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The Use of Structured and Think-Aloud Pair Problem-Solving Instructional Strategies on Students' Interest and Retention in Machine Shop Practice

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ABSTRACT

The study assessed how students' learning results in the machine shop practice were affected by structured and think-aloud pair problem-solving instructional tactics. The subjects of this research are 80 Nigerian Certificate in Education (NCE) III metalwork technology students from all colleges of education. The machine Shop Practice Interest Inventory (MSPII), Machine Shop Practice Cognitive Achievement and Retention Test (MSPCART), and Machine Shop Practice Psychomotor Skill Achievement Test are the instruments utilized for data collecting (MSPPAT). Several study findings showed that (i) Students who were taught Machine Shop Practice using the Think-Aloud Pair Problem-Solving instructional strategy had mean gain interest scores that were higher 29.19 than those who were taught using the Structured Problem-Solving instructional strategy, which had a mean score of 27.86. (ii) In comparison to students taught using the Think-Aloud Pair Problem-Solving instructional approach, students taught Machine Shop Practice utilizing the Structured Problem-Solving instructional method had higher mean gain retention scores of 41.37. The study suggested, among other things, that lecturers for Machine Shop Practice should employ structured problem-solving teaching strategies to improve students' cognitive recall and think-aloud pair problem-solving instructional strategies to increase students' attention.

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1. INTRODUCTION

The Nigeria Certificate in Education (NCE) Technical certificate is awarded for Machine Shop Practice (MSP), which is a course provided by final-year Metalwork Technology Education (MTE) students in colleges of education. The course covers a variety of machine techniques that are used to create metallic components. The lecturers' teaching techniques may have contributed to the student's poor performance in the course.

The principles and techniques that lecturers employ to deliver instruction and help students learn are known as instructional strategies. These tactics are chosen in part based on the material to be taught and in part based on the type of learner. Pilato and Ulrich (2014) state that technical courses have traditionally been taught using a variety of instructional styles, including lectures, discussions, and demonstrations. The projected improvements in student interest and retention do not appear to be happening as a result of these measures. However, alternative techniques, such as the Structured and Think-Aloud-Pair problem-solving instructional strategies, could be used to increase students' attention and retention.

The Structured Problem-Solving (SPS) educational technique enables students to assess questions of all sizes in a planned and organized manner. According to Loes *et al*. (2018), the SPS teaching technique enables students to learn how to recognize, analyze, and solve a question in an orderly way to remember knowledge. This assures that a question is solved correctly, with the right solution. According to Coskun and Eker (2018), the SPS teaching approach and other active strategies like the Think-Aloud-Pair Problem-Solving (TAPPS) instructional strategy improved student performance and knowledge retention.

The Think-Aloud-Pair Problem-Solving (TAPPS) educational technique places a strong emphasis on how the problem-solving process can assist students in recognizing procedural mistakes. Tambunan (2018) claims that the TAPPS instructional technique involves assigning specified responsibilities to each student pair and giving them a set of tasks. This helps pupils develop ideas, comprehend the process that underlies their thinking, and spot flaws in other people's reasoning, which enhances their analytical skills (Widuri *et al.,* 2019; Sumantri & Whardani, 2017). MSP instructors may need to continue investigating other teaching approaches, like structured and think-aloud pair problem-solving, as a way to increase classroom activities and students' learning outcomes.

The expected levels of learning that students should attain for the class are indicated by the learning outcomes, which are assessment criteria. Learning outcomes are statements of what a learner is anticipated to know, understand, and/or be able to demonstrate after a learning period, according to Dos-Santos (2019). Retention and curiosity are examples of learning outcomes. According to Akiba and Liang (2016), several variables, including students' hobbies, affect both cognitive and skill performance.

The attraction that motivates a learner to react to specific stimuli is referred to as interest. According to Ogundola *et al.* (2020), with the right instructional tactics, interest can be sparked and maintained in teaching and learning as a successful behavior. Because a student is more likely to become fully involved in an activity when he or she develops an interest in it, it is thought to be a key factor in learning. According to Schraw *et al.* (2011), poor academic performance in students can be significantly impacted by their lack of interest in a subject like MSP, which is heavily influenced by teaching strategies. This suggests that the low interest in MSP among MTE students may be due to their poor academic performance. According to Adams (2017) and Safitri *et al.* (2018), active teaching techniques like SPS and TAPPS can increase students' interest in a subject while also improving their academic achievement. As

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a result, it may also increase students' enthusiasm for MSP, resulting in strong cognitive and skill performance as well as knowledge retention.

