

ASSESSMENT OF THE TEACHING METHODS THAT
INFLUENCE THE ACQUISITION OF EMPLOYABILITY
SKILLS OF MECHANICAL ENGINEERING
TRADES STUDENTS AT TECHNICAL COLLEGE LEVEL

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Abstract

This study is designed to develop a conceptual model based on Structural Equation Modelling (SEM) to determine the teaching methods that influence the acquisition of employability skills of mechanical engineering trades at technical college level. Descriptive survey research design was utilized in carrying out the study. Ninety nine five (99) mechanical engineering trades' teachers in the technical colleges in north central states of Nigeria responded to a structured questionnaire addressing the research question and its corresponding hypothesis. A conceptual model developed consisted of five (5) observed variables that will serve as the most significant determinant of the teaching methods that influence the acquisition of employability skills of mechanical engineering trades at technical college level were identified. It was recommended that the model should be adopted in the teaching of mechanical engineering trades for effectively teaching and learning and the acquisition of employability skills of the students.

Keywords: Structural Equation Modelling, Teaching Methods, Employability Skills, Mechanical Engineering trades, Technical College.

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Introduction

The 21st century modern economy needs highly trained and skilled human capital. Technical vocational institutions are required to turn out qualified graduates to meet the needs of employers and national development through inculcation of generic employability skills. Employability skills are group of skills which help in supporting the ability of an individual to perform effectively in the workplace. The employability skills consists of basic skills, thinking skills, resource skills, information skills, interpersonal skills, system and technology skills and personal qualities (Clarke, 2007). Employability skill is a group of important skills instilled in each individual in order to produce productive workforce, Overtom (Kazilan, *eta l.*, 2009). This is parallel with individuals who have strong characteristics such as a high sense of self-innovative, productive, skilful, and competitive, a strong sense of determination, and creative in facing the challenges of the nation as well as globalization in the 21st century. Technical Vocational Education (TVE) teachers' needs to use the right method of instruction in order inculcate employability skills to the students to enable them to be employable at the end of the completion of their program.

In Nigeria technical colleges are regarded as the principal vocational institutions. They give full vocational training intended to prepare students for entry into various trade areas. The technical colleges are established to produce craftsmen at the craft (secondary) level and master craftsmen at the advance craft (post- secondary) level. According to National Board for Technical Education (NBTE, 2001) the programs of technical colleges are classified into related trades, which includes mechanical engineering trades, electrical/electronic trades, construction trades, miscellaneous trades and business trades. However, the ultimate goal of training mechanical engineering trades students at technical college level is for the acquisition of knowledge, attitude and marketable skills for sustainable development. The training of the students is based on the production of skilful individuals who are proficient in production of goods and services that are not only relevant to themselves but to the society (Udofia, *eta l.*, 2012). The acquisition of a life-long employable skills calls for effective and efficient teaching methods and the utilization of improved and standard instructional facilities, to ensure the production of desired quality of the graduates with enterprising skills. The quality of the teachers and the utilization of the right method of teaching by the teachers play an important role in the

acquisition of employable skills of the students. It is on this basis that the study is design to identify the teaching methods that has significant influence on the acquisition of employability skills of mechanical engineering trades at technical college level in north central states of Nigeria.

Objective of the study

The main purpose of this study is to develop a conceptual model for the identification of the teaching methods that influence the acquisition of employability skills of mechanical engineering trades program at technical college level in Nigeria. Specifically, Structural Equation Modelling (SEM) was utilized to analyze the quantitative data collected from the respondents that participated in the research. The teaching methods that were considered in the study includes: demonstration method, lecture method, discussion method, problem based learning, work based learning, project based learning, computer based instruction, simulation, field trip, context based learning, student centered method of teaching and tutorials and seminar method.

Research Design

Descriptive survey research design was utilized for data collection in the technical colleges in north central states of Nigeria. Analysis involving correlations was done on the initial model to verify significant influence of observed variables on the unobserved variable. A hypothesized initial measurement model was tested for fit indices and compared against the default model.

Sample and Sampling Technique

Simple random sampling techniques was used to select 16 out of 28 technical colleges offering mechanical engineering trades in the technical colleges in north central states of Nigeria. A sample of 99 respondents was selected using a purposive sampling technique from the 16 technical colleges that were utilized as sample for the study. Only institutions owned and controlled by the Federal and State Government of Nigeria based on their similar and harmonised

characteristics in admission, curriculum and graduation requirements were involved in the selection of respondents for this research. Purposive sampling technique was employed in that, only teachers teaching mechanical engineering related trades were involved in the study.

Data Collection Instrument

A 24 items questionnaire was initially developed and was modified to 12-items, using 5 –point rating scale after validation and pilot study. The questionnaire developed comprised of significant approach considered determinants of the teaching methods that influence the acquisition of employability skills of mechanical engineering trades. A questionnaire was utilized in the collection of data on the opinion of mechanical engineering trades teachers at technical college level in north central states of Nigeria.

