the integrative efforts necessary to make connection between educational models and educational environment. They successfully integrated mastery learning along with thinking skills in their curriculum.

Clark, Guskey and Benninga (1983) [7] investigated the effect of mastery learning on achievement and motivation. They found that the experimental group demonstrated higher levels of achievement, fewer absences and more motivation towards learning course materials. In a similar study; Ritchie and Thorkildsen (1994) [18] examined achievement and accountability and found a statistically significant difference between the informed group and the uninformed group. They theorized that the difference may have been due to the fact that the informed group were aware and thus more motivated to meet the specific goals. Both of these studies challenged claims of mastery learning critics that concluded that mastery learning programs increased achievement solely by increasing instructional time because of remediation.

Methods

Design: A quasi-experimental pretest-posttest-control design was adopted for the study involving two (2) groups, the experimental and the control groups, of senior secondary two (SSII) chemistry students.

Population: All senior secondary school students studying chemistry in Obio-Akpor Local Government Area of Rivers State, Nigeria.

Sample and Sampling Techniques: The sample was composed of 120 senior secondary two (SS II) students studying chemistry in two schools randomly selected from the 14 public secondary schools in Obio-Akpor Local Government Area. Purposive sampling was used in assigning 60 students each into the experimental and control groups. Both the experimental and control groups were composed of 30 male and 30 female students.

Instrument for Data Collection: A 10-item observational checklist wherein the researcher recorded the attitude and interest of students was used for data collection. The instrument was constructed based on a 4-point Likert scale scored as follows:

Very-Good	-	4 points
Good	-	3 points
Average	-	2 points
Poor	-	1 point

Validity of the instrument was done by subjecting it to expert judgement in Science Education, as well as in Measurement and Evaluation. Their suggestions and modifications were integrated into the final version of the instrument. Reliability of the instrument using test-retest technique yielded a value of 0.84.

Data Collection Procedure: After obtaining permission from relevant authorities and soliciting for the support and assistance of the school teachers, the researcher administered the research instrument to both the experimental and control groups to obtain the pre-test (baseline) result. Thereafter the experimental group was taught using the mastery learning strategy for two periods of 40 minutes on two separate days of the weeks during a four-week interval. The control group was also taught for the same period, however, the method of instruction adopted was the lecture (conventional) method.

Data Analysis Procedure: Mean difference and standard deviation were used to answer the research questions, while chi-square(X^2) with a 2x4 contingency table was used to analyse the null hypothesis.

Results

Table 2: Mean rating on the observed attitude of the students towards chemistry in the experimental group and the control group

S/No	Observational Checklist			Experimental group		Control group		
	Statement	Sample Size	Total point	Mean ($\bar{x}$)	Decision	Total points	Mean ($\bar{x}$)	Decision
1.	The teaching and learning of chemistry is fun	60	199	3.32	Positive	144	2.42	Negative
2.	Desire for the lessons to end before the actual time	60	95	1.58	Negative	179	2.93	Positive
3.	Flimsy excuses to leave the class during lesson	60	97	1.57	Negative	188	3.13	Positive
4.	Attentive and readily respond to questions	60	214	3.57	Positive	181	3.02	Positive
5.	Ask relevant questions during the lesson	60	211	3.52	Positive	134	2.23	Negative
6.	Have developed positive and desire to offer chemistry at higher levels	60	262	4.37	Positive	132	2.20	Negative
7.	Independently carry out tasks	60	199	3.32	Positive	143	2.38	Negative
8.	Master concept with ease	60	205	3.42	Positive	156	2.60	Positive
9.	Willingly request for tutorial classes	60	230	3.83	Positive	80	1.33	Negative
10.	Happily, teach one another	60	211	3.50	Positive	80	1.33	Negative

Decision rule: mean score from 2.50 and above are positive while below 2.50 are negative

Table 2 reveals that the students in the experimental group (mastery) recorded more positive attitude than those in the control group (conventional). Of the 10 items used in observing the students in the experimental group recorded 8 positive attitudes while those in the control group recorded only 5. This implies that the students in the experimental group had more positive attitude towards chemistry than those in the control group. Item 6 shows that the experimental group had a high mean score of 4.37 while the control group had a lower mean score of 2.20. It then means that if students are exposed to mastery learning strategy, a lot of them will desire to offer chemistry and chemistry related courses at higher levels through changed attitudes.

Table 3: Comparison of the effect of mastery learning strategy and conventional instructional method on the attitude of the students towards chemistry

Variables	Very Good	Good	Average	Poor	Frequency	Percentage (%)
Mastery method	45	25	5	5	80	67
Conventional method	5	5	10	20	40	33
Total	50	30	15	25	120	100

Table 3 revealed that mastery method had a total of 67% from the observational checklist against 33% for the conventional method. This implies that the mastery learning strategy has more positive effect on the attitude of the students towards chemistry than the conventional institutional method. This could also be seen in the post-test mean score of the students in the mastery learning strategy group which is much higher than that of the conventional instructional method.

Table 4: chi-square (x^2) comparison of the effect of mastery learning strategy and conventional instructional method on the attitude of the students towards chemistry.

Method	Very Good	Good	Average	Poor	Total	X^2 cal	Df	α	X^2 crit
Mastery	45 (33.33)	25 (20.00)	5 (10.00	5 (16.67)	80	39.86	3	0.05	7.815
Conventional	5 (16.67)	5 (10.00)	10 (5.00)	20 (8.33)	40				
Total	50	30	15	25	120				

Table 4 showed a calculated x^2-test value of 39.86 and a critical x^2-test value of 7.815 at 0.05 level of significance and a degree of freedom of 3. The calculated x^2 – test value is higher than the critical x^2-test value hence we reject the null hypothesis and accept the alternative hypothesis that there is a significant difference between the effect of mastery learning strategy and conventional instructional method on the attitude of the students towards chemistry. The result is in favour of the mastery learning strategy. The figures in parentheses are the expected frequencies.

Discussion of Findings

A comparison of the attitude of the students towards chemistry in their respective groups shown in Table 2 has revealed that the students after exposure to mastery treatment developed a greater positive attitude towards chemistry. This may have been due to the fact that mastery learning strategy allows students to master a unit before moving to the next unit. Students knowing that their teachers will give them every opportunity to gain mastery of a concept will surely develop a positive attitude. The result is in line with the findings of Ibrahim *et al* (2005) [11] and Myers (1975) [14] who in his study on the effect of mastery and aptitude on students' achievement and attitude on introductory geography course recorded that the students developed high positive attitude after being exposed to mastery treatment. The 2 x 4 contingency analysis shown in table 4 shows a significant difference between the effect of mastery and conventional instructional method on the attitude of the students towards chemistry. The result was in favour of the mastery method. It is also obvious that there is a relationship between achievement and attitude. This is because a student who scored very high marks in a subject will in no doubt develop a positive attitude towards the subject. This implies that the higher mean score recorded by the mastery group may have influence on their attitude

toward chemistry.

Recommendations

From the result obtained, the following recommendations are made:

1. Government at all levels should train and retrain teachers, review their salary upwards and pay them promptly.
2. Lack of infrastructure is a hindrance to teaching for mastery. The local, state and federal governments, as well as the ministry of education, should improve on the existing infrastructure and also build new ones.
3. Students that have performed creditably well should be rewarded to encourage other students.
4. School principals should allocate more time on chemistry lessons to enable the teachers to adopt mastery learning strategies.

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