EFFECT OF CONCEPT MAPPING WITH STANDARDIZED-BASED TESTING ON AUTO-MECHANIC STUDENTS' ACADEMIC PERFORMANCE IN TECHNICAL COLLEGES IN KATSINA STATE

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Abstract

The study focused on the effect of concept mapping with standardized-based testing on Auto-mechanics students' academic performance in technical colleges, in Katsina State. The study was guided by six (3) research objectives, while the research questions where four (2), and the hypotheses were six (3) which are in line with these objectives. The study adopted pretest posttest quasi-experimental research design, on a population of three hundred and thirteen (313) TT2 Technical school Students in technical colleges of Katsina state, where one hundred and three (103) students were purposively selected across two technical colleges among others. Data for the study was collected using an Auto-mechanics Achievement Test (AMAT). The research instruments (AMAT), lesson notes, test blue print and marking guide were face validated by two experts, one from Educational Measurement and Evaluation and other from Automobile Technology. Establishment of reliability coefficient of AMAT items was conducted using twenty (20) students and analyzed using Kuder Richardson Formula 20 which yielded a reliability coefficient of 0.82. The instrument was administered to the students with the help of two experienced Auto-mechanics teachers. Data obtained from the study were analyzed using Wink SDA to answer research questions. As Descriptive Statistics was used to answer the research questions then Analysis of Covariance statistics was used to test hypotheses at 0.05level of significance. Findings from the study revealed that the use of concept mapping with standardized-based testing highly influence students' academic performance ($F_{3,99}$ = 92.751; P<0.05), while age interval was found not to be a significant factor on the students' academic performance on Auto-mechanics subject ($F_{3,99}$ = 0.861; P>0.05). Based on the findings of the study, the researcher concludes that the use of concept mapping with standardized-based testing has a positive effect on the Auto-mechanics students' academic performance. Based on the findings, it was recommended among others that the use of concept mapping as teaching method and standardized-based testing as formative evaluation process should serve as template in other fields of study, more specifically in technical schools.

Keywords: Concept Mapping; Standardized-Based Testing; Auto Mechanics, Academic Performance

Introduction

Education is an avenue of training and learning, especially in schools to improve knowledge and develop skills. The ultimate purpose of education is to empower an individual to excel in a chosen field of career and to be able to positively impact his environment. Education remains the veritable instrument of positive change for sustainable human development. Education is a sacred ingredient of development; a potent means of an enduring life and is the bedrock of economic development of any nation (Olutola, Galadanchi

& Olatoye, 2023). On the contrary, the end results of the processes of education have failed to maintain a high degree of academic distinction and excellence amongst learners and recipients of education in institutions of learning as of these days, more specifically science and technical subjects (Assefa, 2018). In the technical schools, there are different trades to study and Auto-mechanics is one of these trades.

Auto-mechanics in Technical Colleges is a trade unit of study which is geared towards the production of craftsmen who have skills, attitude, and knowledge to meet the demand and development in the automobile industry (Osho, 2017). The craftsmen are expected to test, diagnose fault, service and repair modern automobiles. Auto-mechanics is one aspect of technology that has continued to experience constant changes and improvement. Dynamism in auto-mechanics technology necessitates effective training and re-training of the craftsmen who will handle it. This training actually has to begin from the classroom. This is very necessary so that the students would be able to have the insight of what engine details entails. Considering the place of automobile in social, economic and political development of any country, issues relating to its repairs and services should not be left to chance. An ill- maintained automobile can lead to wastage of both life and resources. Osho (2017) revealed that auto-mechanics in the Technical Colleges is still bedeviled by a mirage of problems ranging from improper management of human and material resources, inadequate skilled and competent professionals that can assist students in learning and acquiring skills that would make them proficient in their automobile career and lack of appropriate instructional materials to facilitate learning.

Most auto-mechanics teachers in the technical colleges do constantly face the decision of how to design instruction, which will best meet the needs of the students. The decisions include selecting the best strategy that would be appropriate for teaching and learning (Amen, 2017). An appropriate strategy for teaching auto-mechanics subjects may foster the academic performance of auto-mechanics students in technical colleges. Jimoh (2018) observed that students' achievement connotes performance in school subjects as symbolized by a score on an achievement test. Furthermore, Anene as cited in Jimoh, (2018) explained that achievement is quantified by a measure of the students' academic standing in relation to those of other students of his/her age. A concept mapping is simpler in construction, easy to carry and move about because it is not heavy as in the case of a real auto-engine. Concept mapping can also be used to facilitate teaching and learning in some trades offered in technical colleges in which auto-mechanics technology is one (Safdar, 2018). Auto-mechanics technology includes auto-mechanicals' work, auto-electricity, auto-body repair, spray painting, auto- body building work, parts merchandising. An effective strategy is required in teaching these auto-mechanic parts, and concept mapping is one of these strategies.