Result

The research question with its corresponding hypothesis that guided the conduct of the research was answered and tested respectively. The research question reads; *(What are the teaching methods that influence the acquisition of employability skills? H₀₁ There is no significant difference in the teaching methods that influence the acquisition of employability skills of mechanical engineering trades students).*

Structural Equation Modelling Using Analysis of Moment of Structures

Analysis of Moment of Structures (AMOS) is one of the most powerful and user friendly Structural Equation Modelling (SEM) software that enables the user to support their research and theories by extending standard multivariate analysis methods, factor analysis, regression, correlation, as well as analysis of variance (Arbuckle and Wothke, 1999). It is therefore imperative to use AMOS in order to identify the important areas based on their level of contribution and retained and also eliminate those areas that do not contribute to the model fitness. SEM is used to show the relationship that exist between the determinants, variables and

the latent variable in order to enable us come up with the structure of the model and how observed variables relates within and between them and major variable (latent variable).

Model Evaluation

The model was evaluated using chi- square (X^2), degree of freedom (df), significance level ($p < 0.05$), and covariance statistics. Other parameters such as Goodness of Fit Index (GFI), Tucker Lewis Index (TLI), and Comparative Fit Index (CFI) are shown to explain the variance. Root Mean Square Residual (RMR) and Root Mean Square Error of Approximation (RMSEA) were provided to describe mean covariance residual and fit index precision respectively. Measurement model was then tested using SPSS- AMOS version 18. Chi- square (X^2), df, GFI, CFI, RMSEA, TLI and P standard values (Table 1) were used for comparison to determine the fitness or otherwise of both the initial measurement model and the modified model.

Table1: Default Model Fit Indices

No	Model Fit Indices	Range Values
1.	Chi- square (X^2)/df	< 3.00
2	Goodness of Fit (GFI)	≥ 0.9
3	Incremental Fit Index (IFI)	≥ 0.9
4	Tukers- Lewis Index (TLI)	≥ 0.9
5	Comparative Fix Index (CFI)	≥ 0.9
6	Root Mean Square Error of Approximation (RMSEA)	≥ 0.9
7	Non-normed Fix Index (NFI)	≥ 0.9

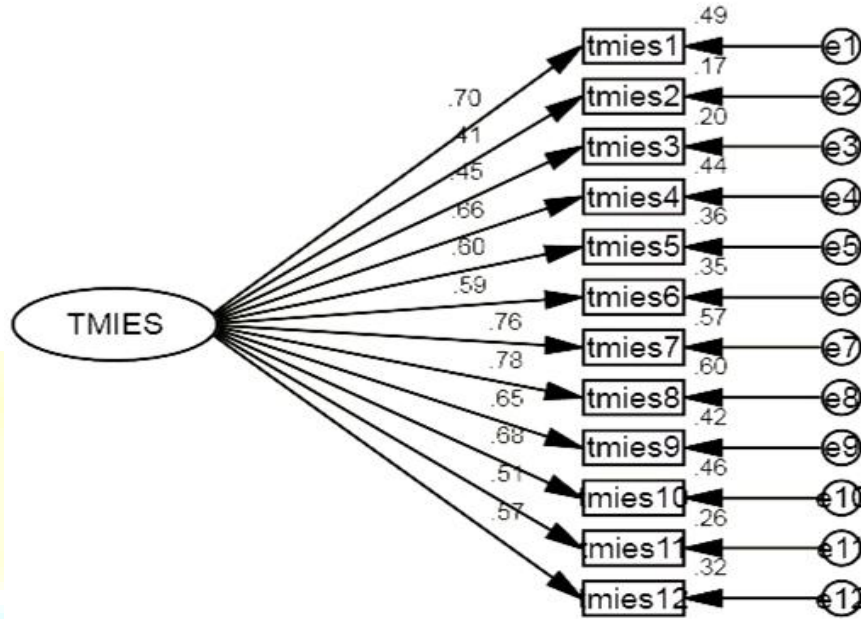


Figure 1. Initial Measurement Model of the Teaching Methods on the Acquisition of Employability Skills.

