Teaching Methods and Creativity Levels of Students on Acquisition of Entrepreneurial Skills in the Rewinding of Coil in Electric Motor

Abstract

The study was designed to investigate teaching methods and creativity levels of students and acquisition of entrepreneurial skills in the rewinding of the coil in an electric motor. The study area is Obio/Akpor Local Government Area of Rivers State. A sample of 60 physics senior secondary school students was purposively selected and subjected to quasi-experimental pre-test post-test design with two experimental and one control group with each group taught with different instructional methods. Data was obtained using Creative Ability Test (CAT) and Entrepreneurial Skill Acquisition Test (ESAT) instruments, with reliability coefficients of 0.95 and 0.74 respectively, was analysed using mean and percentage for the research questions while 3×3 Multivariate Analysis of Covariance was used to test the hypotheses. The results show that students with high creative ability gained most in the acquisition of measurement and manipulative skills when taught with cooperative strategy, while students with average and low creative abilities gained most in the acquisition of measurement, manipulative and finger dexterity skills when taught with demonstration strategy. However, the post hoc analyses show that the significant difference in the instructional strategies was credited to demonstration strategy. The study thus recommends that the creative abilities of the students should be developed, while students–centred instructional strategies like demonstration and cooperative methods should be preferably used by teachers in teaching students rewinding of the coil in an electric motor.

Keywords: Entrepreneurial skill acquisition, teaching methods and creative ability.

Introduction

The teaching of science has gone beyond the cognitive approach to the translation of knowledge acquired into the long-lasting end product. Exposing the students to hands-on activities to bring out the best in them is a welcome development in science education. The need to be creative is apt, more especially as the need for youth to become self-reliant. When an individual is creative, it enables him to compete favourably in the job market. Mumford (2003) explained that creativity involves the production of novelty, in creating things that are original, durable and worthwhile. Bilton (2007) also acknowledged that creativity provides the foundation for innovation and business growth as well as impacting positively on society.

The importance of creativity in resolving and translating an idle platform to a busy one must be emphasized in our school, most especially science education. Avwiri (2014) acknowledged that creativity is the act of turning new and imaginative ideas into reality, leading to critical thinking and production. Creativity is synchronizing to entrepreneurship, as entrepreneurship is the end product of creative thinking. This brings about many contributions to economic growth and employment creation. Much creativity is required in the rewinding of the coil in electric motor, most people find the task of rewinding very tasking and difficult because it requires more of measurement, manipulative and finger dexterity skills. So it is simply to throw away the electric motor coil than to repair. When students possess these skills they are the better groom and ready to take up these task and as

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such make income for themselves. These can be achieved through entrepreneurial skills and teaching method imply in schools (Papadakis, 2018; Kalogiannakis & Papadakis, 2019).

The need for entrepreneurship cannot be overemphasized, as such, there is need to develop these skills in the students. In doing this, as noted by Akaezi (2009) creativity can hardly be separated from entrepreneurship. It is, therefore, necessary to consider the teaching methods that the teacher uses to teach, to develop the creative and entrepreneurship skills in the students.

The teaching methods to be investigated are a demonstration, guided inquiry and co-operative strategies. The entrepreneurship skills to be taught to the students are the measurement, manipulative and finger dexterity skills. The measurement skill will enable the students to acquaint themselves with accuracy in finding size, length, quantity or degree of something. The manipulative skill allows the students to confidently handle an object with appropriate control and speed of movement required to complete the task while the finger dexterity skill allows the students to manipulate small objects primary with the finger.

The theory for the study is Rogoff (1990) apprenticeship theory in which a novice student that has worked closely with an expert teacher through dialogue discuss in the zone of proximal development can perform and achieve better results beyond the task which he or she primarily is independently capable of handling. The creative ability level of the students and the teaching method apply is very important (Isabekov & Sadyrova, 2018; Ahmadi & Besançon, 2017) when considering their acquisition of skills. Avwiri (2017) investigated the creativity of secondary school students; entrepreneurship skills acquisition in the construction of potentiometer in physics it was revealed that students with high creative ability gained the most when taught with demonstration strategy while students with low creative ability gained the most when taught with guided-inquiry. In the acquisition of finger dexterity skills in the construction of potentiometer, the students acquired the skills irrespective of their creative abilities. However, Odili (2006) emphasised that teachers should focus on strategies that could promote students activity and problem-solving.

