

# Impact of Improvised Injection Moulding on Students' Psychomotor Achievement In General Metalwork In Technical Colleges In Niger State

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**Abstract:** This study was designed to determine the impact of improvised injection molding on students' psychomotor achievement in general metalwork in technical colleges in Niger State. A pre-test, post-test, non-equivalent control group, quasi-experimental research design was adopted. The study constituted a total number of 122 subjects, 63 for the experimental group, while 59 for the control group. The instruments used for data collection was Metalwork Psychomotor Achievement Test (MPAT). The instruments were also subjected to face validation by three experts from Department of Industrial and Technology Education, Federal University of Technology Minna. The MPAT was trial-tested to determine its psychometric indices and reliability coefficient. The trial test for determining the coefficient of stability of the MPAT was carried out using test re-test reliability method. Pearson product moment correlation coefficient of WCAT was found to be .78. Mean was used to answer the research questions; while ANCOVA was employed to test the hypotheses. The study revealed that students taught metalwork using improvised injection molding had a higher mean score than students taught using the lecture method in psychomotor achievement test. In each mean score of males taught metalwork using improvised injection molding was higher than the mean score of females taught using the same improvised injection molding in the psychomotor achievement test. The differences in the mean scores of male and female in the psychomotor achievement test was found to be insignificant. Consequently, the research recommended among others that; Teachers should endeavour to make use of improvised injection molding for teaching relevant area in the curriculum technical colleges with a view to ascertain its usefulness and The private enterprises as such based industries should make available to technical colleges in Niger State spare parts as well as consumable materials needed for teaching Foundry.

**Keywords:** improvised injection molding, psychomotor achievement, metalwork, technical colleges

## I. INTRODUCTION

In Nigeria, technical colleges are the vocational schools saddled with the responsibility of giving vocational training to equip trainees with knowledge as well as skills needed for effective performance in the world of work. Technical colleges provide technical education that leads to the acquiring of technical knowledge as well as vocational skills or competencies which makes individual to be efficient in performing specific tasks in chosen occupations. This type of

education is practical based and leads to advancement in technology and in the pattern of handling technical tasks in specific occupations. Technical education is practical based and leads to advancement in technology and in the pattern of handling technical tasks in specific occupational area. (Uwaifo, 2009).

Technical colleges offered courses in various trades such as block laying, bricks laying and concreting, motor vehicle mechanics (MVM), radio and television, electrical electronics, carpentry and joinery and welding and fabrication among others. General Metalwork as a course is been offered among Engineering trades such as MVM, welding and fabrication craft practiced, mechanical engineering craft practice. Ideally, General Metalwork should be taught using the same equipment the practitioners are using in the field, because teaching General Metalwork involves the study of industrial technology. It therefore requires industrial facilities that include machinery or simulated industrial setting known as workshop. General Metalwork (GMW) consists of topics and sub-topics relevant to these trades such as: heat treatment, soldering, foundry and forging. These aspects of the courses can be successfully delivered using a furnace as an instructional method.

Metal injection moulding (MIM) is a metalworking technology for cost-effectively producing small, complex, precision metal parts in high run volumes. An overview is given of both the process and the industry. The process steps will be reviewed and, where appropriate, compared with the conventional powder metallurgy. The overview includes a review of selected design parameters and their limits of applicability, the relative economics of the process, and the competitive position of MIM in relation to other metalworking technologies (Merher, 2010). The molding process allows high volume, complex parts to be shaped in a single step. After molding, the part undergoes conditioning operations to remove the binder (debinding) and densify the powders. Finished products are small components used in many industries and applications.

Studies conducted by several authors such as: Ogundu (2015), Onaga (2014), Mbata (2010) revealed that in most technical

colleges particularly in Niger state this important teaching aids has not been available for instruction. Therefore, teaching heat treatment, soldering, foundry and forging in a workshop without functional furnace is a challenge to the instructor. The ability of the instructor or teacher to effectively teach these skill-based concepts will to a large extent depends on his/her ability to improvise the workshop tools and equipment required. An example of such improvisation by the teacher is the improvised furnace. The use of this improvised furnace may lead to improved psychomotor achievement of students in General Metalwork.

