

Think-Pair-Share Instructional Strategy: A Variety Tool for Enhancing Students' Achievement in Secondary School Chemistry

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Abstract

This study adopted a quasi-experimental design, specifically pre-test, post-test, non-equivalent control group, to investigate the effect of think-pair-share instructional strategy on students' achievement in Chemistry. Two research questions and two null hypotheses guided the study. A sample of 100SS one students was drawn by simple random sampling technique from the five co-educational secondary schools in Ikwuano LGA in Umahia Education Zone. The instrument for data collection was the particulate nature of matter achievement test. The instrument was validated by two experts in Science Education Department of Michael Okpara University of Agriculture, Umudike. The reliability of the instrument was determined using test-retest method and the score correlated using Pearson's Product Moment correlation which yielded an index of 0.93. The research questions were answered using descriptive statistics while the null hypotheses were tested at .05 level of significance using analysis of covariance. The result of data analysis showed a significant difference in the mean achievement scores of the experimental and control groups in favour of the experimental group. Again, the findings of the study revealed that male students exposed to think-pair-share instructional strategy achieved higher than their female counterparts. It was recommended among other things, that teachers should adopt the use of think-pair-share instructional strategy as a variety tool for enhancing students' achievement in chemistry.

Key words: Think-Pair-Share, Instructional Strategy, Achievement and Chemistry

Introduction

Science, Technology, Engineering and Mathematics (STEM) Education plays a vital role in national development. According to Nwosu and Ebere in Eboka (2014), STEM education has its focus on preparing individuals with appropriate skills, abilities and competences both mental and physical to live and contribute to the development of the society. Chemistry education occupies a pivotal position in STEM education. According to Njoku (2004), the enviable position which Chemistry occupies in the educational system of most countries of the world including Nigeria is perhaps, justifiable in the sense that chemistry can exert a dominant if not a decisive influence on the life of individuals in the areas of industry, agriculture, infrastructure as well as in the developmental effort of a nation. Igboegwu and Ikoku (2012) viewed chemistry education as a necessary ingredient for becoming self-reliant, earning a living and contributing toward building a sustainable national development. Nwaka, Egbo and Okechineke (2016) asserted that there is virtually no process of production which does not involve one aspect of chemical process or the other. Chemical principles are employed in oil refineries, petrochemical industries and in the manufacture of soaps, dyes, cosmetics, nylon, glass, plastics, drugs and pesticides.

In spite of the importance of Chemistry in national development, researchers have observed low achievement among chemistry students in senior secondary school certificate examinations

(Giginna and Nweze 2014; Aniodoh and Eze, 2014; Ellison, 2007). Chief examiner's report 2010-2014 indicated poor achievement of chemistry students in WASSCE and NECO. The poor achievement of students in chemistry has been blamed on teacher-related factor (Giginna and Nweze 2014). The STEM teachers play a very vital role in ensuring success in the delivery of subject matter. According to Ibrahim (2011), STEM teachers hold the key to the door of scientific and technological knowledge and are therefore undisputedly the ultimate determinant of national development and survival. No wonder, Afe (2002) asserted that the realization of the best educational policies, curricular design and expenditure of colossal sum of money depends on the teachers because they are responsible for translating policy into action and principles into practices in their interactions with students in their programmes. For the teacher to be functional and effective in delivery, such teacher should be knowledgeable both in content and pedagogy. Ezeliora and Ali in Igbanugo (2014) opined that students' interest in learning chemistry could be enhanced by chemistry teachers through careful choice of the most appropriate teaching methods. Alayi in Okoye (2014) asserted that teaching and learning have gone beyond the teacher standing in front of the learners to disseminate information to them without learners actively participating.

However, there is evidence in literature that chemistry classrooms are dominated with conventional methods of teaching which make students passive recipients in the teaching/learning process. For example, Oluruntegebe and Oduntunji in Giginna and Nweze (2014) blamed the poor achievement in chemistry on poor teaching strategies adopted by chemistry teachers over the years. Chemistry as a subject is not only abstract but volatile and requires to be taught by using a variety of teaching strategies so as to ensure that the learners have a good understanding of the concepts. According to Njelita (2015), the use of one instructional strategy makes teaching boring to students and their interest might not be sustained. Ezeliora in Igbanugo (2014) observed that the conventional lecture method commonly used in teaching chemistry in Nigeria is boring and uninteresting. Uzoechi (2014) opined that science education (chemistry inclusive) programmes must focus attention on innovative teaching methods that can promote creative thinking in scientific problem-solving. Science educators advocate a shift from teacher-centred methods to learner-centred methods that engage students actively in the process of learning. Prominent among such learner-centred methods is cooperative instructional strategy.

