**EFFECT OF META-COGNITIVE INSTRUCTIONAL STRATEGIES ON ACADEMIC ACHIEVEMENT IN WOODWORK TECHNOLOGY**

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**ABSTRACT**

The study investigated the impact of Meta-cognitive instructional strategy on technical school students’ Woodwork Technology achievement and interest in Minna, Niger State. The population of the study comprised all the technical school students in Minna, Niger State. A sample of one hundred and Nineteen (119) SS11 students from two public coeducation schools and two intact classes randomly selected for the study. The design for this study was quasi-experimental using non-randomized, non-equivalent pre-test, post-test control group design. The Instruments of Woodwork Technology Achievement Test (WAT) and Woodwork Technology’ Interest Inventory (WTII) were used to collect data on cognitive achievement and interest of students in Woodwork Technology respectively. Three research questions were answered using mean and standard deviation scores while Analysis of Variance (ANOVA) and t-test were used in testing the three null hypotheses formulated at 0.05 level of significance. The results revealed that the use of Meta-cognitive instructional strategy increased students’ achievement and interest in Woodwork Technology more than lecture method used on the control group. There was no significant difference on the achievement of male and female students exposed to Meta-cognitive instructional strategy. Both male and female students achieved highly as a result of the use of Meta-cognitive instructional strategy on students' achievement in Woodwork Technology. Based on the results, it was recommended among others that Woodwork Technology teachers should be trained on how to master the technique needed for preparation and the use of Woodwork Technology meta-cognitive instructional strategy for effective teaching and learning by students.

**Keywords:** Woodwork Technology, Achievement, Interest, and Meta-cognitive instructional strategy.

**Introduction**

Technical Colleges are one of the principal technical and vocational institutions saddled with the responsibility for training craftsmen in Nigeria. These institutions play vital roles in Technological development in Nigeria. They are designed to offer theoretical and practical education for the acquisition of skills as well as basic scientific knowledge at the secondary school level (National Board for Technical Education, 2020). Technical Colleges are established to train craftsmen for industry as well as making individuals to be self-employed and create jobs in the struggle towards technological advancement.

The curricula of Technical Colleges are centred on craft/engineering trades and agriculture which includes Agric- Mechanisation, Motor-mechanics, Building Construction, Electrical Installation, Metalwork, Plumbing, and Woodwork among others. Following the Boko haram insurgency in Niger State, there is increased demand of Training the unemployed youth with Vocational and Technical skills for self-employment which led to the establishment of more Technical Colleges where woodwork trade is taught.

Woodwork trade is referred to as activity that involved skills for the production and servicing of wooden articles. According to Hornby (2019), woodwork is also seen as the activity or skill of making objects from wood by woodwork craftsmen. It is an integral part of Technical Vocational Education and Training (TVET) programme.

Federal Republic of Nigeria (2021) identified areas of woodwork as follows: carpentry and Joinery, furniture making and Upholstery. The emphasis of government on skills acquisition led to the establishment of institutions that emphasize skills acquisition at all levels of educational system (Ogbu, 2017). Among these institutions are the Technical Colleges that are expected to have workshops for various trades offered and must be well equipped as to enable the transfer of practical skills to the learners for construction of wooden projects.

Workshop is a work area with fixed or portable metal or wood-working machineries where the primary function is to fabricate or machine materials. According to Jibril (2020), a workshop is an area, room or building where machines, equipment, hand tools, work benches and materials are used in the manufacturing or repairing of things. A wood workshop is a building where tools, machines and wood materials are used in the production of wooden articles under the guidance of woodwork teacher.

To improve the teachers abilities, workshops are expected to be well equipped and coordinated to enable woodwork teachers teach woodwork skills effectively. Abba (2018) expressed that woodwork technology by its nature, requires the establishment of uniformity of working conditions, operation and motion sequences, materials, workshop arrangement, tools and equipment for teachers to carry out their duties effectively. Nwokolo (2019) opined that teacher’s activities in wood workshops include: the effective use of hand tools; operation of machines; supervision of student’s activities; demonstration and maintenance of tools and equipment. Teachers’ and students’ activities in wood workshops are solely on skill transfer that make individual acquire manipulative techniques for self-reliance. The capability of accomplishing a job with precision of certainty, practical knowledge in combination with ability, cleverness and expertness (Abdullahi, 2018). This shows that skill is applicable in every field of human activities. Acquisition of skills is therefore necessary especially in teaching woodwork trade that involves instructive and manipulative skills. To increase the chances for self-reliance and employability, woodwork teachers must help students to acquire skills that are flexible and relevant to the demands of the present day. If such diverse expectations are to be met, substantial improvements are required. Woodwork trade teachers responsible for preparing the skilled personnel should possess the necessary skills for the construction of wooden projects in terms of preparation of timber to size, marking-out and cutting of wood joints. Other skills needed in the production of woodwork project involves application of adhesive and assembling, finishing techniques and maintenance of tools and equipment, which are the foundation of skills development in woodwork practice.