The utilization of teaching aid by instructor could possibly influence the learners' psychomotor achievement in terms of scoring high in examinations as well as in practical skill acquisition. Ndukwe (2016) unveiled that after a prescribed duration of learning in technical schools, learners write the National Business and Technical Examination Board (NABTEB) examinations. National Business and Technical Examination Board (NABTEB, 2017) external examiners report revealed that there is a decrease in learners' achievement in General Metalwork. The report showed that students' achievement in General Metalwork in schools have been fluctuating recently in education, poor performance called for urgent scrutiny with the view to ascertain the real courses of problems. Federal Ministry of Education (FME), (2017) reiterated that technical colleges are designed to train and provide craftsmen in various trade areas. For over ten years, technical colleges have experienced more than 65 percent failure rates in NABTEB examinations. Similarly, NABTEB (2017) Chief examiners report revealed that the General Metalwork trainees who wrote the examination failed to attain the pass mark and thus failed the examination.

Furthermore, NABTEB examination conducted on General Metalwork in May/June, 2017 recorded 30 per cent failure in questions on sheet metal practice, 60 per cent failure in forging and 65 per cent failure in foundry (NABTEB, 2017) The National Business and Technical Education Board (NABTEB, 2017) grade distribution from 2016-2017 May/June result revealed failure of 46 per cent for the students who sat for the examination in General Metalwork. The results also revealed unsatisfactory achievement of the students in questions bordering on heat treatment and soldering with failure rate of 42.5 and 45.5 per cent respectively. This is an indication of overall achievement, retention and interest of candidates achieving below average during the examinations. It has been observed by NABTEB (2017) that the persistent poor achievement emanates mainly from the inappropriate teaching methods and instructional methods adopted by technical teachers. Moreover, NABTEB (2017) added that only 2 percent of the total students that were enrolled for the examination in General Metalwork attempted question on use of furnaces and that the results they performed poorly.

Psychomotor achievement simply relates to students' achievement in practical tasks. Therefore in this study,

psychomotor achievement refers to achievement of students in Metalwork practical task which is usually represented by a score or mark obtained in a performance test. Okoro (2011) explained that performance test involves the use of tools and equipment in a direct assessment of the amount of practical skills possessed by the student. According to Atherton (2013) student's cognitive and psychomotor achievement is influenced by several factors among which are the instructional method and the learner's ability. However, it is also observed that students' cognitive and psychomotor achievement may also be influenced by gender of the student.

Gender refers to the characteristics, whether biological or socially influenced, by which people define male and female (Myers, 2012). Gender may also be explained as the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women. Disparities according to Okoro (2011) usually exist in the levels of performance between males and females. Hence, this study seeks to investigate the impact of improvised furnace on students' psychomotor achievement in General Metalwork in Technical Colleges in Niger State.

#### *Statement of Problem*

In technical education, students are expected to be taught the theory and practical aspect to make them employable in commerce and industry or any type of enterprises that requires the use of tools and machinery for the operation, production, preservation and distribution of goods and services (Joshua, 2012). For effective teaching, instructional methods are to be made available for learning of the students where necessary. But lack of functional furnace may have contributed to the students' poor exposure to practical classes which is a major problem in Niger State Technical colleges. There is lack of functional furnace in Niger State Technical Colleges. Even where furnaces are available, the high voltage electricity needed to power it is not reliable. Lack of functional furnace has possibly led to poor psychomotor achievement of the students in external examination such as National Business and Technical Examination. Candidates performed poorly because, according to the report from NABTEB Exam Ethics project (2017), students were unable to attempt questions on blacksmith shop equipment and other equipment for General Metalwork which contributed to poor achievement of students in General Metalwork. It therefore become necessary to find out what effect improvised injection molding will have on students' achievement in General Metalwork in Technical Colleges in Niger state, Nigeria.