A concept map is a graphical representation of knowledge that is composed of concepts and the relationships among them. Among the many techniques available, concept mapping as an effective tool for organizing new information and integrating it with the existing knowledge can provide learners with opportunities to learn and construct knowledge (Ojima, 2016). Ojima further illustrated that various studies on concept mapping have revealed that this technique has prominent roles in a variety of instructional settings and is widely implemented in classroom instruction which leads to more comprehensive learning of technical skills. In addition, research indicates that concept mapping is an effective learning strategy in genetics, ecology, physics, chemistry and so on (Chularut & DeBacker, 2018). Furthermore, students in health-related programs, medical and nursing education, and technology education have adopted concept mapping as a way to facilitate the understanding of theories and the internalization of concepts, challenging the traditional methods of rote memorization and passive learning

(Kostovich, Poradzisz, Wood, & O'Brien 2017). After a successful instruction by the teacher using the best teaching strategy for the topic(s), to ascertain the students' level of performance the teacher need to use the best method of assessing the students such as standardized based testing. Standardized based testing is one of the best strategies to obtain students' level of performance (Wilfredo, 2018). School-based standardized testing aims to provide uniform, rapid measurement of some kind of mental capability that is related to education. The distinguishing features of a standardized test are uniform administration and some form of calibration. Before routine use, standardized tests or component items will be tried out with groups intended to represent populations of test- takers (Maganga, 2016).

It is against this background that the present study seeks to examine the effects of Concept Mapping with Standardized-Based Testing on Auto-Mechanics Students' Academic Performance in Technical Colleges in Katsina State. Concept mapping will serve as a teaching strategy in teaching auto-mechanic while standardized-based testing will serve as a method of assessing the students' performance formatively.

Objectives of the Study

The main objective of this study is to examine the effects of concept mapping with standardized-based testing on academic performance of auto-mechanics students in technical colleges in Katsina State. Specifically, the study sought to:

1. determine the main effect of concept mapping with standardized based testing on Technical College Students' achievement in Auto-mechanics.
2. find out the main effect of concept mapping with standardized based testing on Technical College Students' achievement in Auto-mechanics based on age interval.
3. determine the interactional effect of concept mapping with standardized based testing and age interval on technical students' achievement in Auto-mechanics.

Research Questions

The following research questions guided the study:

1. What is the effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics?
2. What is the effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval?

Hypotheses

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

H_{01}: There is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics.

H_{02}: There is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval.

H_{03}: There is no significant interactional effect of concept mapping with standardized based testing and age interval on technical students' achievement in Auto-mechanics.

Methodology

The study adopted the pre-test, post-test, non-equivalent control group quasi-experimental research design. Quasi-experimental research design is considered appropriate for the study because intact classes

will be used to avoid disruption of normal class lessons. The pre-test scores were used to find out the initial difference between the two groups and also to control selection bias which is a threat to internal validity.

Population and Sampling

The population of the study consists of three hundred and thirteen (313) Public Senior Secondary Schools two (TT II) students in technical schools within Katsina State. The sample for this study consist one hundred and three (103) auto-mechanics students from the sampled schools. Purposive sampling technique was used to select two technical colleges out of the five technical colleges because they are offering Auto-mechanic.

Instrumentation

The instrument developed for the data collection in this study was: Auto- Mechanics Achievement Test (AMAT). The Auto-Mechanics Achievement Test (AMAT) was a 40-multiple choice item constructed by the teacher. Each has four options. The instruments covered the content areas of the topic selected for the study. Measures were taken to ensure that the necessary psychometric properties are well established. The psychometric properties of AMAT items were determined by individual item analysis.

Validity and Reliability

The research instrument (AMAT), lesson notes, test blue print and marking guide was face validated by two experts, one expert in measurement and evaluation from University of Jos and the other expert in the Automobile Technology education from Abubakar Tafawa Balewa University (ATBU) Bauchi. These experts validated the items in terms of clarity of instruction, clarity of language, appropriateness and adequacy of the items in measuring what they are supposed to measure. The advice of the experts helped to modify and select the set of test items that was used for data collection. A trial test was conducted on the AMAT for the purpose of determining the psychometric indices of the test. In the trial test, the AMAT was administered to Year Two Auto-mechanics students in another Technical College, different from the sampled schools.