Cooperative learning is the deliberate instructional use of heterogeneous small groups of students who work together to maximize each other's learning (Igbanugo 2014). Le Francois and Putnam in Ifamuyiwa and Onakoya (2013) viewed cooperative learning as an instructional strategy in which learners work together in small groups in such a manner that each member of the group can participate in a clearly collective task and engage in discussion with one another while participating in authentic learning activities relevant to real life that encourage them to teach one another. Types of co-operative learning according to Eze (2015) include; role play, game show, group discussion, panel discussion, debates, peer tutoring, computer-assisted instruction, think-pair-share and so on.

Think-pair-share instructional strategy is a learner-centred technique which presents students with a task or question and gives them time to think individually, then share their views in pairs and finally share with the larger class. According to Lyman (1987), think-pair-share is a learner-centred strategy designed to provide students with an opportunity to think a given topic, subject matter or concept by enabling them to formulate individual ideas and share these ideas with another student. Think-pair-share instructional strategy is a cooperative learning strategy that belongs to the group of strategies called inquiry-based learning strategy. It derived its name from the three stages of learners' actions while implementing the strategy, with emphasis on what

learners are expected to do at each of the stages (Johnson & Johnson,1999). According to Ifamuyiwa and Onakoya (2013), the process commences with the teacher giving out a problem or asking an open ended question to which there may be a variety of answers. The teacher then gives learners “think time” and directs them to think about the question and how to answer it. During the think time, learners turn to their partners and work together, sharing ideas, discussing, clarifying and challenging one another towards arriving at a reasonable answer. The pair then shares their ideas with another pair or with the whole class. In other words, think-pair-share takes place in three stages; individuals think silently about a question or task presented by the teacher; individuals pair up and exchange ideas; pairs share their views with the whole class.

Some research studies have been carried out on the effect of think-pair-share instructional strategy on students’ achievement. However, reports on the effect of think-pair-share instructional strategy are inconclusive. Nwaubani, Ogbueghu, Adeniyi and Eze (2016) investigated the effects of think-pair-share and student teams-achievement division instructional strategies on students’ achievement in economics. The study adopted a quasi-experimental design of non- equivalent control group. The sample consisted of 224 students and the instrument for data collection was economics achievement test which was validated and trial tested for reliability. Research questions were answered using mean and standard deviation while the null hypotheses were tested at .05 level of significance using ANCOVA. Findings revealed that both think-pair-share and student teams-achievement divisions significantly improved students achievement. Similarly, female students achieved better than their male counterparts.

Bamiro (2015) explored the effects of guided discovery, think-pair-share and lecture methods on students’ achievement in secondary school chemistry. Two hundred and forty-two SS1 students comprised the sample. The null hypotheses were tested at .05 level of significance using analysis of covariance and multiple classification analysis. Scheffe’s test was further used as post hoc measures. Results showed that students exposed to guided discovery and think-pair-share strategies obtained significantly higher posttest mean scores than those exposed to lecture method.

Ifamuyiwa and Onokoya (2013) investigated the impact of think-pair-share instructional strategy on students’ achievement in secondary school mathematics. The study adopted a quasi-experimental design of non- equivalent control group. One hundred and twenty (120) SS1 students in Odogbolu L.G.A of Ogun State comprised the sample. Results obtained using analysis of covariance at .05 level of significance revealed that students exposed to the think-pair-share instructional strategy achieved significantly better than those exposed to conventional methods. Again there was no significant difference in the mean achievement scores of male and female students exposed to think-pair-share instructional strategy. Based on the controversy observed above, the present study was necessitated to make contribution to existing knowledge.

