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USING SIMULATION GAME – ASSISTED INSTRUCTION TO MODIFY STUDENTS' ATTITUDE TOWARDS INTEGRATED SCIENCE

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ABSTRACT: *The study determined the effect of simulation game – assisted instruction, cognitive style, numerical ability and gender on students' attitude towards the subject. It adopted a 2 x 2 x 3 x 2 non-randomized pretest, post test, control group quasi-experimental design in which the treatment, at two levels (simulation game – assisted instruction, teacher instruction only) was crossed with cognitive style at two levels (analytical, non-analytical), numerical ability at three levels (high, medium, low) and gender at two levels (male, female).The subjects were 305 junior secondary lll students selected from four co-educational school in Akinyele Local Government Area of Oyo State, Nigeria.Four valid and reliable instruments were used for data collection: Attitude Towards Science scale (ATSS); Numerical Ability Test (NAT), Cognitive Style Test (CST); AND Operational Guide for instruction (OGI). The study, which lasted for six weeks, involved exposing the students in the experimental group to three types of simulation games (water pollution game, chemical symbol, equation and formulae), while those in the control were not exposed to any game, but were rather taught in the conventional way. Data analysis involved the use of analysis of covariance (ANCOVA) and Scheffe range test as post hoc measures. The result showed a significant main effect of treatment on students attitude towards integrated science ($F_{(1,304)} =24. 173; p<0.05$). Students exposed to simulation game –assisted instruction exhibited more positive attitude towards the subject than those not so exposed. The implication of these findings for curriculum planning, teacher training and in-service programmes, development of curriculum material and classroom practice were discussed.*

KEYWORDS: Simulation Game, Instruction, Modify Students, Integrated Science

INTRODUCTION

Science has today bestowed a better quality of life on man if only man can control his selfish instincts, there would be no question of the destructive uses of science as feared by anti-nuclear Protestants. Virtually, all the gadgets that make life worth its while are derived from science.In consequence, the goals of science education should include, among other things, development of scientifically literate citizens who can think and act rationally.

The developed nations attach a lot of importance to the teaching of school science subjects (Comber and Keeves, 1973; Kyle, 1997; Muriithi and Wakira,2013; Adegbija,2014&Bilesanmi-Awoderu,2015). It is thus necessary that in Nigeria, a developing country, more efforts should be made towards authentic development of science and technology (by equally emphasizing science teaching and learning in schools) so that the citizens can manufacture and maintain the basic materials they need and thus "avoid undue importation of almost everything including tooth picks" (Okpala, 1995). The need to emphasize science teaching and learning in schools made UNESCO to organize the first international conference on The Use of Integrated Approach in Science Teaching held in

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Droubja (Bulgaria) in 1968. This conference became a five yearly affair and so there was the Maryland Conference in the United States of America (U.S.A. in 1973; and the Nigmegan Conference in the Netherlands in 1978. By 1970, Nigerian science educators and teachers had become sensitive to the need to use integrated approach in science teaching. Thus, the Science Teachers Association of Nigeria (STAN) in 1970 published a Curriculum Newsletter No. 1 which contained a statement of the philosophy, methodology, content and evaluation of integrated science. Subsequently, integrated science was introduced into the Nigerian school system based on suggestions from UNESCO and STAN.

The concept of integration in school science subjects lays emphasis on both concept/theme and teaching methods. D'Arbon (1972) had noted that integration; when applied to science courses, means that the course is devised and presented in such a way that students gain the concept of the fundamental unity of science; the commonality of approach to problems of scientific nature; and are helped to gain an understanding of the role and function of science in everyday life and the world in which they live.

A search through the literature has revealed that attitude has some characteristic features. Attitudes are learnt (Klausmeler and Goodwin 1966). Fishbein and Ajzen, 1975, Okoye, 1983, Mcguire, 1984, Klaumeler and Goodwin (1966) asserted that; Attitude are not acquire through memorizing and telling about verbal statements. Rather it is from many specific experience that the individuals integrate the meaning and feeling components into increasing larger and more stable behaviour pattern.