Knowledge retention refers to a person's capacity to recreate important information over time. According to Adams (2017), retention of knowledge is the learner's repeated repetition of the behavior they have previously learned. When transitioning from the classroom to the workplace, students must have the skills necessary to succeed. They must also have the ability to analyze and recall material at the appropriate time thanks to their long-term memory retention abilities. This suggests that these active instructional tactics may tend to improve students' memory of the material and maybe narrow the achievement gap between pupils.

Due to the high rate of failure over the past five years, Nigerian colleges of education may have been dealing with a variety of problems with their classroom instruction tactics that are now having an impact on students' learning results in machine shop practice (Sidik & Masek, 2021). As can be seen from the chart below, the rate of poor academic learning outcomes among students in the Metalwork Technology Education program at the N.C.E. III level has been concerning over the past five years. If this trend continues, it will have a negative impact on student's ability to perform well at work. The data gained demonstrated that students who completed collegiate N.C.E. programs had poor learning outcomes, which came as a result of their lecturers' use of unengaging and uninspiring instructional tactics. Nonetheless, it has been proven that a lack of student interest is to blame for the high number of learners who fail Machine Shop Practice in institutions of education.

This is one additional reason why researchers are working on many studies to find new teaching techniques that can enhance academic accomplishment, classroom instruction, student interest, and active learning (Akiba & Liang, 2016; Coskun & Eker, 2018). The traditional teaching approach that was used may have contributed to the poor learning outcome, which resulted in students in the Machine Shop Practice course performing poorly on an assessment. By selecting and implementing a more effective instructional technique in teaching in colleges of education, this failure rate could be reduced and improved (Winarti *et al.,* 2019; Malik & Aswandi, 2019). In light of this, it is necessary to find a suitable instructional technique that will enhance students' academic knowledge and skills, pique their interest, and increase students' academic accomplishment and retention to reach the desired learning outcome. To do this, the study examined how students' learning results in the machine shop practice in North central Nigeria were affected by structured and think-aloud-pair problem-solving instructional methodologies.

The goal of the study was to ascertain how structured and think-aloud pair problem-solving instructional tactics affected students' interest and retention in machine shop practice. The study's precise goals are to ascertain the effects of:

(i) The influence of structured and Think-Aloud Pair problem-solving education on students' interest in machine shop practice
(ii) The effects of structured and Think-Aloud-Pair problem-solving education on students' recall of machine shop practice

The investigation offered responses to the following questions:

(i) How do students' interests in machine shop practice change as a result of structured and think-aloud pair problem-solving instructional strategies?
(ii) How do structured and pair think-aloud problem-solving instructional tactics affect students' memory of machine shop practice?

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Two null hypotheses were proposed and tested via Analysis of Covariance (ANCOVA) at a 0.05 level of significance in order to direct the study.

(i) HO_1: The mean interest scores of students who were taught Machine Shop Practice utilizing structured and Think-Aloud Pair Problem-Solving teaching styles did not significantly differ from one another.

(ii) HO_2: The mean retention scores of students who were taught Machine Shop Practice utilizing structured and Think-Aloud Pair Problem-Solving teaching styles did not significantly differ from one another.

2. METHODS

A quasi-experimental design with pre-test, post-test, and non-equivalent control groups was used in the investigation. The measuring of learning outcomes both before and following the therapy was a component of the pre-test and post-test research design approach. Thus, Structured Problem-Solving was identified as the experimental group, and Think-Aloud Pair Problem-Solving was designated as the control group in a random approach. Because cause-and-effect relationships between and within structured and think-aloud pair problem-solving (independent factors) and students' interest in and retention in MSP (dependent variables) could be easily established, the design was deemed appropriate for the study.

The 80 Nigerian Certificate in Education (NCE) III metalwork technology students in all of the colleges of education providing technical education in the study area during the 2020–2021 academic session made up the study's population. 18 students from the Kwara State College of Education (Technical), Lafiagi; 13 students from the Nassarawa State College of Education, Akwanga; 7 students from the Niger State College of Education, Minna; and 42 students from the Federal College of Education, Pankshin made up the study's population. Because Machine Shop Practice is the only class level at the colleges of education that offer it, the NCE III metalwork technical education class was chosen for the study.