A woodwork project refers to an article made from wooden materials by a woodworker that required being prepared to specification to give the desired size, shape and colour for a specific purpose. The part members are needed to be prepared by planing of faces and edges and cutting off ends. Planing is the smoothing of surfaces and edges of rough sawn timber by taking off shavings with planes or machines (Walton 2021). It is the removing of imperfections on the piece of rough sawn wood to make it smooth and attractive. Cutting also describes the action of a saw which separates wood fibres in the process of cutting wood, (John, 2019). This is necessary for a perfect joint to be made. Joints in woodwork are devices for holding parts of wooden structures together firmly (Sackey, 2019). It involved cutting of members to fit into each other according to the type and method of assembling. When joints are, they are collected together to make a whole using bonding substances. To make the body more attractive, decorating and protecting the surface has to take place by a process called finishing with brush, spray or roller. Choosing a particular finish is influenced by the function of the project. The continuous use of woodwork tools render them inefficient to perform optimally, as such maintenance is required. It is carried out as a supporting service on any device to prolong its serviceable life (Parrish, 2021). It involves the systematic supply of necessary materials for the continuous operation of given equipment which includes; Lubricants, grease, fluid and water.

Therefore, it is important for a woodworker to possess these skills to enable him pass same to the learners for effective learning in wood workshop. These skills seems to be lacking in the woodwork teachers of Technical Colleges in Niger state judging by the poor performance of craftsmen in practical aspect of the trade. Although the state government has done much to improve the quality of training given to wood craft practice students by establishing new Technical Colleges and procuring tools and equipment. Ogundeji (2022), opined that the problem facing technical institution in Nigeria is that of production of unskilled technical personnel who cannot function effectively in the society. Ogundeji further stressed that, the above situation is attributed to lack of skills on the part of technical teachers or they are weak in teaching practical skills in their school wood workshops. It is on the basis of these inadequacies that the researcher seeks to determine the skills improvement need of woodwork teachers in Technical Colleges of Niger state.

Teaching involves both the teacher and the students in the transfer of knowledge in the classroom. For teaching and learning to be done in a classroom setting, it is important to ensure that the two-way communication channel exists between the teacher and the students. Students are expected to develop cognitive and practical skills that will enable them to apply their knowledge to explain phenomena that happen around them and to solve the problem. The desired goals are yet to be achieved among students instead the teaching-learning situation has largely neglected the higher objectives of education, which are the development of the cognitive critical thinking skills and the affective domain. The effect of this is that students were found to be deficient in cognitive and critical thinking skills, when they are faced with situation where they are expected to apply what they have learnt to solve specific problem. Ayodele (2021) opined that what was learnt by students was a function of how it is taught. Successful teaching requires that the students make sense out of what they are taught. The traditional (lecture) method of teaching means that the teacher stands in front of the silent group, while the students listen quietly during teaching. It is important for teachers to learn how to use teaching method that encourages highly effective processes and other desirable attitudes. One of the ways by which this could be done is adopting teaching method which encourages problem-solving strategies like Krulik and Rudnick, Rusbult, Meta-cognitive instructional strategy and so no.

Metacognitive instructional strategy consist of those skills required for deliberate planning, monitoring, regulation and evaluation of cognitive process and its outcome (Eze, 2020). Metacognitive skills enable the learners to become aware, understand, monitor, control and manipulate their learning processes. These suggest that learners with appropriate metacognitive skills are able to organize, monitor and direct their own learning process (Eze, 2020). As students become more skilled in using metacognitive skills, they gain confidence and become more independent as learners. Independent approach leads students to assume ownership of the learning processes as they realize they can pursue their own intellectual needs and discover a lot of information at their pace. The task of the educator then is to acknowledge, cultivate, exploit and enhance the metacognitive capability of all learners (Brown, 2018; Alexandra, *et al.,* 2021).

The use of metacognitive skills has been suggested to be essential for learning. The skills ensure that the learner will be able to construct meaning from information. To accomplish this, the learners must be able to think about their own thought processes, identify the learning strategies that work best for them and consciously manage them as they learn (Flavell, 2017). Good examples of metacognitive skills in mathematics include planning, checking, testing, reversing and evaluation (Ellis, 2019).