Statement of the problem

The quest for self-reliant was necessitated in other to solve the problem of unemployment in the land. Students in secondary schools and higher institutions of learning get knowledge and obtain various degrees and qualifications in their course of study while the creative ability of the students is downplayed in the course of teaching and learning. Why are teachers concern on students passing the external examination and not developing the students' creative ability alongside teaching? Could it be the teaching strategy employed by the teacher? Therefore this study will look at the teaching methods and creative ability that will enable students to acquire entrepreneurial skills in the rewinding of the coil in an electric motor.

Aim and objectives of the study

The study investigated the teaching method and creativity level of students on the acquisition of entrepreneurial skills in the rewinding of the coil in an electric motor. The following specific objectives were considered to:

I. Investigate the relative effects of demonstration, guided- inquiry and cooperative strategies on the student's acquisition of measurement skills in rewinding of the coil in electric motor considering their level of creativity.

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II. Assess the relative effects of demonstration, guided- inquiry and cooperative strategies on students acquisition of manipulative skills in rewinding of the coil in electric motor considering their level of creativity.

III. Investigate the relative effects of demonstration, guided- inquiry and cooperative strategies on students acquisition of finger dexterity skills in rewinding of the coil in electric motors considering their level of creativity.

Research questions

I. What are the effects of demonstration, guided- inquiry and cooperative strategies on students acquisition of measurement skills in the rewinding of the coil in electric motors, considering their level of creativity?

II. How would demonstration, guided- inquiry and cooperative strategies impact on students acquisition of manipulative skills in rewinding of the coil in electric motors considering their level of creativity?

III. What is the relative effect of demonstration, guided- inquiry and cooperative strategies on students acquisition of finger dexterity skills in rewinding of the coil in electric motors, considering their level of creativity?

Hypotheses

H_{01} There is no significant difference among the students of high, average and low creative ability in their acquisition of measurement skills when taught with demonstration, guided -inquiry and cooperative strategies in rewinding of the coil in electric motors.

H_{02} There is no significant difference among the students of high, average and low creativity ability in their acquisition of manipulative skills when taught with demonstration, guided -inquiry and cooperative strategies in rewinding of the coil in electric motors.

H_{03} There is no significant difference among the students of high, average and low creative ability in their acquisition of finger dexterity skills when taught with demonstration, guided -inquiry and cooperative strategies in rewinding of the coil in electric motors.

Methodology

The study adopted a quasi-experimental, pre-test- post-test control group design. The study area is Obio/Akpor Local Government Area of Rivers State. There were two experimental and one control groups. The factors in the study were instructional strategies and creativity; each existing at three (3) levels. Purposive sampling technique was used to select three schools from the target population. The instruments for this study are Entrepreneurial Skills Acquisition Test (ESAT) and Creative Ability Test (CAT). They were validated for content and construct. The reliability indices are 0.95 and 0.74 for CAT and ESAT respectively, using Cronbach Alpha; expected to measure students' ability, on- the- spot during rewinding of the electric motor coil in an electric motor. The questions were practical-oriented and were scored a maximum of 5 marks each. It consisted of twenty questions on rewinding of electric motor coil. The questions on rewinding were broken down into five items on Measurement Skills, eight items on Manipulative Skills and seven items on Finger Dexterity Skill. This gave a total of 100 marks for rewinding of the coil in an electric motor. The Creative Ability Test (CAT) has twenty questions and each attracted a score of 1 mark giving a total of 20 marks. The test is expected to measure students' creative ability based on imaginative thinking. The subjects' creative abilities were classified as high, average and low after the Creative Ability Test was administered to the different groups. They were treated with the

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three different teaching strategies (Guided-Inquiry, Co-operative and Demonstration Strategies). A sample size of 60 students was used for the study. Based on the data collated, the research questions were analysed using descriptive statistics such as percentages and mean scores while the hypotheses were tested with 3x3 factorial Analysis of Co-variance.