#### *Purpose of the Study*

1. Impact of improvised injection molding on students' psychomotor achievement in general metalwork.
2. Influence of gender (male and female) on students' psychomotor achievement in general metalwork.

### Research Questions

1. What is the improvised injection molding on students' psychomotor achievement in general metalwork?
2. What is the influence of gender (male and female) on students' psychomotor achievement in general metalwork?

### Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance:

*HO<sub>7</sub>*: There is no significant difference in the mean improvised injection molding on students' psychomotor achievement in general metalwork.

*HO<sub>8</sub>*: There is no significant difference between the mean of gender on general metalwork psychomotor achievement of students (male and female).

*HO<sub>9</sub>*: There is no significant mean interaction effect of treatment given to students taught using improvised injection molding and their gender (male and female) with respect to their mean scores in general metalwork psychomotor achievement.

### III. METHODOLOGY

This study adopts a quasi-experimental design. Specifically, the pretest, posttest design was employed for the study. The study involved the use of intact classes where the researcher randomly assign subjects to the treatment or control group completely (Becker and Maunsaiyat, 2004). The use of intact classes in a quasi-experimental design is supported by Aremu (2013) who stated that learners in a secondary school class in most cases, form natural clusters having similar age, height and other attributes. The study was conducted in Niger state because the state is one of the states where students' poor performance in metalwork was reported by National Board for Technical Education (NBTE) 2016- 2019. The population for this study consists of all 122 second year students of metalwork in the four technical colleges offering metalwork technology in Niger State. Simple random sampling technique (balloting) was used to assign two schools to experimental group and two schools to control group. Two intact classes of year II students each to the two treatment groups. Each intact class comprises of male and female students, the entire population of 122 was used for the study.

The instruments used for data collection for this study was metalwork psychomotor achievement test (MPAT). The MPAT was developed by the researcher based on NBTE NTC II metalwork trade curriculum and course specifications. Both content and face validation were carried on MPAT. The instrument was validated by three experts from the department of industrial and technology education, federal university of technology, Minna, Nigeria. The MPAT was trial-tested on 40 NTCII students in Government Technical College, Patigi, Kwara State using test retest reliability technique. GTC, Patigi was used because it did not form part of the study institutions

but uses the same entry requirement as the study groups. The reliability of the MPAT was determined using Pearson Product Moment Correlation Coefficient and was found to be .78. The researchers will the help of three research assistant administered the instrument to the students.

The data collected from the pre-test, post-test, were analyzed using mean to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

### IV. RESULTS

#### Research Question 1

What is the improvised injection molding on students' psychomotor achievement in general metalwork?

Table 1: Mean and standard deviation of pretest and posttest scores of experimental group and control group in psychomotor achievement test for achievement test

Group	N	Pretest scores $\bar{x}$	SD	Posttest scores $\bar{x}$	Mean gain $\bar{x}$
Experimental	63	17.66	10.08	65.87	48.21
Control	59	21.35	9.81	66.01	44.66

Table 1 shows that experimental group had a Mean score of 17.66 and Standard Deviation of 10.08 in the pre-test and a Mean score of 65.87 and Standard deviation of 13.51 in the post-test making a pre-test, post-test Mean gain of 48.21. Control had a Mean score of 21.35 and Standard Deviation of 9.81 in the pre-test and a post-test Mean of 66.01 and Standard Deviation of 13.31 with a pre-test, post-test Mean gain of 44.66. With these results, both experimental and control group are effective in improving students psychomotor achievement in metalwork but the effect of experimental group in improving students' psychomotor achievement in metalwork is higher than the effect of control group.

#### Research Question 2

What is the influence of gender (male and female) on students' psychomotor achievement in general metalwork?