Odubunmi (1998)in Afuwape (2016) definition of Attitude: "Attitude could be regarded as a favourable or an unfavourable reaction towards some experience, situations or activities as a result of the way such an individual perceives and conceptualizes them". From the foregoing, one can affirm that a person's attitude is very important in achieving any goal.Pulos and Sneider (1994) and the Society for the Advancement of Games and Simulation (SAGS) described games as an enjoyable and competitive social activity with goals, rules and educational objectives. On the other hand, simulations are operations in which real situation is represented in another form (Cowie 1986). In most situations, games are associated with simulations.

The use of games and simulations in teaching-learning situations has been in existence probably because games and simulations provide fascinating challenges to learners and add interest, activity and novelty to the lesson (Anikweze, 1992). These attributes augur well for science teaching and learning. Thus, the use of games would likely help students to achieve a mastery of integrated science. Moreso, the use of games and simulation can be tailored to suit the interest of children and adults respectively (Hyman, 1968).

The cognitive style orientation of a learner refers to his preference in modes of perceptual organization and conceptual categorization of the external environment (Kegan et. al., 1963). Educators e.g. Robinson and Gray, 1974) have identified three cognitive style dimensions among student as categorical, descriptive and relational. Categorical responses refer to the use of common class membership in relating stimuli (e.g. a dog and a sheep are both animals). This type has also been referred to as inferential mode of conceptualization since it uses abstract labels in summarizing detailed relationship among stimuli. It is concerned with how the students conceptualize their external learning environment. Moreso, when science

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learning is becoming increasingly conceptual (Saracho and Dayton, 1980; Okpala and Adeoye, 1999).

The quantitative nature of some aspects of integrated science might be associated with students' learning problems in the subject. As noted by Abah (1985) secondary students in Nigeria tend to perceive the quantitative aspect of integrated science to be more difficult than the qualitative aspects. The study results also indicated that the perceived topic difficulty, however, depend on the students' mathematics ability. It is considered necessary to focus the present study on the use of games and simulations in teaching integrated science "a method of instruction that could provide learners with enough hand – on – experience to reduce their learning problems especially problems that are associated with poor numerical ability.

Research studies have shown that in general, boys perform better than girls in sciences (Awuwoye and Ufort, 1987; Onocha, 1988; Debaz, 1994; Okpala and Adeoye,1999;Alebiosu,2012 & Adebija, 2014) There are also indications that boys outnumber girls in science classes (Shakeschaft, 1995; Weinburgh, 1995; Onocha; Okpala and Offoruma,1995,WAEC,1998;Bilesanmi-Awoderun,Afuwape&Jolaosho,2015) These situations might not be unconnected with the current wave of research emphasis (Allen, 1995) channeled towards boosting girls' interest, participation and performance in science. The research emphasis should be sustained in Nigeria where the gender difference in performance and enrolment have resulted 12 boys and girls having unequal access to employment in science, technology, mathematics and engineering (STEM & E) professions (Adeniyi, 1996). The paucity of Nigerian girls and women in STM & E have also been documented by other science educators (Alele Williams, 1996; Nwana, 1997; Balogun, 1994; Yoloye, 1994;Afuwape & Oludipe,2012). It thus seems that gender stereotyping is still very much in Nigerian educational setting, and it may be a militating factor to education of girls in science in Nigerian secondary schools (Erinosho, 1994; Okpala, 1995, Onocha, Okpala and Offoruma, 1995; Okpala, 1999). In consequence, this study also considers it a worthwhile exercise to assess the extent to which gender, and its interaction with the other three variables, would affect students' attitude in integrated science.

Statement of Problem

The study seek to examine using simulation Game – Assisted Instruction to Modify Students' Attitude Towards Integrated Science. The study also investigated the effect of student cognitive style, numerical ability and gender on students' attitude.

Research Hypotheses

Based on the stated problem, the study tested the following null hypotheses

1. Attitude towards integrated science of:
   a. Students exposed to game and simulation – assisted instruction (treatment) is not significantly higher than that of students in the control group.
   b. Analytical student is not significantly higher than that of non-analytical.
   c. High numerical ability students is not significantly higher than those of medium and low ability students respectively.
   d. Male Students are not significantly better than that of females.
2. Attitude towards integrated science is not significantly affected by interaction of:
   a. Treatment and cognitive style

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b. Treatment and numerical ability
c. Treatment and gender
d. Cognitive style and Numerical ability
e. Cognitive style and gender
f. numerical ability and gender

3. Attitude towards integrated science is not significantly affected by interaction of:
   a. Treatment, cognitive style and numerical ability
   b. Treatment, cognitive style and gender
   c. Treatment, numerical ability and gender
   d. Cognitive style, numerical ability and gender
4. Attitude towards integrated science is not significantly affected by interaction of treatment, cognitive style, numerical ability and gender.

