A QUASI EXPERIMENTAL STUDY ON CREATIVITY OF MECHANICAL ENGINEERING CRAFT PRACTICE STUDENTS IN NIGERIAN TECHNICAL COLLEGES

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Abstract

This quasi-experimental study on creativity of Mechanical Engineering Craft Practice Students in Nigerian Technical Colleges was guided by three research questions and three null hypotheses. All the Technical Colleges in Ogun State were the population for the study. Two instruments tagged Problem Solving Instructional Guide (PSIG) and Mechanical Practical Test (MPT) were the instruments used for the study. PSIG consisted instructional plan stating the roles of participants (Teachers and Students), while MPT is a standardized test which has 2 practical questions of 6 hours. The instruments were validated by three experts and subjected for reliability test. The reliability coefficient of the MPT was found to be 0.87 using test re-test and Pearson Product Moment Correlation Coefficients. Descriptive and inferential statistics were used for data analysis. The result of this study indicated a significant difference between the pre-test and post-test mean scores of students taught with Problem Solving Method for hypothesis 1, no significant difference between the pre-test and post-test achievement scores of students taught with Lecture Method for hypothesis 2 and a significant difference between the post-test mean scores of students taught with Problem Solving Method and post-test mean scores of students taught with Lecture Method for hypothesis 3. Based on these findings, the study recommended the adoption of Problem Solving Method to improve students' creativity in Technical Colleges.

Keywords: Creativity, Teaching; Teaching Method; Technical College; Problem Solving Method; Lecture Method.

1. INTRODUCTION

Skill acquisition and creativity development are important component of a functional educational system in any part of world. While skill acquisition according to Joseph (2020) remains the most viable and sustainable solution to rising unemployment in Nigeria,creativity on the other hand according to Oke (2019) is highly required for sustainability in every facet of life. Harris and Staley (2011) viewed creativity in three perspectives. That is, as an ability**,** attitude and a process. From ability perspective, creativity refers to the capability to imagine and event something new. In this case, a creative individual has the potential power to visualize or think abstractly and then produce an object (Oke, 2016).

As an attitude, creativity builds up individuals in a way to accept changes. It can also empower them with readiness to play with ideas. Which means a creative person will not only be flexible, he will also look for every possibility of improving on new ideas. Li, Li, Huang, Kong, Yang, Wei, Cheng, Zhang, Qiu, and Liu (2014) noted that creativity is very crucial to the growth of human civilization as it has led to some scientific discoveries. Creativity involves the generation of new ideas or the recombination of known elements into something new, providing valuable solutions to a problem (Oke & Olakotan, 2017). Oke (2019) also noted that through creative thinking, something more than ordinary or which often leads to decision making is taking place. Oke (2019) noted that every nation that is conscious of its economic growth should include creative thinking skills in all aspects of her educational curricula especially at the Technical College level.

Technical colleges according to Olakotan (2021) are post-basic education institutions where students are exposed to skill-based programmes targeted towards acquiring relevant knowledge and skills in different trades for self-reliance, and employment in the world of work. Oke and Olakotan (2020) averred that technical colleges constitute a vital aspect of the Nigerian education system as the goal of their establishment dwelt on the production of competent manpower for the nation.

Preparation of MECP students in Technical Colleges for all-round skills development and creativity requires appropriate instructional strategies and teaching methods. Teaching methods refer to principles and methods used for instruction to achieve the desired learning in students as implemented by teachers. Teaching methods refer to ways adopted by the teacher to communicate effectively and impact skills to the students in a bid to enhance effective teaching and learning (Olakotan, 2021; Adeosun & Oluwagbohunmi, 2010). Duruji, Azu, Segun, Olanrewaju and Okorie (2014) postulated that teaching is the art of unleashing the potentials that are inherent in the recipient, so as to draw out knowledge from the student and the ability to do this involves making a choice of the most appropriate pedagogical strategy that would ensure optimal students' achievement.

Many studies have identified the teaching problem principally on the teachers' method of teaching, as the major factor contributing to poor academic achievement. The Federal Government of Nigeria (FGN, 2014) observed that no educational system can rise above the quality of its teachers; therefore, the quality of education at any level depends largely on the quality of its teachers and his use of appropriate methods and strategies. Additionally, Oke and Olakotan (2017a) noted that a sound educational system is accepted the world over as the bedrock of human development, thus teachers are the instruments for implementing this

development. Teachers are the prime mover of any worthwhile educational system and their impact in the attainment of Vocational and Technical Education objectives cannot be over-emphasized (Oke & Olakotan, 2017a). A teacher in the view of Oyebolu, Olakotan and Oshin (2016) is saddled with the responsibility of communicating knowledge, and skills and attitude to students in a school. While a Vocational and Technical Education (VTE) teacher teacher according to Oke and Olakotan (2017b) is pedagogically trained personnel who possess the wherewithal to communicate and pass effective instructions to students for all-round development in VTE at any level of the nation's educational system. Oke and Olakotan further noted that if a teacher is saddled with the responsibility of communicating knowledge, and skills and attitude to students in a school, it is of paramount importance that they have what it takes to effect this important task and as such having what it takes require novelty in their method of teaching with the use of modern innovative teaching approaches in line with latest development in global practices. This is necessary to improve the teaching and learning of both the theoretical content and practical content of Mechanical Engineering Craft Practice (MECP).