Table 2: Mean and Standard Deviation of Pretest and Posttest Gender Psychomotor achievement Scores of students taught using improvised injection molding and lecture method

Group	Gender	N	Pretest $\bar{x}$	SD	Posttest $\bar{x}$	SD	Mean gain $\bar{x}$
Experimental	M	50	16.33	9.29	64.80	13.60	48.47
	F	13	18.45	12.85	68.41	12.69	49.96
Control	M	46	22.91	8.74	64.89	13.37	41.98
	F	13	20.16	12.93	70.41	12.69	50.25

The data in table 2 shows that male students taught metalwork with improvised injection molding had a Mean score of 16.33

and Standard Deviation of 9.29 in the pre- test and a Mean score of 64.80 and Standard Deviation of 13.60 in the post-test making a pre-test, post-test mean gain in the male students of 48.47. Female students taught metalwork with improvised injection molding had a mean score of 18.45 and Standard deviation of 12.85 in the pre-test and a post-test Mean of 68.41 and standard deviation of 12.69, with a pre-test, post-test mean gain of 49.96. Also, male students taught with lecture method had a Mean score of 22.91 and Standard Deviation of 38.47 in the pre-test and a Mean score of 64.89 and Standard Deviation of 13.39 in the post-test making a pre-test, post-test Mean gain in the male students of 41.98. At the same time, female students taught metalwork with lecture method had a mean score of 20.16 and Standard Deviation of 12.93 in the pre-test and a Mean score of 70.41 and Standard Deviation of 12.69 in the post-test making a pre-test, post-test Mean gain in the female students of 50.25. With these results female students taught metalwork with improvised injection moulding and lecture method had higher posttest mean scores than male students in the psychomotor achievement test. Therefore, there is an effect attributed to gender on students' psychomotor achievement in metalwork

*Hypotheses testing*

*HO<sub>1</sub>*: There is no significant difference in the mean improvised injection molding on students' psychomotor achievement in general metalwork.

*HO<sub>2</sub>*: There is no significant difference between the mean of gender on general metalwork psychomotor achievement of students (male and female).

*HO<sub>3</sub>*: There is no significant mean interaction effect of treatment given to students taught using improvised injection molding and their gender (male and female) with respect to their mean scores in general metalwork psychomotor achievement.

Table 3: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Impact of Treatment (improvised injection molding and lecture method), their Gender and Interaction Effect with Respect to their Mean Scores on metalwork Psychomotor Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8067.097 <sup>a</sup>	17	474.535	17.619	.000
Intercept	195187.985	1	195187.985	7246.973	.000
METHOD	5593.886	9	621.543	23.077	.000
GENDER	13.708	1	13.708	.509	.017
GENDER * METHOD	337.642	7	48.235	1.791	.097
Error	2801.108	104	26.934		
Total	373893.000	122			
Corrected Total	10868.205	121			

a. R Squared = .742 (Adjusted R Squared = .700)

\*Significant at sig of F < .05

Table 3 shows F-calculated values for three effects: treatment (improvised injection molding and lecture method), gender and interaction of treatment and gender on students' psychomotor achievement in metalwork. The F-calculated value for treatment is 23.079 with a significance of F at .000 which is less than .05. Hence, the null hypothesis of no significant difference between the effect of treatments (improvised injection molding and lecture method) on students' psychomotor achievement in metalwork is therefore, not accepted at .05 level of significance. This means that there was significant mean difference between the impact of improvised injection molding approach and lecture method on students' psychomotor achievement in metalwork. The F-calculated value for gender is .509 with a significance of F at .017. Since the F-calculated value is less than the Significant F-value, the null hypothesis is, therefore, rejected at .05 level of significance. This result means that there was significant effect of gender in favour of females on students' psychomotor achievement in metalwork. The interaction effect of treatment and gender has F-calculated value of 1.791 with significance of F of .097 which is higher than .05. Therefore, the null hypothesis of no significant interaction effect of treatments given to students taught with improvised injection molding and lecture method and their gender with respect to their mean scores on metalwork psychomotor achievement test is accepted at .05 level of significance.