The influence of gender on students’ achievement in science in general and chemistry in particular has been a global concern to science educators and researchers. However, there is no agreement among researchers on the outcomes of studies on gender effect. Whereas some researchers found a significant difference in the achievement of male and female students in chemistry (Giginna and Nweze 2014; Aniodoh and Eze, 2014). Others found no significant difference in the achievement of male and female students in the subject (Bamiro,2015; Fatokun, Egya and Uzoechi,2016). Conflicting results as reported above necessitated further investigations and the present study sought to investigate the effect of think-pair-share instructional strategy as a variety tool for enhancing students’ achievement in secondary school chemistry.

Statement of the Problem:

Chemistry education plays a vital role in scientific, technological and national development. However, there is evidence in literature that students' achievement in the subject is very poor. The poor achievements in chemistry have been attributed to teachers' use of ineffective teacher-centred methods which make students passive in the teaching and learning process. Researchers have recommended that teachers should adopt learner-centred methods that will actively involve the students in the teaching and learning process. One of the learner-centred methods that can engage students actively is think-pair-share instructional strategy. Research reports on think-pair-share instructional strategy and students' achievement is conflicting. Lack of consensus in research reports necessitated the present study which is aimed at investigating the effect of think-pair-share instructional strategy on the achievement of male and female students when taught particulate nature of matter.

Purpose of the Study:

The main purpose of this study was to investigate the effect of think-pair-share instructional strategy on students' achievement in Chemistry. Specifically, the study sought to,

1. Determine the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught with lecture method.
2. Find out the effect of think-pair-share instructional strategy on the mean achievement scores of male and female students exposed to think-pair-share instructional strategy.

Research Questions

The following research questions guided the study,

1. What are the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught with lecture method?
2. What are the mean achievement scores of male and female students taught the concept of particulate nature of matter using think-pair-share instructional strategy?

Hypotheses

The following null hypotheses tested at .05 level of significance guided the study,

- H₀₁:** There is no significant difference in the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught using lecture method.
- H₀₂:** There is no significant difference in the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy.

Method:

The study adopted a quasi-experimental design, specifically, pretest-posttest non-equivalent control group. The study was conducted in Umuahia Education Zone of Abia State, Nigeria. Umuahia Education Zone is made up of four local government areas. The population for the study comprised all the eight hundred (800) SS one students offering Chemistry in the five co-educational secondary schools in Ikwuano LGA. Purposive sampling technique was used to sample Umuahia Education Zone. Simple random sampling technique was used to draw Ikwuano LGA from the four local government areas in the zone. Since gender was a factor in the study, two co-educational secondary schools were sampled from the five co-educational secondary schools in Ikwuano L.G.A using simple balloting. The two co-educational schools were assigned to experimental and control groups using simple balloting.

The instrument for data collection was particulate nature of matter achievement test (PAT) made up of 25-item multiple choice questions. The items in the instruments were adopted from WASSCE and NECO past question papers. WASSCE and NECO past question papers were used because the questions were already standardized. The instrument was validated by two experts in Science Education from Michael Okpara University of Agriculture Umudike. The reliability of the instrument was established to be 0.93 using test-retest methods. The regular chemistry teachers of the sampled schools were used as research assistants. The pre-test was administered to both the control and experimental groups before the treatment. The question papers were retrieved from the research subjects since the items in the pretest were re-organized and used as post-test. After the treatment which lasted for three weeks, the post-test was administered to both the control and experimental groups. The scripts were marked and scores collated. Research questions were answered using descriptive statistics while the hypotheses were tested at .05 level of significance using analysis of covariance (ANCOVA).

Results

Research Questions 1

What are the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught using lecture method?

Table 1: Mean Achievement Scores of Students Taught the Concept of Particulate Nature of Matter using Think-Pair-Share Instructional Strategy and those Taught using Lecture Method:

Group	N	Pre-test		Post-test		Mean gain
		\bar{X}	SD	\bar{X}	SD	
Think-pair-share	50	29.38	10.26	60.56	16.68	31.18
Lecturer method	50	22.29	9.88	49.80	11.66	27.51
Total	100	51.67	20.14	110.36	27.34	58.69

Results from table 1 indicated that the mean achievement scores of students exposed to think-pair-share instructional strategy and those taught using lecture method were 60.56 and 49.89 with standard deviations of 16.68 and 11.66 respectively in the post test. The experimental group exposed to think-pair-share instructional strategy achieved higher than the control group taught using lecture method. Higher standard deviation for the experimental group showed that students' scores were dispersed from the mean.