Mechanical Engineering Craft Practice provides all her recipients practical proficiency in fitting, turning and machining to the level of good craftsman to fulfill the needs of the modern industry which is tailored towards growth (Olakotan & Hamzat, 2020; Ogunmbe, 2015; Atsumbe, Okoro and Ogwo, 2012).

The traditional teaching method which is used for teaching MECP students is a combination of lecture method, demonstration method and discussion method. The lecture method is a teaching method which involves one way channel of communication. The teacher makes an oral presentation of information to which students' role may be relatively passive. The students are not put into the learning situation from where they may make contributions in the learning process to the extent that they would critically think about the solution or solve a problem. Gurpreet (2011) noted that lecture method just like any other method is inappropriate as all-purpose method, despite serving useful instructional functions. According to Norouzi, Mohsenizadeh, Jafary, and Ebrahimzadeh (2011) lecture method is laden with several issues such as inactiveness of the students, tiring long lectures, one-way communication, and fast forgetting of major points in the lesson. Similarly, Safari, Yazdanpanah, Ghafarian and Yazdanpanah cited in Sadeghi, Sedaghat, Sha (2014) were of the view that about 80% of presented trainings are forgotten within 8 weeks when lecture method is adopted. This in its entirety is contrary to the goals of Technical College where skill acquisition and self-reliance are its prime focus. From the foregoing, one would advance that lecture method does not foster critical thinking, creative thinking and problem solving.

One of the best practices in the world over as related to acquisition of skills is allowing students to acquire hands-on experience while still in the training institution. This hands-on experience can only be achieved if students are exposed to practical activities and guided appropriately (Lemo & Olakotan, 2016a). Guiding students appropriately to achieve the desired goals of VTE programmes could be centred on adopting appropriate instructional methods to disseminate knowledge and marshal cogent points to improve students' acquisition of skills and creativity.

In ensuring that students' acquisition of skills and creativity are improved, problem solving method of instruction comes to mind. Problem solving method increase students' ability to solve real-life problems and encourages active learning with emphasis on students participating in the teaching and learning process (Dagnew & Dagnew, 2020; Ridong, Su &

Chich-Jen, 2017; Nasrin, Mumtaz & Muhammad, 2015). There is no doubt that the use of appropriate strategies help in improving students performance and creativity. These are the positions of Gambari, Yusuf and Balogun (2018); Lemo and Olakotan (2016a, 2016b) and Okebukola (2014). Owing to the above fact, enabling environment that encourage creativity and enable students engagement in tasks that increase their skills must be ensured (Lemo & Olakotan, 2018; Amabile, 2012)

The place of the method of teaching adopted by the teacher in the actualization of school goals with reference to skill acquisition and creativity in the field of Vocational and Technical Education cannot be overemphasized. There have been evidences supported by literatures that teaching methods adopted by teachers have to a greater extent significant impact on students' performance. Hence, one would not be categorical that a particular method of teaching is best suited for all situations and all fields. This forms the basis while two teaching methods (Problem Solving and Lecture Methods) were considered in this study for creativity of MECP students in Nigerian Technical Colleges. The essence of this consideration is to ascertain which of the two chosen teaching methods has effect on MECP students' creativity.

1.1 Purpose of the Study

The purpose of this study was to determine the effects of Problem solving method and Lecture method on creativity of Mechanical Engineering Craft Practice students in Nigerian Technical Colleges. Specifically, the study determined:

1. The difference in the pre-test and posttest mean score of students taught with Problem solving method?
2. The difference in the pre-test and posttest mean score of students taught with lecture method?
3. The difference in the posttest mean score of students taught with Problem Solving method and posttest mean score of students taught with lecture method?

1.2.Research Questions

The following research questions guided the study:

1. What is the difference in the pre-test and posttest mean score of students taught with Problem solving?
2. What is the difference in the pre-test and posttest mean score of students taught with lecture method?
3. What is the difference in the posttest mean score of students taught with Problem Solving method and posttest mean score of students taught with lecture method?