RESEARCH METHODOLOGY

This chapter describes the research design, sampling procedure and sample, instrumentation, treatment procedure and method of data analysis.The study made use of a non-randomised pretest-posttest control group design in a quasi-experimental setting. The dependent variables is attitude towards integrated science.

The independent variables are:
i. Instructional Method (treatment); at two levels;
- simulation game
- teacher instruction (conventional method) only
ii. Student cognitive style, at two levels
- analytical; and
- non-analytical
iii. Student numerical ability, at three levels:
- high
- medium
- low

There is only one moderator variable
Gender at two levels
male and
female

Sampling Procedure and Sample

First, judgmental sampling was used to select schools in Akinyele Local Government Area of Oyo State of Nigeria that are considered eligible to participate in the study. Participated schools;

i. Have a full-time university graduate in integrated science teachers from 1998 to date.
ii. Have presented candidates for the Junior Secondary School (JSS) integrated science examinations for at least three times.
iii. Have completed the JS II integrated science curricula at the time of data collection.
iv. Have both male and female students (the study has gender as a moderator variable).

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Next, stratified random sampling (based on geographical location: east, west, north and south was used to select one eligible school from each location to participate in the study). This helped to ensure that no two participating schools are particularly close to each other to allow for undue interaction of students from the schools. In a participating school, simple random sampling was used to pick two JS III classes to participate in the study. All the students in the selected classes were part of the study sample. The choice of JS III class is based on the reason that the topics on which the study games and simulations are developed are among the integrated science topics JS III students and teachers in Nigeria perceive difficult to learn and teach respectively (Abah, 1985; Ogunmuyiwa and Okpala, 1999) in all, a total of 305 students in the study.The sample consisted of students of varied numerical ability (high – medium – and low) and cognitive style – (analytical and non- Analytical).

Instrumentation

Four instruments were used in conducting the study:
Attitude Towards Science Scale (ATSS)
Numerical ability Test (ATSS)
Congnitive Style Test (CST)
Operational Guide for Instruction (OGI) (Stimulus instrument)

Attitude Towards Science Scale (ATSS)

The attitude Towards Science Scale (ATSS) was adapted for the study Onafowokan (1998) had adopted the inventory of students Attitude Towards physics developed and revalidated by Okpala (1985;1989) with results indicating a high measure of construct validity and internal consistency reliability (cronbach coefficient alpha value = 0.91). The ATSS consists of two sections: A and B has a set of 25. attitudinal items placed beside a four-point scale: Strongly Agree SA); Agree (A); Disagree (D) and Strongly Disagree (SD). The student are required to indicate the extent of their agreement or otherwise on the scale. Section A of the instrument solicited for personal information on age and gender. Onafowokan (1998) made use of four education evaluators with science background to ensure that the 25 items of ATSS are highly related to the construct "attitude towards science". These items were also trial tested using 137 JS lll students in four secondary school in lagos. The results showed no ambiguties in the instrument and produced a cronbach's coefficient alpha value of 0.87.

For the present study, the ATSS was trial-tested using 50 JS lll students in Akinyele Local Government Area of Oyo in order to further ensure is validity and reliability. The protest results showed that the students had no difficulties responding to the attitude scale. The result also produced a conbach coefficient alpha value of .87 (a measure of construct validity and eternal consistency reliability of the instrument)
Numerical Ability Test (NAT)

The Numerical Ability Test (NAT) was adapted for the study. Onafowokan (1998) had adapted the NAT from Bakare's (1977)Numerical Aility Test. It was a 40-item test in which each problem was placed besides four options from where the respondent is expected to pick the answer to the problem. A reliability estmate of 0.79 was established for the NAT by Bakare (1977) using test-retest (two weeks interval) procedure. In addition Onafowokan (1998) made use of four educational evaluators with Mathematics and science background to affirm that the NAT items are logically related to numerical ability construct. The NAT was also trial-tested using 137 JS lll students in four secondary schools in Lagos. The pretest

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results showed no ambiguities in the instrument and produced a K-R, 20 reliability estimate of O.86 (Onafowokan 1998).For the present study, the NAT was trial tested using 50 JS lll students in Akinyele Local Government Area of Oyo State the trial test result showed that there were no ambiguities in the instrument, The result also produced a K-R, reliability estimates of 0.80.