Results and Discussion

Research Question 1: What are the effects of Demonstration, Guided- Inquiry and Cooperative strategies on students' acquisition of measurement skills in the rewinding of the coil in electric motors, considering their level of creativity?

Table 1 **Mean gain scores of acquisition of Measurement skills in the rewinding of the coil by students of high, average and low creative abilities and Instructional Strategy.**

Rewinding of the coil in Electric Motor						
MAT Ability	Skill	Method	Pre test$\bar{x}$	Post test$\bar{x}$	Mean gain	Mean gain%
High Level	Measurement	DMS	**5.71**	**19.71**	**14.00**	**245.18**
		GIS	**5.50**	**14.33**	**8.83**	**160.55**
		CPS	**5.43**	**20.00**	**14.57**	**268.32**
Average Level	Measurement	DMS	**5.67**	**22.00**	**16.33**	**288.01**
		GIS	**5.33**	**15.83**	**10.50**	**197.00**
		CPS	**5.33**	**19.83**	**14.50**	**272.05**
Low Level	Measurement	DMS	**5.25**	**21.75**	**16.50**	**314.29**
		GIS	**5.25**	**14.50**	**9.25**	**176.19**
		CPS	**5.29**	**19.43**	**14.14**	**267.30**

Note: DMS = Demonstration strategy, GIS = Guided Inquiry Strategy
CPS = Cooperative strategy

Results in Table 1

Table 1 shows that in the rewinding of coil in electric motor, students with high creative ability gained 268.32 % in the acquisition of measurement skills when taught with cooperative strategy, while students with average creative ability gained 288.01% and low creative abilities gained 314.29% in the acquisition of measurement skills when taught with demonstration strategy.

Research Question 2: How would demonstration, guided- inquiry and cooperative strategies impact on students' acquisition of manipulative skills in the rewinding of the coil in electric motors considering their level of creativity?

Table 2 **Mean gain scores of acquisition of Manipulative skills in the rewinding of the coil by students of high, average and low creative abilities and Instructional Strategy**

Rewinding of the coil in Electric Motor						
MAT Ability	Skills	Method	Pre test$\bar{x}$	Post test$\bar{x}$	Mean gain	Mean gain%
High Level	Manipulative	DMS	**8.57**	**29.57**	**21.00**	**245.04**
		GIS	**8.17**	**26.33**	**18.16**	**222.28**
		CPS	**8.43**	**30.43**	**22.00**	**260.97**
Average Level	Manipulative	DMS	**8.33**	**33.89**	**25.56**	**306.84**
		GIS	**8.17**	**24.83**	**16.66**	**203.92**
		CPS	**9.00**	**30.33**	**21.33**	**237.00**
Low Level	Manipulative	DMS	**8.0**	**32.25**	**24.25**	**303.13**
		GIS	**8.25**	**25.00**	**16.75**	**203.03**
		CPS	**8.29**	**29.71**	**21.42**	**258.38**

Note: DMS = Demonstration strategy, GIS = Guided Inquiry Strategy
CPS = Cooperative strategy

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The table 2 result shows that in the rewinding of coil in electric motor, students with high creative ability gained 260.97% in the acquisition of manipulative skills when taught with cooperative strategy, while students with average creative ability gained 306.84% and low creative abilities gained 303.13% in the acquisition of manipulative skills when taught with demonstration strategy.

Research Question 3: What is the relative effect of demonstration, guided- inquiry and cooperative strategies on students' acquisition of finger dexterity skills in the construction of potentiometer and rewinding of the coil in electric motors, considering their level of creativity?