Although the Purposive Sampling Method (PST) and Simple Random Sampling Technique (SRST) were used for the investigation, the complete population was utilized because it was significant. The colleges of education offering machine shop practice were selected using the PST. Due to the absence of a Metalwork Technical Education Plan that includes Machine Shop Practice, other colleges of education in the study area were not chosen. Nassarawa State College of Education, Akwanga, and Kwara State College of Education, Lafiagi were placed in the experimental group, while the Federal College of Education, Pankshin, and Niger State College of Education, Minna and were assigned to the control group.

Machine Shop Practice Cognitive Achievement and Retention Test (MSPCART) and Machine Shop Practice Interest Inventory are the instruments used for data collecting (MSPII). The Machine Shop Practice (TEM 321) in the N.C.E curriculum served as the basis for the Machine Shop Practice Cognitive Achievement and Retention Test (MSPCART). The researcher also created the Machine Shop Practice Interest Inventory (MSPII). It had 30 items on an interest inventory, each rated on a five-point Likert scale.

Three experts from the Industrial and Technology Department of the Federal University of Technology in Minna, the Examination Development Department of the National Examination Council in Minna, and the Metalwork Technology Department of the Niger State College of Education in Minna, respectively, subjected the draft versions of the MSPCART, MSPPSAT, and MSPII to content and face validation.

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To determine the validity of the final draft of MSPCART and MSPII, a pilot study was carried out with students taking the MSP in Metalwork Technology Education at the Federal Institute of Education (Technical), Akoka- Lagos, South-West Nigeria. The study area of this study does not include the study area for the pilot study. Using the statistical method Kuder-Richardson 20 (KR 21), the dependability index of MSPCART was calculated. Using Cronbach's alpha, the MSPII's reliability was assessed, and it was produced. 88. The respondents received the research tools directly from their respective Machine Shop Practice teachers, who also physically delivered the research instruments back to them.

The study used inferential statistics using Analysis of Covariance (ANCOVA) to test all of the hypotheses at a significant level of 0.05 and descriptive statistics with mean and standard deviation to answer all of the research questions.

3. RESULTS AND DISCUSSION

The data for answering research question three is contained in **Table 1.** This data explained how students' interests in machine shop practice change as a result of structured and think-aloud pair problem-solving instructional strategies.

Table 1. 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	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
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

According to **Table 1,** students who were instructed in Machine Shop Practice using the Think-Aloud Pair Problem-Solving instructional strategy scored more highly on mean interest than those who were instructed using the Structured Problem-Solving instructional strategy.

The data for answering research question four is contained in **Table 2.** This data explains how structured and pair think-aloud problem-solving instructional tactics affect students' memory of machine shop practice.

Table 2. Pre-test and Retention Mean Scores of Students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving Instructional Strategies.

Groups	N	Pre-test		Retention test		
		Mean	SD	Mean	SD	Mean Gain
Structured Problem-Solving Strategy	49	24.18	2.15	65.55	1.17	41.37
Think-Aloud Pair Problem-Solving Strategy	31	25.06	2.48	64.58	0.76	39.50

According to **Table 2**, students who received instruction in Machine Shop Practice using the Structured Problem-Solving instructional strategy had higher mean retention scores than those who received instruction using the Think-Aloud Pair Problem-Solving instructional strategy.

The data for testing hypothesis three is contained in **Table 3**. This data explains hypothesis HO1, regarding the mean interest scores of students who were taught Machine Shop Practice

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utilizing structured and Think-Aloud Pair Problem-Solving teaching styles that did not significantly differ from one another.

According to **Table 3**, students who received instruction in Machine Shop Practice using the Structured Problem-Solving instructional strategy had higher mean retention scores than those who received instruction using the Think-Aloud Pair Problem-Solving instructional strategy.

Table 3. Analysis of Covariance for the test of Significance 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	0.000
Intercept	100.240	1	100.240	56.677	0.000
Pre-test	80.788	1	80.788	45.679	0.000
Group	38.383	1	38.383	21.702	0.000
Error	136.183	77	1.769		
Total	377910.000	80			
Corrected Total	334.800	79			

The data for testing hypothesis one is contained in **Table 4**. This data explains hypothesis HO2: The mean retention scores of students who were taught Machine Shop Practice utilizing structured and Think-Aloud Pair Problem-Solving teaching styles did not significantly differ from one another.