Interest is an important variable in learning because when one becomes interested in an activity, one is likely to be more deeply involved in that activity. Interest is a subjective feeling of concentration or curiosity over something. It is the preference for particular types of activities such as tendency to seek out and participate in certain activities in order to achieve the desired goal (Agwagah, 2018).

Academic achievement, according to Dori (2021), referred to some method of expressing a student scholastic standing. This can be regarded as course or subject grade, an average for a group of courses/subjects in a programme of study.

**Statement of the Problem**

The teaching and learning of Woodwork Technology in secondary school still remain a problem to Woodwork Technology teachers due to the abstract nature of some concepts in the subject. The high rate of students failure in Woodwork Technology has become a subject of constant comments by many people who discovered that the traditional principle of learning established by experimental psychologists are inadequate in solving problems.

The trend in Woodwork Technology teaching over the last few years has been towards emphasizing problem-solving and students' centered learning. Several strategies (like Meta-cognitive instructional strategy) were employed to improve students' performance in school subjects in Nigeria. Among these strategies also is the use of Meta-cognitive instructional strategy for classroom instruction. Based on this, the researchers decided to determine whether the use of Meta-cognitive instructional strategy model would improve secondary school Woodwork Technology Students' achievement and interest in Minna, Niger State.

**Purpose of the Study**

1. Determine the effect of Meta-cognitive instructional strategy on the achievement of secondary school Students in Woodwork Technology
2. Determine the effect of Meta-cognitive instructional strategy on the achievement of male and female technical school students in Woodwork Technology.
3. Determine the effect of Meta-cognitive instructional strategy on the Interest of technical school students in Woodwork Technology

**Research** **Questions**:

1. What is the difference in the mean achievement score of students taught Woodwork Technology using Meta-cognitive instructional strategy and those students taught same concept using the lecture method?
2. What is the difference in the mean achievement scores of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy?
3. What is the difference in the mean interest score of students taught Woodwork Technology using Meta-cognitive instructional strategy and those students taught same concept using the lecture method?

**Hypotheses**:

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

1. There is no significant difference in the mean achievement scores of technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy and those students taught same concept using the lecture method.
2. There is no significant difference in the mean achievement scores of male and female technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy
3. There is no significant difference in the mean interest scores of technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy and those students taught same concept using the lecture method.

**METHODOLOGY**

This study employed a quasi-experimental design using non-randomized, non-equivalent pre-test, post-test control group design. The study was conducted in Minna, Niger State. The population for this study comprises all secondary schools in Minna, Niger State. Two public coeducation secondary schools were randomly selected and two intact classes comprising of One Hundred and Nineteen (119) students of which Sixty-eight (68) are male and Fifty-one (51) female students. The two schools were assigned to experimental and control groups. The two instruments used for data collection were Woodwork Technology Achievement Test (MAT) and Woodwork Technology Interest Inventory (MII).

The instruments were face validated by three experts, two from Department of Science Education, Federal University of Technology, Minna and one secondary school Woodwork Technology teacher. The reliability of MAT was found to be 0.82 using test retest method and PPMC. The coefficient of MII was found to be 0.91 using Cronbach Alpha. The research questions were answered using Mean and Standard Deviations while the formulated null hypotheses were tested using the analysis of variance (ANOVA) and t-test.

**RESULTS**

**Research Question One**

What is the difference in the mean achievement score of technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy and those students taught same concept using the lecture method?

**Table 1: Mean and Standard Deviation of the Achievement Scores of Experimental and Control Groups.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Groups** | **N** | **Pre-Test**  **Mean (X)** | **SD** | **Post-test**  **Mean (X)** | **SD** | **Mean Diff** | **Mean Gain** |
| **Experimental** | 52 | 26.86 | 8.48 | 63.88 | 2.07 | 37.02 | 28.70 |
| **Control** | 67 | 24.24 | 8.65 | 35.18 | 2.00 | 10.94 |  |

The analyzing result presented in Table 1 reveals that the mean and standard deviation of post-test scores of the experimental group is 63.88 and 2.07 respectively. Similarly, the mean and standard deviation of post-test scores of the control group is 35.18 and 2.00 respectively. The experimental group which was exposed to Meta-cognitive instructional strategy had a mean score higher than that of the control group which was exposed to lecture method. Hence the mean gain scores between the experimental and the control group is 28.70 in favour of the experimental group.