Table 3 Mean gain scores of acquisition of Finger Dexterity skills in the rewinding of the coil by students of high, average and low creative abilities and Instructional Strategy

Rewinding of the coil in Electric Motor						
MAT Ability	Skills	Method	Pre test$\bar{x}$	Post test$\bar{x}$	Mean gain	Mean gain%
High Level	Finger Dexterity	DMS	**7.14**	**30.00**	**22.86**	**320.17**
		GIS	**7.00**	**23.83**	**16.83**	**240.43**
		CPS	**7.00**	**27.86**	**20.86**	**298.00**
Average Level	Finger Dexterity	DMS	**7.11**	**31.56**	**24.45**	**343.88**
		GIS	**7.33**	**23.17**	**15.84**	**216.09**
		CPS	**7.33**	**29.17**	**21.84**	**297.95**
Low Level	Finger Dexterity	DMS	**7.00**	**30.25**	**23.25**	**332.14**
		GIS	**7.13**	**22.50**	**15.37**	**215.57**
		CPS	**7.00**	**26.86**	**19.86**	**283.71**

Note: DMS = Demonstration strategy, GIS = Guided Inquiry Strategy
CPS = Cooperative strategy

The table 3 shows that students with high, average and low creative abilities gained 320.17%, 343.88% and 332.14 % respectively which is the highest scores in the acquisition of finger dexterity skills when taught with demonstration strategy in the rewinding of the coil in an electric motor.

Hypotheses

H_{01} There is no significant difference among the students of high, average and low creative ability in their acquisition of measurement skills when taught with demonstration, guided -inquiry and cooperative strategies in the rewinding of the coil in electric motors.

Table 4: Summary of 3x3 Analysis of Covariance of students' acquisition of measurement skills in the rewinding of the coil in electric motor classified by strategies and creative abilities, using pre-test scores as covariate.

Dependent Variable: Post-test scores on measurement skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	487.738[a]	9	54.193	9.253	S
Intercept	364.790	1	364.790	62.284	S
Pre-test	18.048	1	18.048	3.081	Ns
Strategy	425.828	2	212.914	36.353	S
Creative Ability	13.304	2	6.652	1.136	Ns
Strategy * Creative Ability	14.022	4	3.506	.599	Ns
Error	292.845	50	5.857		
Total	21501.000	60			
Corrected Total	780.583	59			

a. R Squared = .625 (Adjusted R Squared = .557)

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Table 4, shows that the main effect of the strategy is significant since its calculated $F_{2,50}$ value is 36.353 at the degree of freedom of 2,50 and probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. Creative ability is not significant since its calculated $F_{2,50}$ value is 1.136 at the degree of freedom of 2,50 and probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. The interaction of strategies and creative ability is not significant since its calculated $F_{4,50}$ value is 0.599 at the degree of freedom of 4,50 and probability level of 0.05 against the $F_{4,50}$ critical value of 2.53. This shows that there is no significant difference in the effect of the teaching strategies on students of high, average and low creative abilities in their acquisition of measurement skills in the rewinding of the coil in an electric motor.

Table 5: Post-hoc analysis of students' acquisition of measurement skills in the rewinding of the coil in electric motor based on the interaction of teaching strategies and creative abilities.

Pairwise Comparisons

Dependent Variable: Post-test scores on measurement skills

(I) Strategy	(J) Strategy	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1.00	2.00	6.444*	0.798	0.000	4.841	8.046
	3.00	1.590	0.796	0.051	-0.009	3.190
2.00	1.00	-6.444*	0.798	0.000	-8.046	-4.841
	3.00	-4.853*	0.770	0.000	-6.400	-3.307
3.00	1.00	-1.590	0.796	0.051	-3.190	0.009
	2.00	4.853*	0.770	0.000	3.307	6.400

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The Post-hoc analysis in Table 5 indicates that strategy 1, which is Demonstration strategy contributed most to the significant difference between the effects of the teaching strategies based on the interaction of teaching strategies and creative abilities in the acquisition of measurement skills in the rewinding of coil in electric motor and followed by cooperative strategy and then guided inquiry strategy.

H_{02} There is no significant difference among the students of high, average and low creativity ability in their acquisition of manipulative skills when taught with Demonstration, Guided -Inquiry and Cooperative strategies in the in rewinding of the coil in electric motors.