Table 4. Analysis of Covariance for the test of Significance Difference Between the Mean Retention 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	49.711[a]	2	24.855	35.990	0.000
Intercept	2274.742	1	2274.742	3293.820	0.000
Pre-test	30.623	1	30.623	44.342	0.000
Group	28.344	1	28.344	41.042	0.000
Error	53.177	77	0.691		
Total	339795.000	80			
Corrected Total	102.887	79			

a. R Squared = 0.483 (Adjusted R Squared = 0.470)

The F-calculated value for comparing the mean retention scores of students who were taught Machine Shop Practice utilizing structured and think-aloud pair problem-solving instructional methodologies are shown in Table 4. The exact Sig. 2-tailed value of 0.00 and the F-calculated value of 41.042 were achieved. The null hypothesis, which claimed that there is no significant difference between the retention means scores of students taught Machine Shop Practice using Structured and Think-Aloud Pair Problem-Solving instructional strategies, is rejected because the associated Sig. 2-tailed value of 0.00 is less than 0.05. This implied that the mean retention scores of students who were taught Machine Shop Practice utilizing structured and think-aloud pair problem-solving instructional styles differed significantly from one another (Sangsawang, 2020).

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According to research on the effects of structured and think-aloud pair problem-solving instructional strategies on students' interest in machine shop practice, students who received instruction using the latter strategy scored higher on mean interest measures than those who received instruction using the former. The result is consistent with research by Widuri *et al.* (2018) on the use of Thinking Aloud Pair Problem-Solving in Mathematical Learning, which showed a significant influence on students' interest. The results showed an intriguing fact: by adopting the Think-Aloud Pair Problem-Solving instructional technique, students' interest might be piqued (Alessio *et al.,* 2019). This implied that a Think-Aloud Pair Problem-Solving instructional technique can be used to pique students' interest in studying Machine Shop Practice.

Similar results were obtained when comparing the mean interest scores of students who were taught Machine Shop Practice utilizing structured and Think-Aloud Pair Problem-Solving instructional styles (Cimermanová, 2018). When compared to the Structured Problem-Solving instructional approach, the statistically significant difference demonstrates the tremendous extent to which the Think-Aloud Pair Problem-Solving instructional strategy promotes students' interest in Machine Shop Practice. The results are consistent with those of Winarti *et al.* (2019), who found a statistically significant difference between the interests of students who were taught trigonometry using Think-Aloud Pair and Traditional Problem-Solving instructional methodologies.

According to research on the effects of structured and think-aloud pair problem-solving instructional strategies on students' retention in machine shop practice, students who received instruction using structured problem-solving instructional strategies fared better than those who received instruction using think-aloud pair problem-solving instructional strategies in terms of mean retention scores. The results unmistakably demonstrated that the structured problem-solving teaching strategy outperforms the think-aloud pair problem-solving instructional strategy in terms of improving student retention in machine shop practice. The results are comparable to those of Treffers (2019), who examined the comparative effectiveness of two problem-solving instructional strategies on students' retention and found that the structured problem-solving instructional strategy is more efficient in enhancing student retention.

The characteristics of the Structured Problem-Solving teaching technique that require students to identify and define the problem as well as establish a strategy for solving the problem may be responsible for its success in enhancing student retention in Machine Shop Practice. These exercises may serve as the catalyst for the cognitive and retention processes that can improve students' retention (Chang *et al.,* 2019; Qablan *et al.,* 2019). This suggested that these characteristics might be to blame for the structured problem-solving instructional method's superior ability to increase students' memory of machine shop practice over the think-aloud pair problem-solving instructional strategy.

4. CONCLUSION

According to the study's findings, it has already been established how structured and think-aloud pair problem-solving instructional methodologies affect students' interest in and retention in machine shop practice in schools of education. According to the study, students who were taught machine shop practice using the structured problem-solving instructional strategy had higher mean retention scores than those who were taught the material using the think-aloud pair problem-solving instructional method.

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The following suggestions were offered in light of the study's findings:

(i) To improve students' skill performance and interest, Machine Shop Practice lecturers should employ the usage of Think-Aloud Pair Problem-Solving instructional strategies, as well as Structured Problem-Solving instructional strategies to improve students' recall.

(ii) To improve students' memory, skill performances, and interest levels, the National Council for Colleges of Education should inform and teach Machine Shop Practice lecturers about the use of structured and Think-Aloud Pair Problem-Solving instructional methodologies.

(iii) To increase student retention and pique their interest, Machine Shop Practice students should be exposed to learning through the use of structured and Think-Aloud Pair Problem-Solving instructional methodologies.