**Research Question 2:**

What is the difference in the mean achievement scores of male and female technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy?

**Table2: Mean and Standard Deviation of the Achievement Scores of Male and Female Technical school students in the Experimental Group.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sex** | **N** | **Pre-Test**  **Mean (X)** | **SD** | **Post-test**  **Mean (X)** | **SD** | **Mean Diff** | **Mean Gain** |
| **Male** | 30 | 28.86 | 9.27 | 62.19 | 2.12 | 33.33 | 1.90 |
| **Female** | 22 | 27.81 | 8.54 | 60.29 | 2.02 | 32.48 |  |

Table 2 reveals the mean and standard deviation of the achievement scores of the male and female technical school students taught Woodwork Technology using Meta-cognitive instructional strategy. From the result, the mean and standard deviation of post-test scores of male students are respectively 62.19 and 2.12. However, the mean and standard deviation of post-test scores of the female students are respectively 60.29 and 2.00. Mean gain of the post-test scores for male and female students is 1.90 in favour of the male students.

**Research Question 3**

What is the difference in the mean interest score of technical school students taught Woodwork Technology using the Meta-cognitive instructional strategy and those students taught same concept using the lecture method?

**Table 3: Mean and Standard Deviation Interest Scores of the Experimental and Control Groups.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Groups** | **N** | **Pre-Test**  **Mean (X)** | **SD** | **Post-test**  **Mean (X)** | **SD** | **Mean diff** | **Mean Gain** |
| **Experimental** | 52 | 34.56 | 5.48 | 69.88 | 5.02 | 35.32 | 18.94 |
| **Control** | 67 | 31.15 | 5.65 | 50.18 | 5.94 | 19.03 |  |

The analyzed result presented in Table 3 reveals that the mean and standard deviation of post-test interest scores of the experimental group are 69.88 and 5.02 respectively. Similarly, the mean and standard deviation of post-test interest scores of the control group are respectively 50.18 and 5.94. The experimental group had a post-test mean interest score higher than that of the control group. The difference in the mean scores of experimental and control groups gives the mean gain score of 18.94 in favour of the experimental group.

**Hypotheses Testing**

**Table 4: Summary Analysis of Variance (ANOVA) for pre-test between Experimental and Control Groups**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sources of variation | Sum of Squares | df | Mean square | F | Sig |
| Between Groups | 198.431 | 1 | 198.431 | 1.554 | 0.215 |
| Within Groups | 17616.455 | 118 | 127.655 |  |  |
| Total | 17814.886 | 119 |  |  |  |

The result in table 4 reveals the pre-test between the experimental and the control groups which shows no-significant difference between the mean scores of the groups before treatment.

**Ho1**: There is no significant difference in the mean achievement scores of students taught Woodwork Technology using and Meta-cognitive instructional strategy and those students taught using lecture method.

**Table 5: Summary Analysis of Variance (ANOVA) for post-test Achievement Scores between Experimental and Control Groups**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sources of variation | Sum of Squares | df | Mean square | F | Sig |
| Between Groups | 9837.255 | 1 | 9837.255 | 95.351 | .000 |
| Within Groups | 14237.317 | 118 | 103.169 |  |  |
| Total | 24074.571 | 119 |  |  |  |

Table 5 shows the ANOVA analysis of post-test achievement scores of experimental and control groups. The table reveals that there was significant difference between the mean achievement scores of the two groups (F (1.118) = 95.351) and P = 0.000, p<0.05). Hence, hypothesis one which stated that there is no significant difference in the mean achievement scores of students taught Woodwork Technology using and Meta-cognitive instructional strategy-model and those students taught using lecture method was rejected because there was significant difference between the groups.

**Ho2**: There is no significant difference in the mean achievement scores of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy.

**Table 6. Summary of t-test Analysis of Mean Achievement Scores of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Group | Variable | No | df | Mean (X) | SD | t-value | P-value |
| Experimental Group | Male | 30 |  | 74.08 | 9.79 |  |  |
|  |  |  | 50 |  |  | 1.70 | 0.09 |
|  | Female | 22 |  | 70.18 | 11.01 |  |  |

Table 6 shows the t-test analysis of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy with t-value =1.70 and p-value = 0.09, p> 0.05. This shows that there was no significant difference between male and female students taught Woodwork Technology using Meta-cognitive instructional strategy. Therefore, the hypothesis which sated that there is no significant difference in the mean achievement scores of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy was no rejected.

**Ho3:** There is no significant difference in the mean interest scores of students taught Woodwork Technology using Meta-cognitive instructional strategy.