1.3.Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

1. There is no significant difference between the pre-test and posttest mean score of students taught with problem solving method
2. There is no significant difference between the pre-test and posttest mean score of students taught with lecture method

3. There is no significant difference between the posttest mean score of students taught with problem solving method and posttest mean score of students taught with lecture method

2. METHODOLOGY

The study employed quasi-experimental design. Specifically, the pretest, posttest, non-equivalent control group design was adopted for this study. According to Gall, Gall and Borg (2007), quasi–experimental design can be used when it is not possible for the researcher to randomly sample the subject and assign them to treatment groups without disrupting the academic programmes of the schools involved in the study.

Group	**Pretest**	**Treatment**	**Posttest**
Experimental	0_1	X	0_2
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Control	0_1	-X	0_2

Where 0_1 = Pretest for both control and experimental group
0_2 = Posttest for both control and experimental group
X = Treatment given to the experimental group (Problem Solving Method)
-X = No treatment given to the control group (Lecture Method)
----- = Non-randomization

The population for the study consists all the Technical Colleges in Ogun State. There are seven Technical Colleges in Ogun State.

Purposive sampling technique was adopted and used to select two Technical Colleges offering Mechanical Engineering Craft Practice. However, the selected Technical Colleges were randomly assigned to control and experimental groups in their respective intact classes. In all, 74 MECP students were the participants for the study.

Two instruments tagged Problem Solving Instructional Guide (PSIG) and Mechanical Practical Test (MPT) were the instruments used for the study. PSIG consisted instructional plan stating the roles of participants (Teachers and Students), while MPT is a standardized test which contains two practical questions of 6 hours. The instruments were validated by three experts and subjected to reliability test. The reliability coefficient of the MPT was found to be 0.87 using test re-test and Pearson Product Moment Correlation Coefficients. MPT is a standardized test which has 2 practical questions of 6 hours. The practical were taught using problem solving for the experimental group while lecture method was used for the control group.

The Two groups (experimental & Control) were subjected to a Pre-test and Post-test. Experimental conditions such as experimental bias and teachers' variability were controlled as regular MECP teachers in Technical Colleges taught the students while the researcher prepared all teaching instruments and trained the participating teachers as well.

The data collected from the administration of Pre-Test and Post-Test were analyzed using Mean (x) and standard deviation for the research questions. The decision rule in answering the research questions was based on the Mean gain score. If the Mean gain score of the Experimental Group is greater than the Mean gain score of the Control Group, it Meant that the treatment had an effect. The hypotheses formulated for the study was tested at 0.05 level of significance using t-test and Analysis of Covariance (ANCOVA). Hypotheses 1 and 2 were tested using t-test, while hypothesis 3 was tested using ANCOVA. ANCOVA tool was appropriate because it controlled the initial differences across groups and also increased the precision, thus reducing error variance that might be due to the extraneous variables. For the hypothesis, if the probability value (p), for the group obtained after data analysis was less than or equal to the 0.05 alpha value at which it

was being tested, the null hypothesis was rejected, which Meant that there was a significant effect of the treatment.

3. RESULTS AND DISCUSSION

The results were analyzed and presented based on the raised research questions and formulated hypotheses.

Research Question 1

What is the difference in the pre-test and posttest mean score of students taught with Problem Solving method?

Hypothesis 1

There is no significant difference between the pre-test and post test mean score of students taught with Problem Solving method

Table 1: Independent Sample t-test of Difference between Pre-Test and Post-Test Mean Score of the Experimental Group

Group	N	Mean	Std. Dev.	Mean Diff.	df	t-value	p-value (Sig. 2-tailed)
Pre-Test		28.92	10.85				
	43			21.01	42	32.714	.000
Post-Test		49.93	8.65				

$\alpha = .05$, $p < .05$ = Significant, N=43

The data presented in Table 1 indicated a significant difference between the pre-test and post-test experimental group taught with problem solving method, in favour of the post test. The t-value is significant, when the p-value and the alpha level are compared. The p-value is less than the alpha (.000< .05), therefore, the Null Hypothesis is rejected in favour of the Alternate Hypothesis. This implies that, there is statistical evidence to support the fact that, participants in the Experimental Groups are different in the Mean score in favour of the Post-Test score (49.93>28.92). Hence the observed difference seen cannot be attributed to chance.

Research Question 2

What is the difference in the pre-test and posttest mean score of students taught with lecture method?

Hypothesis 2

There is no significant difference between the pre-test and post test mean score of students taught with lecture method

Table 2: **Independent Sample t-test of Difference in Pre-Test and Post test Mean Score for the Control Group**

Group	N	Mean	Std. Dev.	df	t-value	p-value (Sig. 2-tailed)
Pretest	31	28.91	10.85			
				30	.440	.660
Posttest		28.31	9.12			

$\alpha = .05$, $p > 05$ Not Significant

The data presented in Table 2 indicated no significant difference between the pre-test and post-test control group taught with lecture method. The t-value is not significant, when the p-value and the alpha level are compared. The p-value is greater than the alpha (.660 > .05, therefore, the null hypothesis is retained. This implies that, there is no statistical evidence that the control group's Mean score at both pretest and posttest level are different. Therefore, the hypothesis of no significant difference was upheld.

