IMPACT OF FRAMING AND TEAM ASSISTED INDIVIDUALIZED INSTRUCTIONAL STRATEGIES STUDENTS' ACHIEVEMENT IN BASIC SCIENCE IN THE NORTH CENTRAL ZONE OF NIGERIA.

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Abstract

The study assessed the relative effectiveness of framing and team assisted individualized (TAI) instructional strategies with 400 Junior secondary two Basic Science students. Two null hypotheses were posted. Two valid instruments, Basic Science Achievement Test (BSC) and Style of Categorization Test (SCT) were administered on the sample and data gathered were analyzed, using the 3x2x2 factorial ANCOVA and Duncan Multiple Range Test. The result indicate significant main effect of treatment ($F(2,360) = 23.782$, $p < .05$) and no significant main effects of style of categorization and gender. Also, no significant interaction effects were found. The findings agree that both TAI and framing strategies are effective in promoting students' achievement in Basic Science in the Northern region of Nigeria. Thus, these teaching strategies could serve as viable alternatives to the teaching Basic Science and a viable strategy to ensure effective implementation of the new 9-year basic Education Curriculum in Nigeria.

As part of on-going national reforms in the education sector in Nigeria, the Nigerian Educational Research and Development Council (NERDC) developed a 9-year Basic Education Curriculum (BEC) which has been approved for use in Nigeria primary and junior secondary schools since 2008. The BEC is geared towards facilitating the attainment of the core elements of the National Economic Empowerment and Development Strategy (NEEDS), as well as the goals of Education for All (EFA) and the Millennium Development Goals (MDGs) (Obioma, 2008). One of the core subjects at the junior secondary school (JSS) level is Basic Science which is considered as an indispensable catalyst to the creation of peace culture. As a core subject Basic Science has a compulsory status in the National Policy on Education and it is considered important in our everyday life. It is therefore cogent that research attention should be focused on how to ensure students' achievement and interest in the subject. Before the advent of BEC studies on the integrated science taught in junior secondary schools revealed that students' poor performance in the subject was generally due to ineffective teaching methods (Unachukwu, 1990). Olarewaju (1986) ascribed the decline in students' academic achievement to factors such as:

- Lack of qualified teachers
- Lack of motivation on the part of the students and teachers (Unachukwu 1990)
- Persistent use of traditional teaching methods that encourage rote memorization
- Home and cultural background of the students

In order to improve students' academic achievement in science, many studies have equally been conducted using carefully planned instructional strategies (Awofala, 2010; Awolola, 2009; Awofala, 2002; Ku & Sullivan, 2000; Abimbade, 1997; Choi & Hannafin, 1997; Akinsola, 1994 and Nneji, 2011).

Despite the concerted efforts, students' achievement in basic science remained low, mind boggling and discouraging at virtually every level of education. Thus the need to focus more research on instructional strategies that have been found to improve students' achievement in the cognitive domains. Two of such strategies are; Framing (Orutokan, 1999) and Team Assisted Individualization (Slavin, 1985; Igwe,2000) .

Frame, described as a big picture or framework or grid for representing knowledge was introduced into cognitive science by Minsky (1975). He introduced it as a product of spatial learning strategy to describe the mechanism for knowledge and knowing. Framing strategy is a visual arrangement that enables a substantial amount of information to be put in a form of grid, framework,

spatial or matrix. Van Pattern, Chao, and Reigeluth (1986) described framing as a cognitive strategy for sequencing and synthesizing information for the purpose of designs. It is posited here, that since framing involves making connections of main ideas and the relationship between them, it might aid students' organization and comprehension of structural knowledge and remembering when needed. Framing has been found useful in science as an alternative instructional strategy. While attention has been given to it in science teaching (Orukotan, 1999; Leonard, 1989), its usefulness in Basic Science education is yet to be explored.

The Team Assisted Individualized (TAI) instruction has been found effective in facilitating performance (Slavin 1994). TAI combines cooperative learning with individualized programmed instruction. Cooperative learning refers to learning together in small groups to effect individual accountability and a common group goal. In individualized programmed instruction, "instructional materials are arranged in a series of successive frames that lead the learner from a body of known concept to unknown, from simple to complex concept within the same area" (UNESCO as cited in Igwe 2000). TAI method uses four-six members, mixed ability learning teams and certificates are awarded to high-performing teams. It involves an individualized sequence of learning governed by a placement test thereby allowing students to proceed at their own pace.