**Table 7. Summary Analysis of Variance (ANOVA) for post-test Interest Scores between Experimental and Control Groups**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sources of variation | Sum of Squares | df | Mean square | F | Sig |
| Between Groups | 3556.806 | 1 | 3556.806 | 75.211 | 0.000 |
| Within Groups | 6526.187 | 118 | 47.291 |  |  |
| Total | 10082.993 | 119 |  |  |  |

Table 7 shows the ANOVA analysis of post-test interest scores of experimental and control groups. The table reveals that there was significant difference between the mean interest scores of the two groups (F (1.118) = 75.211) and P = 0.000, p<0.05). Hence, hypothesis three which stated that there is no significant difference in the mean interest scores of students taught Woodwork Technology using and Meta-cognitive instructional strategy-model and those students taught using lecture method was rejected because there was significant difference between the groups.

**Discussion**

The result presented in table 1 shows that the post-test mean achievement score (63.88) of students, taught Woodwork Technology using Meta-cognitive instructional strategy is higher than the post-test mean achievement score (35.18) of students taught Woodwork Technology with chalkboard method. From table 5, it was confirmed that the achievement of Meta-cognitive instructional strategy group differs significantly showing that treatment using Meta-cognitive instructional strategy produced significant difference on achievement of students in Woodwork Technology. This finding is in line with Mohammed (2020) who stated that problem-solving model is used to enhance and support learning for improvement in students’ performance in applied electricity. This finding is equally in conformity with Nnodi and Nuigbo (2019) who opined that problem solving model has improved greatly and have aided in the development of instructional materials for teaching and learning.

The use of Meta-cognitive instructional strategy on Woodwork Technology teaching and learning is worthwhile. This finding is in agreement with Sungur and Tekkeya (2021) who pointed out that the Computer applications exist to aid every level of education. Sungur and Tekkeya also indicated that problem-solving model are used extensively in scientific research to solve mathematical problems. Problem of poor achievement of students in Woodwork Technology has been solved using Meta-cognitive instructional strategy. Uba (2020) also shows that the achievement of students exposed to the use of problem-solving model was better than their counterparts. Problem Solving like Meta-cognitive instructional strategy should therefore be encouraged in teaching and learning.

The results in table 6 shows that the post-test mean achievement of male and female students taught Woodwork Technology using Meta-cognitive instructional strategy favoured the two genders. However, male students taught Woodwork Technology using Meta-cognitive instructional strategy had mean score slightly higher than the female students taught Woodwork Technology with Meta-cognitive instructional strategy. This result agrees with the findings of Omeje (2018) that problem-solving improved students’ achievement but that gender was not a determinant factor in the acquisition of science process skills in students. The result of this study also agreed with Hammond and Plesca (2020) that boys had higher Woodwork Technology competency than girls. However, Uba (2020), Meta-cognitive instructional strategy should therefore, be encouraged in teaching and learning Woodwork Technology in Colleges of Education.

The results presented in table 7 shows that the post-test mean interest score of students in Meta-cognitive instructional strategy group was higher than the mean interest score for the Control group taught using Chalkboard method (lecture method). Meta-cognitive instructional strategy produced significant difference on students’ interest in Woodwork Technology. This result is in line with the findings of Savery and Duffy (2022) that there was an improvement in students’ interest in Woodwork Technology when instructional package like Problem-Based Learning is used in teaching and learning. Interest of students in learning is encouraged with the use of problem-solving model.

**Conclusion**

The use of Meta-cognitive instructional strategy increased students’ achievement and interest in Woodwork Technology more than the chalkboard method. Woodwork Technology Lecturers should be innovative by considering Meta-cognitive instructional strategy for use as it enhances the achievement and interest of both male and female students in the Meta-cognitive instructional strategy group. Students taught Woodwork Technology using the Meta-cognitive instructional strategy performed higher than their counterparts taught the same Woodwork Technology concept using the chalkboard method. There was no significant difference gender achievement of students taught Woodwork Technology using Meta-cognitive instructional strategy. The achievements of both male and female students were enhanced as a result of the use of Meta-cognitive instructional strategy. Lecturers of Woodwork Technology should be encouraged to use the Meta-cognitive instructional strategy for better performance by students.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

1. Woodwork Technology Lecturers should use Meta-cognitive instructional strategy in teaching Woodwork Technology since the use has been found to enhance students’ achievement and interest in Woodwork Technology
2. School administrators should provide and equip Woodwork Technology laboratories, for more effective teaching and learning in order to promote students’ understanding.

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