Research Question 3

What is the difference between the posttest mean score of students taught with Problem Solving Method and posttest mean score of students taught with lecture method?

Hypothesis 3

There is no significant difference between the posttest mean score of students taught with Problem Solving Method and posttest mean score of students taught with lecture method

Table 3: One –Way Analysis of Covariance of Post-Test Mean Score for Experimental and Control Group

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	27203.146[a]	2	136001.574	96.994	.000
Intercept	108744.976	1	108744.976	775.529	.000
Pretest	11983.633	1	11983.633	86.473	.000
Groups	16068.882	1	16068.882	114.593	.000
Error	25943.774	71	140.221		
Total	468057.000	74			
Corrected Total	53141.917	73			

The data presented in Table 3 indicated a significant difference between the post-test experimental group taught with problem solving method and post-test control group taught with lecture method, in favour of the post-test experimental group taught with problem solving method. The F-value value of 114.593 for the group is significant, when comparison is done between the p-value and alpha. The p-value is less than alpha level ($p<0.05$). Therefore, the hypothesis of no significant difference was rejected.

4. DISCUSSION OF FINDINGS

Tables 1, 2 and 3 showed the descriptive and inferential statistics of the study. The mean scores are descriptive or representative scores of the group or variables they represent while the t-test and ANCOVA provided premise for making inference or deductions on their relevant tested hypotheses.

Table 1 showed a significant difference between the pretest and posttest mean score of students taught with problem solving method. This revealed the positive effects of different treatments given to the experimental group on the students mean score in the post-test. Although no treatment was given to the pre-test group before the test while treatment was given before the test in the case of the posttest. Table 2 showed no significant difference between the pretest and posttest mean score of students taught with lecture method. This forms the basis while the hypothesis of no significant difference was upheld. This is also due to the fact that no treatment was given at both pre-test and post-test stages before the test were taken. Table 3 showed a significant difference between the post-test mean score of students taught with problem solving and the post-test mean score of students taught with lecture method, in favour of problem solving method, giving basis for rejecting the null hypothesis of no significant difference earlier formulated.

The findings of this study as revealed in the data analysis were supported by Dagnew and Dagnew (2020) Ridong, Su and Chich-Jen (2017) Nasrin, Mumtaz and Muhammad (2015) with propositions that problem solving method increase students‘ ability to solve real-life problems and encourages active learning and thus enable students to participate actively in the teaching and learning process. The findings of the study were further corroborated by Gambari, Yusuf and Balogun (2018); Lemo and Olakotan (2016a, 2016b) and Okebukola (2014) noting that the use of appropriate strategies help in improving students performance and creativity.

Similarly, the positions of Lemo and Olakotan (2018); Amabile (2012) as entrenched in the study corroborated the findings of the study. The scholars were also of the view that enabling environment as such provided by the problem solving method encourage creativity and enable students engagement in tasks that increase their skills in the teaching and learning processes.

Furthermore, Gurpreet (2011) noted that lecture method just like any other method is inappropriate as all-purpose method, despite serving useful instructional functions. In relation to the position of Gurpreet (2011), Norouzi, Mohsenizadeh, Jafary, and Ebrahimzadeh (2011)

posited that lecture method is laden with several issues such as inactiveness of the students, tiring long lectures, one-way communication, and fast forgetting of major points in the lesson and as such could not find a place practical class situations. In the same vein, Safari, Yazdanpanah, Ghafarian and Yazdanpanah cited in Sadeghi, Sedaghat, Sha (2014) were of the view that about 80% of presented trainings are forgotten within 8 weeks when lecture method is adopted.

From the foregoing, there is statistical evidence to support the fact that participants in the Experimental Groups are different in the mean score in favour of the treatment given. Hence, the problem solving method enhances creativity of MECP students.

5. CONCLUSION

An insight has been provided in this study on the effects of Problem solving method and Lecture method on creativity of MECP students in the nation's technical colleges. The findings of the study have implications for educational practices as students taught using problem solving method posed high level of creativity than those taught using lecture method. This means that the use of the problem solving method improves students' creativity as against the use of lecture method. It is then hoped that the adoption of problem solving method would encourage students' participation in the teaching and learning processes and thus improve their creativity. Therefore, it is recommended that the adoption of Problem Solving Method by Technical College teachers would go a long way in improving students' creativity in technical colleges.

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