Cognitive Style Test (CST)

The cognitive Style Test (CST) is a modified version of the cognitive style test developed by Sigel (1967). The modification and validation were done by Onyejiaku (1980) to Nigeria environment. This study adapted the modified version. The CST consists of twenty cards numbered 1 to 20. Each card contains three picture in black and white, two of which could have one thing of the other in common or could go together in some ways. The CST was used to classify the students into "analytic" and "non-analytic" style on the basis of their statement regarding the way they perceive the pictures. Thus, the CST is a reasoning test used to measure how respondents choose and analyses sets of drawing of common objects, animals, plants or artifacts for the purpose of classifying them.

Onyejiaku (1980) had estimated the reliability estimates of items in the CST to range from 0.62 to 0.76. Onafowokan (1978) also trial tested the CST using 137 JS lll students in four secondary school in Lagos. The trial test result showed no ambiguities in the instrument. The result also produced a test-retest (two weeks internal) reliability value that range from 0.87 to 0.98. for the present study the CST was trial tested twice (separated by two weeks)using 50 JS lll student in Akinyele Local Government Area of Oyo State in order to further ensure its validity and reliability

Operational Guide for instruction (OGI)

Operational Guide for instruction (OGI) went through three stages of validation, Firstly, four integrated science teacher from different location of Oyo State gave the games a face validation. Secondly, the games were trial tested using two different schools, where subjects were grouped and allowed to play the games; areas of difficulties were noticed, before it was finally arranged. Thirdly two science Educators in a College of Education and two in a University rated the games according to Pulos and Sneider (1994) model for game development and evaluation.

Guidelines for Games Development Model Validation

CONTENTS	4	3	2	1	0
Adequancy of the objectve of the game					
Appropriateness of materials needed					
Adequacy of the game for the task to be lerant					
Clarity of starting instruction					
Clarity of playing instruction					
Clarity of Wining instruction					

Figure 1. Guidelines for games development validation

Operational Guide for instruction (OGI) is an instructional guide for aspects of the treatment of the treatment that involves intruction in the experimental and control groups. It consists of

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four major procedural steps that are sequentially and logically dependent on each other: preamble, exposition, remediation and summary.

Peamable: At this stage, the teacher's activities involved stating the lesson topic and instructional objective, as well as linking the new lesson with the previous one.

Exposition: At this stage, the teacher encouraged learners' active involvement in asking questions discussing, observing, e.t.c.The teacher also involved in helpful activities such as explaining, demonstrating, prompting thinking and discussion, clarifying concepts, asking questions, etc. Remediation: At this stage, the discussion was aimed at identifying learner's areas of weakness for possible remedial instructions with corrective feedback.

Summary: at this stage, the teacher provided a summary of the lesson orally as well as on the chalkboard.

The OGI was developed on the two major topics sub-divided into 18 topics. 13 topics was covered during the six weeks of treatment. The OGI was validated b experienced science teachers and students. The researcher trained the participating teachers in the selected schools to ensure that the master how to use the OGI adequately and consistently. This helped to minimize teacher bias in the course of providing treatment to the pupils.

Treatment Procedure

First, the integrated science teachers in the participating schools (who are trained on how to use the treatment packages and instrument) made the students to respond to three instruments: the ATSS, the NAT, and the CST. The NAT scores served the purpose of classifying the students into numerical ability groups (high, medium and low); while the CST scores served the purpose of classifying the student into cognitive style groups (analytical and non-analytical). The ATSS scores served as pretest (covariate) score. After this, the teacher provided treatments for the experimental and control groups for six weeks. Simple random sampling was used to decide the specific treatment provided for the intact classes of a selected school. At the end of the six weeks of treatment, the teachers administered the ATSS as post test.