Research Question 2

What is the effect of think-pair-share instructional strategy on the mean achievement scores of male and female students taught the concept of particulate nature of matter?

Table 2: Mean Achievement Scores of Male and Female Students Taught the Concept of Particulate Nature of Matter using Think-Pair-Share Instructional Strategy.

Group	N	Pre-test		Post-test		Mean gain
		\bar{X}	SD	\bar{X}	SD	
Male	24	29.75	10.96	68.58	13.29	38.83
Female	26	29.03	9.82	53.15	14.16	24.13
Total	50	58.78	20.74	121.73	27.45	62.96

Results in table 2 showed that the mean achievement scores of male and female students in the posttest were 68.58 and 53.15 respectively with standard deviations of 13.29 and 14.16. The male students in the experimental group exposed to think-pair-share instructional strategy achieved higher than their female counterparts. A lower standard deviation for the males showed that their scores were more clustered around the mean.

Hypothesis 1:

H₀₁: There is no significant difference in the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught using lecture method.

Table 3: Analysis of Covariance of Mean Achievement Scores of Students in the Experimental and Control Groups.

Source	Type III sum of squares	df	Mean Square	F	Significance
Corrected model	3064.445	2	1532.222	8.011	.001
Intercept	34031.412	1	34031.412	177.932	.000
Pretest	170.005	1	170.005	.889	.348
Instructional strategy	2224.685	1	2224.685	11.632	.001
Error	18552.315	97	191.261		
Total	326100.000	100			
Corrected total	21616.76099				

P ≤ .05

Results presented in table 3 showed that F-value of 11.632 for treatment is significant at .001 which is less than .05 alpha level and thus the null hypothesis was rejected. This implies a significant difference in the mean achievement scores of students taught the concept of particulate nature of matter using think-pair-share instructional strategy and those taught using lecture method.

Hypothesis 2:

H₀₂: There is no significant difference in the mean achievement scores of male and female students taught the concept of particulate nature of matter using think-pair-share instructional strategy.

Table 4: Analysis of Covariance of Mean Achievement Scores of Male and Female Students Exposed to Think-Pair-Share Instructional Strategy.

Source	Type III sum of squares	df	Mean Square	F	Significance
Corrected model	3023.198	2	1511.599	7.865	.001
Intercept	17882.626	1	17882.626	93.045	.000
Pretest	52.096	1	52.096	.271	.605
Gender	2940.023	1	2940.023	15.297	.000
Error	9033.122	47	192.194		
Total	195432.000	50			
Corrected total	12056.320	49			

P ≤ .05

Results in table 4 above revealed a significant difference in the mean achievement scores of male and female students taught the concept of particulate nature of matter using think-pair-share instructional strategy. F-value of 15.297 for gender is significant a p-value of .000 which is less than .05 level. The hypothesis was rejected implying a significant difference in the mean achievement scores of male and female students exposed to think-pair-share instructional strategy.

Conclusion

The findings of this study showed a significant difference in the mean achievement scores of students in the experimental group exposed to think-pair-share instructional strategy and those in the control group taught using lecture method. The difference was in favour of the experimental group. Similar results have been reported in Mathematics, Economics and Chemistry. For example, Ifamuyiwa and Onakoya (2013), Nwaubani, Ogbuegbu, Adeniyi & Eze (2016) and Bamiro (2015) in their independent studies found out significant differences in the mean achievement scores of students exposed to think-pair-share instructional strategy and those taught using lecture method in favour of experimental groups.

Findings of this study also revealed that there was a significant difference in the mean achievement scores of male and female students exposed to think-pair-share instructional strategy. This result lends support to the report of Nwaubani, Ogbuegbu, Adeniyi & Eze (2016) who found out a significant difference in the achievement of male and female students when exposed to think-pair-share and student team achievement division instructional strategies. The finding however is at variance with the report of Bamiro (2015) who found out that there was no significant difference in the mean achievement scores of male and female students in Chemistry. It is also at variance with the finding of Ifamuyiwa and Onakoya (2013) who reported a non-significant difference in the mean achievement scores of male and female students in Mathematics.