(iv) The National Commission for Colleges of Education should offer seminars and workshops on the use of structured and think-aloud pair problem-solving instructional strategies for lecturers of Machine Shop Practice.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

6. REFERENCES

Adams, N. E. (2017). Bloom's taxonomy of cognitive learning objectives. *Journal of the Med Library Association, 103*(3), 152-153.

Akiba, M., and Liang, G. (2016). Effect of teacher professional learning activities on students 'Achievement growth. *Journal of Educational Research, 21*(1), 1-12.

Alessio, F. A. D., Avolio, B. E., and Charles, V. (2019). Studying the impact of critical thinking on the academic performance of executive MBA students. *Thinking Skills and Creativity, 31*, 275–283.

Chang, H., Wang, N., Ko, W., Yu, Y., Lin, L., and Tsai, H. (2017). The effectiveness of clinical problem-based learning model of medico-jurisprudence education on general law knowledge for obstetrics/gynaecological interns. *Taiwanese Journal of Obstetrics and Gynaecology, 56*(3), 325–330.

Cimermanová, I. (2018). The effect of learning styles on academic achievement in different forms of teaching. *International Journal of Instruction, 11*(3), 219-232.

Coskun, I. and Eker, C. (2018). The effect of teaching activities done by using activity-based posters on students' academic achievement, and retention levels in their learning. *Universal Journal of Educational Research, 6*(4), 585-597.

Dos-Santos, L. M. (2019). Pre-service teachers' professional development through four-step problem-solving model: A seminar method. *International Journal of Education and Practice, 7*(3), 146-157.

Loes, C. N., Culver, K. C., and Trolian, T. L. (2018). How collaborative learning enhances students' openness to diversity. *Journal of Higher Education, 5*(2), 11- 13,

Malik, A. and Aswandi, A. (2019). The application of reciprocal teaching to improve business text reading comprehension of business administration students of Bengkalis State Polytechnic. *Inovish Journal, 4*(1), 2621-7295

Ogundola, I. P., Agboola, B. G., and Ogunmilade, O. J. (2020). Gender difference in achievement, interest, and retention of students exposed to fabrication and welding engineering craft practice through cognitive apprenticeship instructional technique in Nigeria. *Academic Journals, 15*(4), 194-202.

Pilato, B. and Ulrich, M. M. (2014). Is the case study method an effective pedagogical method for students to learn the fundamentals of financial accounting?. *Proceedings of ASBBS, 21*(1), 541-555.

Qablan, F., Şahin, M., and Hashim, H. (2019). Critical thinking in education: The case in Palestine. *Turquoise International Journal of Educational Research and Social Studies, 1*(1), 20-27.

Safitri, D., Irmawanty, Bachtiar, S., and Rukman, W. Y. (2018). Students' cognitive achievement, critical thinking skills, and metacognitive awareness in problem-based learning. *European Journal of Educational Studies, 5*(4), 248–258.

Sangsawang, T. (2020). An instructional design for online learning in vocational education according to a self-regulated learning framework for problem solving during the covid-19 crisis. *Indonesian Journal of Science and Technology, 5*(2), 283-198.

Schraw, G., Flowerday, T., and Lehman, S. (2011). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211–224.

Sidik, H., and Masek, A. (2021). The effects of problem-based learning in students reading comprehension for mastering the content and vocabulary acquisition. *ASEAN Journal of Science and Engineering Education, 1*(2), 87-92.

Sumantri, M. S., and Whardani, P. A. (2017). Relationship between motivation to achieve and professional competence in the performance of elementary school teachers. *International Education Studies, 10*(7), 118-125.

Tambunan, H. (2018). The dominant factor of teacher's role as a motivator of students' interest and motivation in mathematics achievement. *International Education Studies, 11*(4), 114-151.

Treffers, A. (2019). Direct instruction and problem-solving: Critical examination of cognitive load theory from the perspective of mathematics education. *The Mathematics Enthusiast, 16*(1), 607-620.

Widuri, S. Y. S., Almash, L., and Zuzano, F. (2018). Application of learning engineering techniques thinking aloud pair problem-solving in learning mathematics students' class VII SMPN 15 Padang. *Materials Science and Engineering, 335*(1), 1-9.

DOI:
p- ISSN 2828-3287 e- ISSN 2828-3295

Winarti, E. R., Haryanti, M. D., and Asih, T. S. N. (2019). Students' problem-solving ability in thinking aloud pair problem-solving learning assisted by schoology viewed from mathematical disposition*. UNNES Journal of Mathematics Education, 8*(1), 14-18.

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