It is evident that the use of instructional strategies involves students learning specific content, and the way in which students receive and process this information will be crucial to learning and this has been found to be influenced by their styles of categorization (Awolola, 2009; Olajengbesi, 2006; Awofala, 2002 and Riding and Al-salih, 2000).

In this study, the researcher contends that if metacognitive and cooperative learning strategies such as framing and TAI respectively are used to teach Basic Science, students could be empowered to take charge of their own learning in a highly meaningful fashion; increase their store of scientific knowledge and enhance remembering and transfer of learned content to novel situations. Such students are likely to display an enhanced level of performance irrespective of their style of categorization and gender. Awofala & Nneji in early 2010 conducted the **first, study** on framing and TAI with a focus on Mathematics in Oyo State in the South West Zone of Nigeria. Nneji later in that same year replicated the study with a focus on Basic Science in Rivers State, in the South South Zone of Nigeria, using teachers who were trained in a workshop setting. Results obtained were similer to those obtained by Awofala & Nneji (2010).

The present study is an extension of Nneji (2010) to test the hypothesis. Can these instructional strategies make the same impact in the Northern region?

Method

Following Campbell and Stanley (1996), Awofala & Nneji (2010), and Nneji (2010) an untreated control group, pre-test, post-test, quasi-experimental design was used to contrast the treatment's (at three levels) scores crossed with style of categorization (at two levels) and gender (at two levels).

Sample comprised 350 JSS II students (180 boys and 170 girls) of varied style of categorization (140 field independent and 260 fields dependent). Stratified random sampling was used to select intact classes from six equivalent coeducational Junior Secondary Schools that are distantly located from one another within the city of Jos in Plateau State in the north central zone of Nigeria. Two valid and reliable instruments constructed by the researcher were used to collect data for the study. These were the Basic Science Achievement Test (KR. 20 = 0.78 and Style of Categorization Test (Pearson product moment correlation stability coefficient r = .60 to .74).

Forty Basic Science education teachers drawn from across the local government areas of plateau State were sensitized on the use of BEC en-workshop organized by NERDC in November 2010 in Jos. From the participating teachers, six teachers were selected from six LGA and were given special orientation on the of Framing & TAI strategies respectively

At the outset of the study, the teachers made the subjects respond to two instruments i.e. Basic Science Achievement Test (BSAT) and Style of Categorization Test (SCT). The BSAT served as pretest (covariate) score while the SCT served to categorize the subjects into the extremes of the style of categorization continuum of field independence and field dependence. After this, the teacher provided the treatment conditions, which lasted four weeks. This involved the use of Framing in two schools (experimental group 1), the use of Team Assisted Individualized in two schools (experimental group 2) and the use of the Conventional method in the remaining two schools (control group) all teaching the same topic. Topic for treatment was adopted using the teachers' syllabus for the term; it was observed that the 6 schools involved in the study use the same syllabus so they had the same topics to teach during the period. Thereafter, the BSAT was administered as post-test.

The treatment for the experimental groups was carried out using a specially designed Instructional Guide (IG) for Basic Science, while the conventional method of teaching was used for the control group. The IG involved the following specific phases:

1. Introduction – Identification of topics, concepts, subtopics and instructional objectives. Introducing the strategy as well as holding brief remarks on them.
2. Presentation of theoretical base involving lectures or discussions.
3. Implementation of Strategy – carrying out of specific treatment, either framing or TAI.
4. Evaluation of learning and consolidation of knowledge gained.

In experimental group I (n = 100) subjects were taught using the framing technique. The subjects were made to identify and list main ideas, principles, concepts, examples etc. The teachers gave introductory remarks and presented context summaries from facts isolated by the subject, the subject pointed out relationship between the listed ideas, concepts and generalizations, which were in the form of forms/function, comparison/contrasts. Subjects then labeled the row and columns with any of the relationships in the preceding step to form a grid and lastly the teachers observed and reviewed the activities done to effect necessary correction/ feedback where applicable.