The establishment of the reliability of the AMAT instrument was carried out by administering the instrument to 20 students that were not part of the sample, precisely students from Government Technical College Soba. Data collected were analysed using Kuder-Richardson 20 formula which yielded a correlation coefficient of 0.82.

Data Analysis Technique

The data collected were analyzed using Descriptive and Inferential statistics, mean and standard deviation answered the research questions. The Hypotheses were tested with Analysis of Covariance (ANCOVA) at 0.05level of significance. ANCOVA was used in order to eliminate any existing initial differences between the groups due to non-randomization of the subjects.

Results

Research Question One: What is the effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics?

Table 1: **Mean and Standard Deviation of students' achievement of Experimental and Control Groups in the Auto-Mechanics subject**

	Pretest		Posttest		
Groups	**Mean**	**S.D**	**Mean**	**S.D**	**Mean Gain**
Experimental Group	20.134	1.07912	24.2273	1.78968	4.0933
Control Group	19.738	0.9213	20.6102	1.21793	0.8722
Mean Difference	**0.396**		**23.906**		**3.2211**

The data presented in Table 1 shows that the experimental group had a pretest mean score of 20.134 and standard deviation of 1.07912 with posttest mean score of 24.2273 and standard deviation of 1.78968 in the students' achievement score. The mean gain in the experimental group was 4.0933. The control group had a pretest mean score of 19.738 and standard deviation of 0.9213 with posttest mean score of 20.6102 and a standard deviation of 1.21793 in the students' achievement score. The mean gain in the control group was 0.8722. With this result, the mean gain is in favor of the experimental group with mean difference of 3.2211**,** this indicate that the students in the experimental group performed more in the AMAT than the students in the control group.

Research Question Two: What is the effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval?

Table 2: **Mean and Standard Deviation of students' achievement of Experimental and Control Groups in the Auto-Mechanics subject based on age interval**

		Pretest		Posttest		
Age	**N**	Mean	S.D	Mean	S.D	**Mean Gain**
15-18 years	89	20.5636	2.02254	22.0562	2.29802	1.4926
Above 18	14	20.7119	2.05691	22.7857	2.51698	2.0738
Mean Difference		**0.1483**		**0.7295**		**0.5812**

The data presented in Table 2 shows that the students between 15-18 years has a pretest mean score of 20.5636 and standard deviation of 2.02254 with posttest mean score of 22.0562 and standard deviation of 2.29802 in the students' achievement score. The mean gain in the group was 1.4926. The students above 18 years had a pretest mean score of 20.7119 and standard deviation of 2.05691 with posttest mean score of 22.7857 and a standard deviation of 2.51698 in the students' achievement score. The mean gain in the control group was 2.0738. With this result, the mean gain is in favor of the students above 18 years with mean difference of 0.5812, this indicate that the students in the above 18 years group performed slightly more in the AMAT than the students between 15-18 years group.

Hypothesis One: There is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics.

Table 3: Results of ANCOVA Analysis of Mean Achievement Scores of the Experimental Group and Control Group

Hypothesis	**Source**	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
	Corrected Model	357.177[a]	4	89.294	44.571	.000
	Intercept	697.917	1	697.917	348.359	.000
	Pretest	12.816	1	12.816	6.397	.013
H_{01}	Treatments (Concept-map)	185.822	1	185.822	92.751	.000
	Error	196.337	98	2.003		
	Total	51112.000	103			

Corrected Total	**553.515**	**102**	

In Table 3 above, Hypothesis one which stated that there is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics was tested and the F-value ($F_{3,99}$= 92.751; p<0.05) was obtained. Since the p-value of 0.000 is less than the alpha value of 0.05, therefore, the null hypothesis is rejected. This implies that there is a significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics.

Hypothesis Two: There is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval.

Table 4: Results of ANCOVA Analysis of Mean Achievement Scores of the Experimental Group and Control Group with Age as Moderating Variable

Hypothesis	Source	Type III Sum of Squares	Df	Mean Square	F-value	Sig.
	Corrected Model	357.177[a]	4	89.294	44.571	.000
	Intercept	697.917	1	697.917	348.359	.000
	Pretest	12.816	1	12.816	6.397	.013
H_{02}	AGE	14.278	1	14.278	7.127	.009
	Error	196.337	98	2.003		
	Total	51112.000	103			
	Corrected Total	**553.515**	**102**			

In Table 4 above, Hypothesis two which stated that there is no significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval was tested and found the F-value ($F_{3,99}$= 7.127; p<0.05) was obtained. Since the p-value of 0.009 is less than the alpha value of 0.05, therefore, the null hypothesis is rejected. This implies that there is a significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval.