i. Experimental group: The treatment in this group consisted of teacher instruction and games. First, the students was exposed to teacher instruction which consists of four major procedural steps: Preamble, exposition, remedial and summary. Detail of these steps was as stipulated in the Operational Guide for Instruction (OGI). This direct instruction lasted for half of the time schedule for the lesson. Next, the students were grouped in fours to play the relevant games (i.e. the game associated with the day's lesson). The teacher explained and introduced the mechanics of the games to the students; after which the students will play and complete among the groups of four till the end of the lesson. During this period of games, the teacher played a supervisory role.

ii. Control group: In this group, treatment consists of the four major procedural steps for instruction: preamble, exposition, remediation and summary. Details of these steps will be as stipulated in OGI. This instruction, based on the OGI, lasted for the full time schedule for the lesson.

METHOD OF DATA ANALYSIS

The data generated from the attitude scale was classified into pre and post test scores for both experimental and control groups. The data from the NAT and the CST was used to classify the students into numerical ability and cognitive style groups respectively. The data was analysed during using analysis of covariance (ANCOVA) with the pretest scores as

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covariates. Where the main effect associated with numerical ability is significant, Scheffe pair wise comparison test will be used as post-hoc measure. In the case of significant interaction effect, a separate examination of the differences among categories of one variable at the different levels of the other variables involved in the interaction will be conducted. Thus simple effected analysis was supported with graphical illustrations.

RESULTS AND DISCUSSION

In this chapter, the results of the study are presented and discussed. The sequence of the presentation and discussion is in accordance with that of the study hypotheses.
Hypothesis 1a: Attitude towards integrated science of students exposed to game and simulation-assisted instruction (treatment) is not significantly better than that of students in the control group.Table 1. presents a 2x2x3x2 analysis of covariance of attitude towards integrated science scores by treatment (game and simulation-assisted instruction), cognitive style, numerical ability and gender. The table shows that

Table 1.
Summary of 2x2x3x2 ANCOVA on the Post-test Attitude Scores of Subjects According to Treatment, Students' Cognitive Style, Numerical Ability and Gender

Source of Variation	Sum of Squares	df	Mean of Square	F-value
Covariate	9616.813	1	9616.813	212.07
V8	9616.813	1	9616.813	1 212.97 1
MAIN EFFECT	1256.341	5	251.268	5.541
V1	1096.186	1	1096.186	24.173*
V2	113.468	1	113.468	2.502
V3	42.801	2	21.400	.472
V4	.272	1	.272	.006
2-Way Interaction				
V1 V2	322.375	9	35.819	.790
V1 V3	.510	1	.510	.011
V1 V4	20.799	2	10.400	.229
V2 V3	23.764	1	23.764	.524
V2 V4	10.506	2	5.253	.116
V3 V4	23.634	1	23.634	.521
	256.491	2	128.246	2.828
3-Way Interaction	811.020	7	115.860	2.555
v1 v2 v3	65.694	2	32.847	.724
v1 v2 v4	134.392	1	139.392	2.986
v1 v3 v4	253.071	2	126.536	2.790
V2 v3 v4	64.236	2	32.118	.708
4-Way Interaction	4.865	1	4.865	.107
V1 v2 v3 v4	4.865	1	4.865	.107
Explained	12011.415	23	522.235	11.516
Residual	12742.539	281	45.347	
Total	24753.954	304	81.427	

*Significant at the 0.05 level.

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Table 1.2
Multiple Classification Analysis (MCA) of the Attitude Scores of Subjects According to Treatment, Students' Cognitive Style, Numerical Ability and Gender
Grand Mean = 76.531

Variable Category	+ N	Unadjusted Dev'p	Eta	Adjusted Indepednents Covariates Dev'n	for Beta +
V1. Exp	147	-.18		2.11	
2. Cont	158	.17	.02	-1.96	
					.23
V2					
1. Non-anal.	221	-.18		-.40	
2. Anal	84	2.14	.15	1.06	.07
V3					
1. Low	149	-1.28		-.39	
2. Medium	121	.82		.41	
3. High	35	2.64	.15	22	04
V4					
1. Female	151	-.16		.03	
2. Male	154	.16		-.03	
			.02		.00
Multiple R^2					.439
Multiple R					.663