Table 6: Summary of 3x3 Analysis of Covariance of students' acquisition of manipulative skills in the rewinding of the coil in electric motor classified by strategies and creative abilities, using pre-test scores as covariate.

Dependent Variable: Post-test scores of manipulative skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	561.132[a]	9	62.348	3.105	S
Intercept	505.169	1	505.169	25.162	S
MPPRETEST	.145	1	0.145	0.007	Ns
Strategy	424.215	2	212.108	10.565	S
Creative ability	8.643	2	4.321	0.215	Ns
Strategy * Creative ability	67.507	4	16.877	0.841	Ns
Error	1003.851	50	20.077		
Total	52665.000	60			
Corrected Total	1564.983	59			

a. R Squared = .359 (Adjusted R Squared = .243)

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Table 6 shows that the main effect of the strategy is significant since its calculated $F_{2,50}$ value is 10.565 at the degree of freedom of 2,50 and a probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. Creative ability is not significant since its calculated $F_{2,50}$ value is 0.215 at the degree of freedom of 2,50 and probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. The interaction of strategies and creative abilities is not significant since its calculated $F_{4,50}$ value is 0.841 at the degree of freedom of 4,50 and probability level of 0.05 against the $F_{4,50}$ critical value of 2.53. This shows that there is no significant difference in the effect of the teaching strategies on students of high, average and low creative ability in their acquisition of manipulative skills in the rewinding of the coil in an electric motor.

Table 7: Post-hoc analysis of students' acquisition of manipulative skills in the rewinding of the coil in electric motor based on the teaching strategies.

Pairwise Comparisons

Dependent Variable: Post-test scores of manipulative skills

(I) Strategy	(J) Strategy	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1.00	2.00	6.505*	1.469	0.000	3.554	9.456
	3.00	1.760	1.472	0.237	-1.197	4.717
2.00	1.00	-6.505*	1.469	0.000	-9.456	-3.554
	3.00	-4.745*	1.456	0.002	-7.668	-1.821
3.00	1.00	-1.760	1.472	0.237	-4.717	1.197
	2.00	4.745*	1.456	0.002	1.821	7.668

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The Post-hoc analysis in Table 7 indicates that strategy 1 which is demonstration strategy contributed most to the significant difference between the effects of the teaching strategies on students' acquisition of manipulative skills in the rewinding of the coil in electric motor followed by cooperative strategy and then guided inquiry strategy.

H_{03} There is no significant difference among the students of high, average and low creative ability in their acquisition of finger dexterity skills when taught with Demonstration, Guided -Inquiry and Cooperative strategies in the rewinding of the coil in electric motors.

Table 8: Summary of 3x3 Analysis of Covariance of students' acquisition of finger dexterity skills in the rewinding of the coil in electric motor classified by strategies and creative abilities, using pre-test scores as covariate.

Dependent Variable: Post-test scores of finger dexterity skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	628.396[a]	9	69.822	3.802	s
Intercept	138.483	1	138.483	7.540	ns
FDPRETEST	.016	1	.016	.001	Ns
Strategy	532.687	2	266.344	14.501	S
Creative Ability	17.024	2	8.512	.463	Ns
Strategy * Creative Ability	10.758	4	2.690	.146	Ns
Error	918.337	50	18.367		
Total	46046.000	60			
Corrected Total	1546.733	59			

Dependent Variable: Post-test scores of finger dexterity skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	628.396[a]	9	69.822	3.802	s
Intercept	138.483	1	138.483	7.540	ns
FDPRETEST	.016	1	.016	.001	Ns
Strategy	532.687	2	266.344	14.501	S
Creative Ability	17.024	2	8.512	.463	Ns
Strategy * Creative Ability	10.758	4	2.690	.146	Ns
Error	918.337	50	18.367		
Total	46046.000	60			
Corrected Total	1546.733	59			

a. R Squared = .406 (Adjusted R Squared = .299)