Hypothesis Three: There is no significant interaction effect of concept mapping with standardized based testing and age interval on technical students' achievement in auto-mechanics.

Table 5: Results of ANCOVA Analysis of Interactional effect in Achievement Scores of the Experimental Group and Control Group based of Age interval

Hypothesis	Source	Type III Sum of Squares	Df	Mean Square	F-value	Sig.
	Corrected Model	357.177[a]	4	89.294	44.571	.000
	Intercept	697.917	1	697.917	348.359	.000
	Pretest	12.816	1	12.816	6.397	.013
H_{03}	AGE * Treatments	1.724	1	1.724	.861	.356
	Error	196.337	98	2.003		
	Total	**51112.000**	**103**			
	Corrected Total	**553.515**	**102**			

In Table 5 above, Hypothesis three which stated that there is no significant interaction effect of concept mapping with standardized based testing and age interval on technical students' achievement in Auto-mechanics was tested and the F-value ($F_{3,99}$= 0.861; p>0.05) was obtained. Since the p-value of 0.356 is

greater than the alpha value of 0.05, therefore, the null hypothesis is retained. This implies that there is no significant interaction effect of concept mapping with standardized based testing and age interval on technical students' achievement in Auto-mechanics.

Discussion of Findings

The study investigated on the effect of concept mapping with standardized based testing on Auto-mechanic students' academic performance in Technical Colleges in Katsina state. The findings provide crucial insights into the role of teaching model (concept mapping) with standardized based testing in the academic performance of the students. This section discusses the results in details, comparing them with existing literature and providing possible explanations for the observed trends.

The data presented in Table 3, 4 and 5 provided answer to the tested hypotheses 1, 2 and 3. The findings revealed that students taught with concept mapping performed better than those taught without mapping. This is an indication that the use of concept mapping in teaching auto-mechanics improved students' achievement than teaching with lecture method. This result conforms to Oyenuga (2018), Charles, Kelechi and Eton (2019), and Ezeugo and Ahwagah (2018) that the use of concept mapping indicated superiority over non-use of it in teaching and learning process. So also, Piaget (1969) supported the use of model as superior over other techniques of improving on intelligence.

The hypothesis one with the obtained F-value of ($F_{3,99}$= 92.751; p>0.05). Since the p-value of 0.000 is less than the alpha value of 0.05, therefore, the null hypothesis is rejected. This implies that there is a significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics. The second hypothesis on the table was found to have the F-value of ($F_{3,99}$= 7.127; p>0.05). Since the p-value of 0.009 is less than the alpha value of 0.05, therefore, the null hypothesis is rejected. This implies that there is a significant effect of concept mapping with standardized based testing on technical students' achievement in Auto-mechanics based on age interval. While hypothesis three was also tested and obtained the F-value ($F_{3,99}$= 0.861; p<0.05). Being the p-value of 0.356 is greater than the alpha value of 0.05 therefore, the null hypothesis was retained. That means there was no significant interactional effect of concept mapping with standardized based testing and age interval on technical students' achievement in Auto-mechanics.

Conclusion

The study found out that the use of Concept Mapping with Standardized-Based Testing is more effective in improving the achievement of auto-mechanics students in the technical colleges. Irrespective of ability level, the use of model showed significant improvement in the academic achievement of auto-mechanics students in the technical colleges. However, the results showed that the use of Concept Mapping with Standardized-Based Testing is a viable teaching strategy for teaching auto-mechanics subjects in the technical colleges.

Recommendations

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

1. Government should make available various Concept Mapping of vehicle system for effective teaching and learning in the classroom.
2. Regular workshop should be organized to promote the production and usage of engine Concept Mapping in Nigeria vocational institutions.
3. Teachers should inculcate the idea of using various vehicle systems Concept Mapping whenever

auto-mechanic subjects are being taught in the classroom.

4. Use of Concept Mapping for teaching various concepts in vehicle systems should be incorporated into the Technical College and other vocational education curriculum.
5. Auto-mechanic work teachers/instructor in Technical Colleges should adopt Concept Mapping as way of removing gender related differences in classroom teaching.
6. Students should also be encouraged to produce Concept Mapping as this will help in coming closer to the understanding of the concept of vehicle systems as this will make learning auto-mechanic work more concrete.

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