The effect of treatment on students' attitude towards integrated science was significant [$F_{(1,304)}$ =24.173; $p < 0.05$]. Thus, hypothesis 1a was rejected. In order to determine which of the two groups of students (students in the experimental group and those in the control group) had better attitudinal disposition towards integrated science, reference was made to the Multiple Classification Analysis (MCA) in Table 1.2. The Table shows that students in the experimental group (those exposed to game and simulation-assisted instruction) had better attitude towards integrated science then their counterpart in the control group. The experimental and the control group students on the average had adjusted post test scores of 78.64 and 74.57 respectively. These values were computed by summing up the grand mean and the adjusted mean respectively. The Table also shows that treatment accounted for 5.29% ($.23^2$) of variation in the attitude of students towards integrated science.

The significant impact of treatment is not unexpected, considering that previous researches (Adeniran, 1994; Adelakun, 1997 & Adegbija,2014) had reported that game and simulation could be used to increase student's interest and participation in science. The result also corroborated the study findings of Knirk and Gustafson (1986) who were of the opinion that attitude enhancement is a major reason why game and simulation should be used in science teaching. In addition, there are indications that game and simulation-assisted instruction:

(i) generate enthusiasm, excitement, total involvement and enjoyment of the lesson (Ernest, 1986);

(ii) make learning pleasurable, realistic, and fun (Williams, 1986); and

(iii) enhance interaction, peer learning and friendship among learners (Akinyemi, 1997&Muriithi&Wakira,2013).

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It thus seems that game and simulation-assisted instruction should be one of the valuable methods of teaching integrated science in Nigerian secondary schools. The importance of this method of teaching science cannot be over-emphasized considering that the development of positive attitude towards integrated science is basic to solving the problem of students' underachievement in the subject (Onafowokan and Okpala, 1998; Ogunwuyi, 2000). As noted by Kremer and Walbery (1981). Okpala (1985), Okebukola (1986), German (1988) and Aghadiuno (1995 attitude towards a science subject greatly influences performance in that subject. Indeed, attitude towards a subject is said to be the very basis of cognitive development and motivation as well as several other positive correlates of achievement in the subject (Emina, 1986). All these tend to emphasize the educational import of the study result that game and simulation-assisted instruction had significant effect on students' attitude towards integrated science. Other hypotheses were not significant.

EDUCATIONAL IMPLICATIONS AND RECOMMENDATIONS

The implications of the findings of this study and the associated recommendation border on the following aspects of integrated science education: classroom practice; curriculum planning; development of curriculum materials; and teacher training/in-service programmes.
The significant effect of treatment on students' attitude towards integrated science provide the empirical basis to suggest that practising integrated science teacher should constantly expose their students to game and simulation-assisted instruction. It is hoped that the resultant positive attitude of the students' towards integrated science would in turn improved their achievement in the subject.

In using game and simulation-assisted instruction, teachers should pay extra attention to non-analytical students (irrespective of their gender and numerical ability groupings) since the non-analytical tend not to experience the effect of game and simulation-assisted instruction as much as their analytical counterparts.

Integrated science teacher should increase their use of instructional and counseling strategies (e.g. quantitative-based project and cognitive restructuring therapy) that could improve student numerical ability and cognitive style. The teacher should also seek the co-operation of mathematics teachers and member of the school curriculum committee to ensure that integrated science students' learn relevant mathematics concepts/ topics with a view to sharpening the students' numerical ability (Iroegbu and Okpala, 1998).

Science educators involved in curriculum development should reorganize the integrated science syllabus and textual materials to make them more inviting for non-analytical associated with low and medium numerical groups. The re-organization could be through introduction of more opportunities for out-of-school scientific activities and extra curricular programme (e.g games; riddles, jocks, etc) that are rooted in mathematics concepts and quantitative reasoning.

Integrated science teachers' methodology courses in teacher education and in-service programmes should be made to emphasize the need to teach the subject using methods that are characterized by game and simulation, among other things. The training and in service programmes should be activity oriented with enough opportunities for the programme

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participants to master the theory and practice integrating different types or game and simulation in teaching. Perhaps, it could be suggested that the exit performance criteria for such training and in-service progammes include, among other things, a level of mastery with regards to participants. Ability to build game and simulation into integrated science teaching.

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