THE EFFECTIVENESS OF THE STRUCTURED AND THINK-ALOUD PAIR PROBLEM-SOLVING INSTRUCTIONAL STRATEGIES ON STUDENTS' SKILL ACHIEVEMENT AND INTEREST IN MACHINE SHOP PRACTICE

BY

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Abstract

The study determined the Effectiveness of the Structured and Think-Aloud Pair Problem-Solving Instructional Strategies on Students' Skill Achievement and Interest in Machine Shop Practice. Two research questions were raised and answered as well as two hypotheses were formulated and tested at 0.05 level of significant. The study employed a quasi-experimental design of pre-test, post-test, and non-equivalent control groups. The study was conducted in Kwara, Nassarawa, Niger, and Plateau States, Nigeria. The targeted population for the study was 80 Nigerian Certificate in Education (NCE) III Metalwork Technology Education students in all the Colleges of Education offering technical education in the study area during the 2020/2021 academic session. The population of the study consisted of 18 from College of Education (Technical), Lafiagi; 13 from College of Education, Akwanga; Seven from College of Education, Minna and 42 students from College of Education, Pankshin. The study utilized the entire population of the study. The instruments used for data collection include Machine Shop Practice Interest Inventory (MSPII), and Machine Shop Practice Psychomotor Skill Achievement Test (MSPPSAT) subjected to face and content validation by three experts. The reliability index of MSPPSAT was determined using Kendall's Tau coefficient of concordance and yielded .81 while the reliability index of MSPII was determined using Cronbach's alpha and it yielded .88. Data were collected by administering copies of the instruments through hand delivery. The data collected were analysed using descriptive statistics (mean & standard deviation) and Inferential Statistics of Analysis of Covariance (ANCOVA). Findings from the study revealed that: Students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had higher mean skill performance (41.38) and interest (29.19) scores than students taught using Structured Problem-Solving instructional strategy with mean skill performance (40.49), and interest (27.86). The study also revealed that: There was a significant difference between the mean skill performance, and interest scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. Based on the findings, the study recommended among others that: Seminars and Workshop should be organized for lecturers of Machine Shop Practice on the use of Structured and Think-Aloud Pair Problem Solving Instructional Strategies by National Commission for Colleges of Education.

Keywords: Structured Problem-Solving, Think-Aloud Pair Problem-Solving, Instructional Strategies, Skill Achievement, and Interest

Introduction

Students offering Machine Shop Practice (MSP) deals with several machine operations in the fabrication of metallic components in Metalwork Technology (MWT). The aim of MSP is to equip MWT education students with technical knowledge and skills in advanced machine shop process using series of instructional strategies such as the Structured Problem-solving (SPS) and Think-Aloud Pair Problem-solving (TAPPS). The SPS and TAPPS instructional strategies improve analytical skills by helping students to formulate ideas, rehearse concepts, understand the sequence of steps underlying their thinking, and identifying errors in someone else's reasoning (Barkley *et al.*, 2014). It also promotes a deeper understanding of the subject matter since it requires students to

relate information to existing conceptual frameworks and apply existing information to new situations. As posited by Tambunan (2018), SPS & TAPPS instructional strategies has student pairs receive a series of problems and are assigned specific roles. This improves students' analytical skills by helping them formulate ideas, understand the sequence of steps underlying their thinking, and identify errors in another's reasoning (Widuri *et al.,* 2018; Sumantri & Whardani, 2017).

Statement of the Research Problem

The poor performance and rate of low academic learning outcomes among students in the MWT programme at the Colleges of Education (COEs) in Nigeria with certification in National Certificate in Education (N.C.E) III level is worrisome and the effect will be poor performance in their place of work if not improve upon. This is also coupled with multi-faceted challenges in the classroom instructional strategies which are now affecting students' learning outcomes in MSP due to the experienced rate of failure in the last five years. The poor learning outcome of students emanated as a reason of non stimulating instructional strategies such as the conventional lecture utilized by their lecturers. This rate of failure could be improved upon by choosing and applying a more suitable instructional strategy in teaching in colleges of education (Winarti *et al.,* 2019; Malik & Aswandi, 2019). Against this backdrop, there is a need for an appropriate instructional strategy that will improve learners for a better learning outcome. To achieve this, the study investigated the effectiveness of Think-Aloud-Pair Problem-Solving instructional strategies on students' learning outcomes in MSP.