Table 8 shows that the main effect of the strategy is significant since its calculated $F_{2,50}$ value is 14.501 at the degree of freedom of 2,50 and a probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. Creative ability is not significant since its calculated $F_{2,50}$ value is 0.463 at the degree of freedom of 2,50 and probability level of 0.05 against the $F_{2,50}$ critical value of 3.15. The interaction of strategies and creative ability is not significant since its calculated $F_{4,50}$ value is 0.146 at the degree of freedom of 4,50 and probability level of 0.05 against the $F_{4,50}$ critical value of 2.53. This shows that there is no significant difference in the effect of the teaching strategies on students of high, average and low creative abilities in their acquisition of finger dexterity skills in the rewinding of the coil in an electric motor.

Table 9: Post-hoc analysis of students' acquisition of finger dexterity skills in the rewinding of the coil in electric motor based on the teaching strategies and creative abilities,

Pairwise Comparisons

Dependent Variable: Post-test scores of finger dexterity skills

(I) Strategy	(J) Strategy	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1.00	2.00	7.432*	1.405	0.000	4.611	10.254
	3.00	2.696	1.398	0.059	-0.111	5.503
2.00	1.00	-7.432*	1.405	0.000	-10.254	-4.611
	3.00	-4.736*	1.365	0.001	-7.477	-1.996
3.00	1.00	-2.696	1.398	0.059	-5.503	0.111
	2.00	4.736*	1.365	0.001	1.996	7.477

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

The Post-hoc analysis on Table 9 indicates that strategy 1, which is demonstration strategy contributed most to the significant difference between the effects of the teaching strategies on students' acquisition of finger dexterity skills in the rewinding of the coil in electric motor followed by cooperative and then guided inquiry strategy.

Discussion

There is no doubt that creativity is the construction of ideas or physical products which are new, innovative and potentially useful, which must meet the needs of the society. With creativity, the individual is allowed to organize and take advantage of the opportunity to

produce positive results which can bring about environmental change and development to the society that is while the methods of teaching should also be given preference.

The results of this study revealed students with high creative ability gained most in the acquisition of measurement skills when taught with cooperative strategy, while students with average and low creative abilities gained most in the acquisition of measurement skills when taught with demonstration strategy in the rewinding of the coil. Also in the acquisition of manipulative skills, students with high creative ability gained most when taught with cooperative strategy, while students with average and low creative abilities gained most in the acquisition of manipulative skills when taught with demonstration strategy. This is at variance with Avwiri (2017), that students irrespective of their creative abilities gained most in the acquisition of measurement and manipulative skills in the construction of potentiometer when taught with demonstration strategy.

However, students with high, average and low creative abilities gained most in the acquisition of finger dexterity skills when taught with demonstration strategy in the rewinding of the coil in an electric motor. This also is at variance with Avwiri (2017) that in the acquisition of finger dexterity skill in the construction of potentiometer, students with high creative ability gained most when taught with cooperative strategy, the average creative students gained most when taught with demonstration strategy, while the low creative ability students gained most when taught with guided-inquiry strategy this, agrees with Onwioduokit, (2014) that when learners are guided by the teacher to discover information their entrepreneurial skill is enhanced and they become more creative, better critics with improved reflective thinking. It also agrees with Odili (2006) that students cantered activity strategy should be employed by teachers to enable learners to solve the problem.

Conclusion and Recommendations

The findings from this study imply that students creativity should be developed in the course of teaching the sciences, especially in physics. There are so many electrical devices in the physics curriculum that the students should be exposed to and also how to construct them. With the electric coil rewinding the students are taught to do, it will reduce the way spoilt coils are been thrown away, the students engaging in the repair will improve their creativity, the patience in pain taking, and the reasoning ability of the students to analyse and synthesize will be improved upon. It is therefore recommended that:

1. The students' levels of creativity should be taken into consideration in the course of teaching.
2. In the course of teaching physics, the students should be taught to acquire skill from the content of the curriculum and not just to pass external examinations.
3. Students–centred and interactive method like demonstration and cooperative strategies should be preferably used by teachers and artisan in teaching rewinding of electric motor coil.

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