In experimental group II (n = 140) subjects were divided into six-member groups that were heterogeneous with regard to style of categorization as well as sex and were trained on how to use the TAI based on the model of Gallagher et al (1992) cited in Igwe (2000). Using teamwork and individualized programme instruction, the subject guided by the teacher engaged in fact finding, problem finding, brainstorming, solution finding, and implementation of the preferred solution and evaluation of the implemented solution.

The control group (n = 110) was taught using the modified conventional instructional strategy of chalk and talk some post test was administered to the 3 groups.

The post-test achievement scores were subjected to analysis of covariance using pre-test scores as covariates. Duncan multiple-range test was utilized in post hoc contrasts of the groups' pre and post- test achievement mean scores.

Results

Table 1 shows the analysis of covariance of achievement using pre-test scores as covariates. The table shows significant main effect of treatment [$F(2,349) = 23.682$, $p < .05$] and no significant main effect of style of categorization [$F(1,349) = .190$, $p > .05$] and gender [$F(1,349) = .022$, $p > .05$]. Also, the two-way and three-way interactions were not significant.

Table 1: Summary of Analysis of Covariance of Achievement Test (BSC) Scores by Treatment, Style of Categorization and Gender

Sources of Variation	Sum of Squares	Df	Mean Square	F	Significance of F
Covariates	1185.002	1	1185.002	174.451	.000
Main Effects	801.235	4	200.309	12.575	.000
Treatment	295.139	2	147.570	23.682	.000*
Style of Categorization (SC)	1.238	1	1.238	.190	.663
Gender	.143	1	.143	.022	.884
2 way Interactions	48.651	5	9.730	1.496	.192
Treatment x SC	21.029	2	10.515	1.616	.201
Treatment x Gender	33.165	2	16.583	2.549	.087
SC x Gender	0.004	1	.004	.001	.981
3 way Interactions	36.400	2	18.200	2.797	.068
Treatment x SC x Gender	36.400	2	18.200	2.797	.068
Explained	1521.288	12	126.774	19.485	.000
Residual	2192.566	337	6.506	-	-
Total	3713.854	349	10.641	-	-

*Significant at $p < .05$

The Multiple Classifications Analysis, MCA (table 2) shows the magnitude of the post-test mean achievement scores exposed to the different treatment conditions. The team assisted individualized group (TAI) had the highest adjusted mean score of 11.139 followed by the framing strategy group (FRS) with 10.639, then the control group (CRG) with 8.889. Therefore, the team assisted individualized strategy is the most efficient of the treatment conditions and the direction of decreasing effect of instructional strategy on mathematics achievement is CRG < FRS < TAI.

Table 2: Multiple Classification Analysis (MCA) of BSC Scores by Treatment Groups, Style of Categorization and Gender

Grand mean = 10.289

Variable + Category	N	Unadjusted Derivation	Eta	Adjusted for Independent + Covariates	Beta
Treatment	100	-.36		.35	
1. FRS	140	.65		.85	
2. TAI	110	-.50	.45	-1.40	.60
3. CRG					
Style of Categorization					
1. Field independence	140	.13		.07	
2. Field dependence	210	-.08	.03	-.05	.02
Gender					
1. Male	183	-.27		.02	
2. Female	167	.25	.08	- .02	.01
Multiple R squared					.387
Multiple R					.622

The results from post-hoc analysis (table 3) indicate that the Basic Science achievement of students exposed to the TAI is significantly higher than those of the CGS group. However, the main score of observed significant difference was due to the significant difference between TAI

and CRG groups. The difference between the post-test mean scores of students in the FRS and TAI groups as well as FRS and CGS groups were statistically not significant.

Table 3: Duncan Multiple Range Comparisons of Treatment Groups' Mean Score on MAT

Mean	Group	FRS: 1	TAI: 2	CGS: 3
9.929	FRS: 1			
10.939	TAI: 2			*
9.7891	CRG: 3		*	