Aim and Objectives of the Study

The aim of the study was to determine the effectiveness of Think-Aloud Pair Problem Solving instructional strategies on students' learning outcomes in MSP. The specific objectives of the study are to determine the effectiveness of:

1. Think-Aloud Pair problem solving instructional strategies on students' skill performance in MSP

2. Structured and Think-Aloud Pair problem solving instructional strategies on students' interest in MSP.

Research Questions

The study provided answers to the following research questions:

1. What is the the effectiveness of the Structured and Think-Aloud Pair Problem-Solving Instructional Strategies on Students' Skill Achievement and Interest in MSP?

2. What is the effectiveness of Structured Problem-solving and Think-Aloud Pair Problem-Solving instructional strategies on students' interest MSP?

Research Hypotheses

To guide the study, two null hypotheses were postulated and tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

HO$_1$: There is no significant difference between the mean skill performance scores of students taught MSP using Structured Problem-solving and Think-Aloud Pair Problem-Solving instructional strategies

HO$_2$: There is no significant difference between the mean interest scores of students taught MSP using Structured Problem-solving and Think-Aloud Pair Problem-Solving instructional strategies.

Research Methodology

The study employed a quasi-experimental design of pre-test, post-test, and non-equivalent control groups. The two groups of learners were designated accordingly with Structured Problem-Solving as experimental groups and Think-Aloud Pair Problem-Solving to serve as a control in a random procedure. The design was considered suitable for the study because cause-and-effect were easily established between and within Structured and Think-Aloud Pair Problem-Solving on students' skill performance, and interest in MSP.

The study was carried out in the North- Central geo-political zone of Nigeria. The area was chosen for the study due to the low performance of metalwork technology education students in MSP recorded in performances of the semester examination for the period of five years from 2015 to 2019 respectively. The study area consisted of four COEs offering MWT that include: Lafiagi, Akwanga, Minna and Pankshin respectively were considered for the study.

The population of this study comprised of the entire 80 Nigerian Certificate in Education (NCE) III metalwork technology education students in all the COEs offering technical education in the study area during 2020/2021 academic session. The population of the study consisted of 18 students from COEs Lafiagi (18) Akwanga (13) Minna (07) and Pankshin (42). The NCE III MWT education class was chosen for the study because, it is the only class levels in the COEs that MSP as a course is offered.

The study utilized the entire population while Purposive Sampling Technique (PST) and Simple Random Sampling Technique (SRST) were used to choose the COEs offering MSP. Other COEs in the study area were not selected simply because MWT Education Programme that involves MSP is not offered. The SRST was used to assign, Pankshin and Minna to control group (SPS) while Akwanga and Lafiagi to experimental group (TAPPS). The SRST was used in order to ensure that there is no bias in the assignment of subjects to the groups.

The instruments for data collections are: (1) Machine Shop Practice Interest Inventory (MSPII), and (2) Machine Shop Practice Psychomotor Skill Achievement Test (MSPPSAT).

The Lesson Plans (LP) for Structured and Think-Aloud Pair Problem-Solving instructional strategies were used to guide the lecturers in the class during the treatment procedure. The lesson plans were developed by the researchers considering the contents of the N.C.E curriculum of MSP to guide the lesson presentations in the teaching of the course outlines.

The reliability index of MSPCART was determined using Kuder-Richardson 20 (KR 21) statistical technique was .77 which shows that the consistency of the instrument is highly reliable. The reliability index of MSPPSAT was determined using Kendall's Tau coefficient of concordance yielded .81. The reliability of MSPII was determined using Cronbach's alpha and it yielded .88. Reliability of 0.5 – 0.6 and above adjudged an instrument as reliable. From the total summation of all the two instruments, their overall reliability value was .84.5 which is higher than .70.

The research instruments were personally administered to the respondents and collected back through hand delivery by their respective MSP lecturers.

The study employed the use of descriptive and inferential statistics to analyse the data. Descriptive statistics using mean and standard deviation was used to answer all the research questions and inferential statistics using Analysis of Covariance (ANCOVA) to test all the hypotheses at significant level of 0.05.

Results

Research Question One: What is the effect of Structured and Think-Aloud Pair Problem-Solving instructional strategies on students' skills performance in Machine Shop Practice? The data for answering research question two is contained in Table 1.1.