This, therefore, means that there is no significant interaction effect of treatments given to taught with improvised injection molding and lecture methods and their gender with respect to their mean scores on metalwork psychomotor achievement test.

V. DISCUSSION

The data presented in Table 1 provided answer to research question one. It was revealed that improvised injection molding model is effective in improving students' psychomotor achievement in metalwork, but the impact of improvised injection molding in improving students' psychomotor achievement in metalwork is higher than lecture method. The result indicates that improvised injection molding is more effective in improving students' psychomotor achievement in metalwork. However, analysis of covariance was used to test the seventh hypothesis (Table 3) at the calculated F- value (23.077), significance of F (.000) and confidence level of .05. It was revealed that the mean difference between the effect of improvised injection molding and lecture method on students' psychomotor achievement in metalwork was not statistically significant. Hence, the null hypothesis of no significant mean difference was not accepted. The result means that there was significant mean difference between the impact of improvised injection molding and lecture method on students' psychomotor achievement in metalwork.

The result of this study regarding students' psychomotor achievement could be explained by the fact that teachers' adoption of authentic instructional technique in learning

group, where visual aids (e.g. metalwork were not only used to address students' visual-spatial intelligence but also used in development of reasoning strategies and development of effective self-directed learning strategies) engaged the students in higher order thinking tasks such as analysis synthesis and evaluation. This improved the students learning abilities in metalwork. Burriss (2014) noted that authentic instruction fosters higher order thinking skills in students. He explained that higher order thinking requires students to manipulate ideas in ways that transform their meaning and applications. The manipulation of information and ideas allows students to discover solution to problems (Afolabi and Akinbobola 2012). It implies that students in this group could have problem with learning skills etc. In addition, practical activities in improvised injection molding, aimed at addressing and developing students' skills, consequently, improved students' technological understanding by applying theoretical principles to real life situations. This, therefore, also enhanced their manipulative skills and mastery of problem solving strategies which led to their considerable psychomotor achievement.

The data presented in Table 2 provided answer to research question two. Findings revealed that mean score of female was higher than the mean score of male in psychomotor achievement test. The finding was in contrary to the study of Owoso (2010) in which the male students outperformed the female students in Automobile technology.

Research has shown that, on general measures of intelligence, the sexes perform about equally the same. Also, Udofia (2008) emphasized that there are more similarities than differences between the learning abilities of males and females. Similarly, Eze (2009) maintained that there are no genetically based differences between male and female students in their ability to learn. Therefore, it is unlikely that gender differences in academic achievement is explained by biological differences, if biology were the reason, girls would not have improved significantly in certain subjects (such as math and science) where boys used to outperform girls traditionally, in the past two decades. However, findings of the present study with regards to gender achievement in metalwork confirm the findings of Iwendi & Oyedum (2012) and Oviawe (2010) who, in their separate studies in other vocational subjects, found out that male and female students have no significant difference in psychomotor achievement.

## VI. CONCLUSION

From the results that emanated from the findings of the study, it can be deduced that the improvised injection molding enhances psychomotor achievement of students compared to traditional instructional methods. The finding revealed that students develop more interest towards General Metalwork as a result of the used or improvised injection molding. This study has strong implication for teaching and learning processes in Nigeria technical colleges as made evident in the findings of the study

## VII. RECOMMENDATIONS

From the findings that emanated from the study, the under listed recommendations emerged:

1. Teachers should endeavour to make use of improvised injection molding for teaching relevant area in the curriculum technical colleges with a view to ascertain its usefulness.
2. School management should make fund available for the purchase of the necessary materials needed for production of improvised injection molding as instructional methods.
3. The private enterprises as such based industries should make available to technical colleges in Niger State spare parts as well as consumable materials needed for teaching Foundry.

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