*Pairs of group significantly different at p< .05

Discussion and Conclusion

The results presented in Table 1 showed significant main effect of treatment on achievement measure. The results indicate that students' academic achievement was greatly improved when they were exposed to the teaching strategies of framing and team assisted individualized when compared with the conventional teaching method. This finding supports earlier findings, of Nneji (2010) which associate improved content learning to the use of Framing & TAI strategies in Basic Science classroom in the south south zone of Nigeria. This is further substantiated considering the views of Ige (2001) that learner centred teaching strategies make students more reflective and critical in their thinking when compared with the traditional teaching method, which emphasized teacher activity at the expense of pupil involvement. Framing strategy was found to be effective in promoting achievement in Basic Science in this study because the strategy provided learners with opportunity to spend their time more efficiently, increase their attention span, and become more confident following instruction. Research findings (Dreher & Singer, 1980; Carey et al 1987; Orukotan, 1999) have indicated that framing strategy can promote achievement significantly in subject content. This is because the strategy guides learners better in their learning and assists them in recalling important information. Team assisted individualized strategy was found to be more effective because students had the opportunity to work together in teams, share views and opinions, and engage in brainstorming on problems.

The non-significant main effect of style of categorization on students' achievement (Table 1) is in line with previous studies (Ige, 2001 & Awofala & Nneji 2010) but at variance with those of (Awolola, 2009; Olajengbesi, 2006 and Awofala, 2002) who believe that processing of information in an analytic way as opposed to non-analytic way improves achievement in content learning greatly. This result may be attributed to the fact that more field dependent than field independent students participated in this study and as such majority of the students experienced events in an undifferentiated way.

The main effect of gender on students' Basic Science achievement in this study was statistically not significant (table 1). This result is at variance with the work of researchers who believe that gender stereotyping is still dominant in the Nigerian educational system (Erinosho, 1997; Odogwu, 2002; Ojo, 2003). The result however supports the findings of Onabanjo (2000), Popoola (2002), Awofala & Nneji (2010) who reported no significant main effect of gender on students' mathematics achievement and Nneji (2010) who reported no significant effect in Basic Science in River State. This finding suggests that no differential experiences of boys and girls exist within the classroom in the Northern region.

The results of this study showed that there were no significant interaction effects of treatment and gender, treatment and style of categorization and gender and style of categorization. These results suggest that the personal variables of gender and style of categorization do not interact with instruction to produce results. These results indicate that treatment is neither sensitive to gender nor style of categorization on achievement in Basic Science. This is in agreement within Awofala & Nneji

(2010) for achievement in Mathematics as well as Nneji (2010) for Basic Science in the South South Zone of Nigeria.

The non-significant 3-way interaction effect of treatment, gender and style of categorization on students' achievement in mathematics is in line with previous studies (Olajengbesi, 2006; Awofala, 2002). This result revealed that the treatment, gender and style of categorization did not mutually influence achievement in Basic Science to produce a joint effect. The non-significant 3-way interaction effect is explicable in that the interaction of two of the variables did not change at different levels of the third variable. Thus, achievement of students with different gender and different style of categorization tend to be consistent under any instructional strategy irrespective of whether the students are male or female or whether they exhibit field dependent or field independent style of categorization. This view is recognized by other researchers (Awolola, 2009; Ifamuyiwa, 2005 and Ogunkola, 2000)

In a nutshell, the findings of the study revealed that the strategies of framing and team assisted individualized instruction were effective methods of learning science. They had the potentials of improving students' achievement in Basic Science. It's therefore recommended that these strategies be put to use in the teaching and learning of Basic Science and teachers of Basic Science should endeavour to match teaching strategies with the manner in which students receive and process information. The non-significant main effect of gender recorded in this study implied that framing and team assisted individualized strategies could be used to advance learning and close the gap of gender disparity in the learning of Science. These strategies could be used as a basis for individualizing instruction for male and female students.

It is pertinent to note that the new 9-year Basic education curriculum does not highlight Framing and TAI as teaching strategies. The NERDC which has the full autonomy to produce the curricula for both basic and post basic education in the country is now enjoined to infuse these strategies of teaching and learning during the review of the school curricula. As shown in this study, these strategies lend themselves well to the Basic Science and thus laying foundation for science at SS level and helping the Basic Education Curriculum achieve the goals.

Findings here are similar to findings of Awofala & Nneji (2010) for Mathematics in South West Zone of Nigeria, Nneji (2010) for Basic Science in the South South Zone and now North Central Zone. The implication here is that these instructional strategies lend to effective BEC implementation irrespective of classification style, gender and location and therefore can be recommended for national use.

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