Table 1.1: Pre-test and Post-test Mean Skill Performance Scores of Students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving Instructional Strategies

Groups		Pre-test		Post-test		
	N	Mean	SD	Mean	SD	Mean Gain
Structured Problem-Solving Strategy	49	30.46	2.07	70.95	2.22	40.49
Think-Aloud Pair Problem-Solving Strategy	31	31.58	2.09	72.96	2.24	41.38

Table 1.1 shows that students taught Machine Shop Practice using Structured Problem-Solving instructional strategy had a pre-test mean skill performance score of 30.46 with a standard deviation of 2.07 and a post-test score of 70.95 with standard deviation of 2.22. The mean gained between the pre-test and post-test skill performance scores of the students taught Machine Shop Practice using Structured Problem-Solving instructional strategy was 40.49. The students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had a pre-test mean skill performance score of 31.58 with a standard deviation of 2.09 and a post-test score of 72.96 with standard deviation of .24. The mean gained between the pre-test and post-test skill performance scores of the students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy was 41.38. This indicated that students taught Machine Shop Practice using

Think-Aloud Pair Problem-Solving instructional strategy had higher mean skill performance scores than students taught using Structured Problem-Solving instructional strategy.

Research Question Two: What is the effect of Structured and Think-Aloud Pair Problem-Solving instructional strategies on students' interest in studying Machine Shop Practice? The data for answering research question three is contained in Table 1.2.

Table 1.2: Pre-test and Post-test Mean Interest Scores of Students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving Instructional Strategies

Groups		Pre-test		Post-test		
	N	Mean	SD	Mean	SD	Mean Gain
Structured Problem-Solving Strategy	49	39.87	1.05	67.73	1.25	27.86
Think-Aloud Pair Problem-Solving Strategy	31	41.03	1.53	70.22	2.17	29.19

Table 1.2 shows that students taught Machine Shop Practice using Structured Problem-Solving instructional strategy had a pre-test mean interest score of 39.87 with a standard deviation of 1.05 and a post-test score of 67.73 with a standard deviation of 1.25. The mean gained between the pre-test and post-test mean interest scores of the students taught Machine Shop Practice using Structured Problem-Solving instructional strategy was 27.86. The students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had pre-test mean interest score of 41.03 with standard deviation of 1.53 and post-test score of 70.22 with standard deviation of 2.17. The mean gained between the pre-test and post-test mean interest scores of the students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy was 29.19. This indicated that, students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had higher mean interest scores than students taught using Structured Problem-Solving instructional strategy.

Hypothesis One: There is no significant difference between the mean skills performance mean scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. The data for testing hypothesis one is contained in Table 1.3.

Table 1.3: Analysis of Covariance for the test of Significant Difference Between the Mean Skill Performance Scores of Students Taught Machine Shop Practice Using Structured and Think-Aloud Pair Problem-Solving Instructional Strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	371.351[a]	2	185.676	151.876	.000
Intercept	645.238	1	645.238	527.781	.000
Pre-test	294.750	1	294.750	241.095	.000
Group	16.721	1	16.721	13.677	.000*
Error	94.136	77	1.223		
Total	412167.000	80			
Corrected Total	465.487	79			

a. R Squared = .798 (Adjusted R Squared = .793)

Table 1.3 shows the F-calculated value for testing the significant difference between the skill performance scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. The F-calculated value of 13.677 was obtained with associated exact Significant Two-Tailed (Sig. 2-tailed) value of 0.02. Since the associated Sig. 2-tailed value of .000 is less than the stated level of significance (0.05), the null hypothesis which stated that there is no significant difference between students' skills achievement mean scores in Machine Shop Practice when taught using Structured and Think-Aloud Pair Problem-Solving instructional strategies is rejected. Hence, there is significant difference between students' skills achievement mean scores in Machine Shop Practice when taught using Structured and Think-Aloud Pair Problem-Solving instructional strategies.

Hypothesis Two: There is no significance difference between the mean interest scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. The data for testing hypothesis three is contained in Table 1.4.

Table 1.4: Analysis of Covariance for the test of Significant Difference between the Mean Interest Scores of Students Taught Machine Shop Practice Using Structured and Think-Aloud Pair Problem-Solving Instructional Strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	198.617[a]	2	99.309	56.151	.000

Intercept	100.240	1	100.240	56.677	.000
Pre-test	80.788	1	80.788	45.679	.000
Group	38.383	1	38.383	21.702	.000*
Error	136.183	77	1.769		
Total	377910.000	80			
Corrected Total	334.800	79			

a. R Squared = .593 (Adjusted R Squared = .583)

Table 1.4 shows the F-calculated value for testing the significant difference between the interest mean scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. The F-calculated value of 21.702 was obtained with associated exact Sig. 2-tailed value of 0.00. Since the associated Sig. 2-tailed value of 0.00 is less than 0.05, the null hypothesis which stated that there is no significant difference between the mean interest scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies is rejected. This implied that, there is significant difference between the mean interest scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies.