Recommendations

The following recommendations were made,

1. Teachers should adopt the use of think-pair-share instructional strategy as a variety tool in Chemistry classrooms.
2. Curriculum planners should incorporate think-pair-share instructional strategy into the curriculum of pre-service teachers. This will enable any prospective teachers who passes through College or Faculty of Education to be exposed to the use of the instructional strategy.
3. Professional bodies such as Science Teachers' Association of Nigerian should organize workshop and seminars on think-pair-share instructional strategy for in-service teachers.

References

- Afe, J.O. (2002), Reflections on becoming a teacher and the challenges of teacher education. *Inaugural lecture series, 64, University of Ibadan.*
- Aniodoh, .H.C.O and Egbo, J.J (2014), Effect of gender on students' achievement in chemistry using inquiry-role. *Instructional journal of social science and education, 4(2), 185.*
- Aniodoh, H.C.O and Eze, G,N, (2014), Achieving effectiveness in secondary school students chemistry classrooms using constructivist Approach. A case study of physical and chemical changes. *55th annual conference proceeding of STAN, 247-252.*

- Bamiro, A.O. (2015), Effect of guided discovery and think-pair-share strategies on secondary school students' achievement in chemistry. *Available online journals, sagepub.com*
- Eboka, .C.O. (2014). Toward effective integration of creativity in science education, implication for cooperative learning strategy. *55th annual conference proceeding of STAN, 80-83.*
- Ellison, D. (2007), Social network site: definitions, history and scholarship. *Journal of computer mediated communication 13(1), 1-11.*
- Eze.G.N. (2015), Investigating science teachers' utilization of research findings on active learning strategies in secondary schools. *54th annual conference proceeding of STAN, 122-129.*
- Fatokun, K.V.F; Egya, S.O & Uzoechi B.C (2016), Effect of games instructional approach on chemistry students' achievement and retention in periodicity. *European journal of research and reflection in educational sciences 4(7), 29-39.*
- Giginna, L.I & Nweze, B.N. (2014). Creativity in chemistry teaching; effect of e-learning on students' achievement in acids, bases and salts. *55th annual conference proceeding of stan, 253-263.*
- Ibrahim, A. (2011), Effective primary science teachers; the bedrock for the attainment of universal basic education (ube) programme. *Journal of research in science education 2 (1), 44-48.*
- Ifamuyiwa, A.S and Onakoya, S.K. (2013), Impact of think-pair-share instructional strategy on students' achievement in secondary school mathematics. *Journal of STAN, 48 (1), 27-35.*
- Igbanugo, B.I (2014), Effect of cooperative learning on students' interest in secondary school difficult chemistry concepts. *55th annual conference proceeding of STAN, 271-278.*
- Johnson, M.D & Johnson, F (1999). *Working together, group theory and group skills. 5th edition.* Boston. Allyn and Bacon.
- Njelita, C.B (2015), Chemistry teacher's level of awareness and their application of research findings in classroom instruction. *56th annual conference proceedings of STAN, 215-221.*
- Njoku. Z.C. (2004). Fostering the application of science education research findings in Nigerian classrooms. Strategies and needs for teachers' professional development, *45th annual conference proceedings of STAN, 217-222.*
- Nwaka N.I.; Egbo, J.J & Okechineke. C.I (2016). Utilization of ICT social media networking sites (SMNS), by senior secondary school students in the learning of chemistry in Enugu education zone. *57th annual conference proceedings of STAN, 433-440.*
- Nwaubani, O.O. Ogbueghu, S.N.; Adeniyi, K.D & Eze, D.M (2016). Effect of think-pair-share and student teams- achievement divisions instructional strategies on senior secondary school students' achievement in economics. *Australian journal of basic & applied science. 10(3). 1-9.*
- Okoye, P.O (2014). E-learning utilization: an approach to dimensions of creativity for effective STEM curriculum delivery in colleges of education in Nigeria. *55th annual conference proceedings of STAN, 3-14.*
- Uzoechi, B.C (2014). Enhancing students' creativity through innovative science, technology and mathematics teaching. *55th annual conference proceedings of STAN, 61-79.*