Findings

Findings on the effectiveness of Structured and Think-Aloud Pair Problem-Solving instructional strategies on the skill performance of students taught Machine Shop Practice revealed that the students taught using Think-Aloud Pair Problem-Solving instructional strategy had a higher mean skill performance scores than students taught using Structured Problem-Solving instructional strategy. This indicated that the students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy performed better in the skill performance test than the students taught using Structured Problem-Solving instructional strategy. The finding is similar to the findings of Simpol et al. (2017) on the effect of thinking aloud pair and Polya problem-solving instructional strategies in fractions that revealed students exposed to Think-Aloud Pair Problem-

Solving instructional strategy achieved higher in trigonometry achievement test than those exposed to Polya problem-solving instructional strategy.

Furthermore, the test for significant difference between the mean skills performance scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies revealed statistical significant. This entailed that, there is much difference between the mean skill performance scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies. The finding is similar to the finding of Febrina *et al.* (2018) on the effects of Thinking Aloud Pair Problem-Solving instructional strategy on the skill of students in impulse and momentum that revealed significant difference between the Post-test mean scores of the experimental and control group of recall variable in favour of the experimental group. The finding implied that, substantial improvement in the skill performance of students is obtainable if they are taught Machine Shop Practice using Think-Aloud Pair Problem-Solving Strategy.

Findings on the effectiveness of Structured and Think-Aloud Pair Problem-Solving instructional strategies on students' interest in Machine Shop Practice revealed that the students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had higher mean interest scores than students taught using Structured Problem-Solving instructional strategy. The finding provided a clearer understanding that, the interest of students in learning Machine Shop Practice is stimulated using Think-Aloud Pair Problem-Solving instructional strategy than using Structured Problem-Solving instructional strategy. The finding is in agreement with the claims of Winarti *et al.* (2019) that showed the effectiveness of Think-Aloud Pair Problem-Solving instructional strategy over Problem-Solving Strategy on students' interest in trigonometry in Cameroon. The finding is also in-line with the findings of Widuri *et al.* (2018) on the application of

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Thinking Aloud Pair Problem-Solving in learning Mathematics that revealed significant impact on the interest of students.

Similarly, finding on the test for significant difference between the mean interest scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies revealed statistical significant. The statistical significant difference revealed shows the great extent to which Think-Aloud Pair Problem-Solving instructional strategy stimulates students' interest in Machine Shop Practice especially, when compared with Structured Problem-Solving instructional strategy. Literarily, the finding is in harmony with the finding of Winarti *et al.* (2019) that revealed statistical significant difference between the interest of students taught trigonometry using Think-Aloud Pair and Conventional Problem-Solving instructional strategies. The finding is particularly important to stakeholders in technical education at colleges of education level as it will provide a basis for using Think-Aloud Pair Problem-Solving instructional strategy to stimulate the interest of students in Machine Shop Practice.

Conclusion

Based on the findings of the study, insights on the effects of Structured and Think-Aloud Pair Problem-Solving instructional strategies on students' skill performance, and interest in Machine Shop Practice in colleges of education is provided. The study found out that students taught Machine Shop Practice using Think-Aloud Pair Problem-Solving instructional strategy had higher mean skill performance and interest scores while students taught Machine Shop Practice using Structured Problem-Solving instructional strategy had higher mean cognitive achievement and retention scores.

Recommendations

Based on the findings from the study, the following recommendations were made:
1. Machine Shop Practice lecturers should adopt the use of: Think-Aloud Pair Problem-Solving instructional strategy to enhance students' skill performance and interest.

2. National Commission for Colleges of Education should sensitize and train Machine Shop Practice lecturers on the use of Structured and Think-Aloud Pair Problem-Solving

instructional strategies in order to enhance students' skill performances, as well as stimulate their interest.

3. Administrators of colleges of education should ensure encourage the teaching of Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies in order to enhance students' skill performances, as well as stimulate their interest.

4. Seminars and Workshop should be organized for lecturers of Machine Shop Practice on the use of Structured and Think-Aloud Pair Problem Solving Instructional Strategies by National Commission for Colleges of Education.

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