Table 2: Standardized Estimates of the Initial Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

No	Model Fit Indices	Computed Values	Range Values	P
1.	Chi- square (X^2)/df	3.13	< 3.00	
2	Goodness of Fit (GFI)	0.84	≥ 0.9	
3	Incremental Fit Index (IFI)	0.70	≥ 0.9	
4	Tukers- Lewis Index (TLI)	0.63	≥ 0.9	0.00
5	Comparative Fix Index (CFI)	0.69	≥ 0.9	
6	Root Mean Square Error of Approximation (RMSEA)	0.12	≥ 0.9	
7	Non-normed Fix Index (NFI)	0.61	≥ 0.9	

The model revealed that the teaching methods that influence the acquisition of employability skills consist of twelve variables. The result of the Confirmatory Factor Analysis (CFA), using the Path Analysis (PA) indicated that the result did not comply with the acceptable limits of goodness of fit ($CHI-SQUARE (X^2) = 172.136, DF = 55, RATIO = X^2/DF = 3.130, P = .000, GFI = .667, IFI=.696, TLI = .625, CFI = .689, RMSEA = .122$ and $NFI = .610$). Hence, no indicator in the standardized estimates, fit well to the corresponding data of 145 respondents.

Therefore, the initial measurement model should be re-adjusted or trimmed and re-run in order to develop a good model fit. Therefore, the issue of which and how many variables should be removed from an initial measurement model involves iterative sequences before achieving the proper model that complies and fits well to the data at $p = 0.05$. All relevant indicators such as multivariate normalities, standardized residuals, covariance, modification indices and outliers must be specifically examined and properly treated in order to obtain a good measurement model.

Table 3: Normality of Initial Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

Variable	min	max	skew	c.r.	kurtosis	c.r.
tmies12	1.000	5.000	.162	.795	-.548	-1.348
tmies11	1.000	5.000	.639	3.140	-.479	-1.178
tmies10	1.000	5.000	.593	2.913	-.530	-1.302
tmies9	1.000	5.000	.672	3.303	-.549	-1.350
tmies8	1.000	5.000	.581	2.855	-.520	-1.279
tmies7	1.000	5.000	.203	1.000	-1.000	-2.514
tmies6	1.000	5.000	.456	2.240	-.190	-.466
tmies5	1.000	5.000	.192	.944	.085	.209
tmies4	1.000	5.000	-.062	-.303	-.417	-1.025
tmies3	1.000	5.000	-.014	-.071	-.765	-1.881
tmies2	1.000	5.000	.161	.791	-.363	-.891
tmies1	1.000	5.000	-.120	-.590	-.505	-1.240
Multivariate					53.552	17.590

Table 3 shows the normalities of the initial measurement model of the teaching methods that influence the acquisition of employability skills. Ideally each variable should be approximately normal in univariate distribution when the skewness and kurtosis range between -1 to +1. This indicates that the univariate normal distribution were achieved.

Table 4: Standardized Residual Covariance of Initial Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

	tmies 12	tmies 11	tmies 10	tmies9	tmies8	tmies7	tmies6	tmies5	tmies4	tmies3	tmies2	tmies1
tmies 12	-0.975											
tmies 11	-0.509	-0.773										
tmies 10	-0.202	-0.828	-1.399									
tmies9	-0.171	-0.080	-1.850	-1.268								
tmies8	-1.384	-1.915	-1.726	-2.021	-1.827							
tmies7	-1.255	-1.479	-2.036	-2.420	-1.059	-1.726						
tmies6	-1.889	-0.054	-1.888	-1.203	-2.566	-2.000	-1.071					
tmies5	-2.383	-2.118	-2.140	-1.609	-1.672	-2.377	-0.223	-1.088				
tmies4	-2.042	-3.384	-1.905	-1.506	-2.018	-2.302	-1.697	-0.624	-1.317			
tmies3	-1.223	-0.614	-3.006	0.096	-2.379	-1.040	-1.457	-0.921	-0.250	-0.608		
tmies2	-3.272	-0.819	-1.325	-1.067	-2.267	-1.480	-0.183	0.030	0.128	0.164	-0.508	
tmies1	-4.573	-3.020	-3.612	-4.867	-4.691	-4.653	-3.034	-3.284	-3.123	-2.165	-1.932	-4.579

The standardized residual covariance analysis in Table 4 indicated that the maximum residual covariance between a pair of variable is 0.96 in absolute value. For a proper model, most standardized residuals covariance should be less than two (2.00) in absolute value.

Table 5: Covariance of Initial Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

			M.I.	Par Change
e10	<-->	e12	6.501	.206
e9	<-->	e12	5.554	.215
e9	<-->	e11	4.470	.211
e7	<-->	e8	12.982	.226
e5	<-->	e6	4.513	.124
e4	<-->	e11	12.248	-.273
e3	<-->	e10	8.851	-.248
e3	<-->	e9	4.297	.195
e3	<-->	e8	4.060	-.151
e2	<-->	e12	10.638	-.250
e1	<-->	TMIES	23.622	-.460
e1	<-->	e12	6.923	-.244
e1	<-->	e9	7.521	-.260

The covariance analysis in Table 5 suggests that e12 was correlated to several other measurement errors (e10, e9, e2, and e1) the chi-square statistics might reduce to a certain amount as shown in the column *Par Change*. Deleting these observed factors might increase the chi-square statistics to an acceptable limit of good model fit.

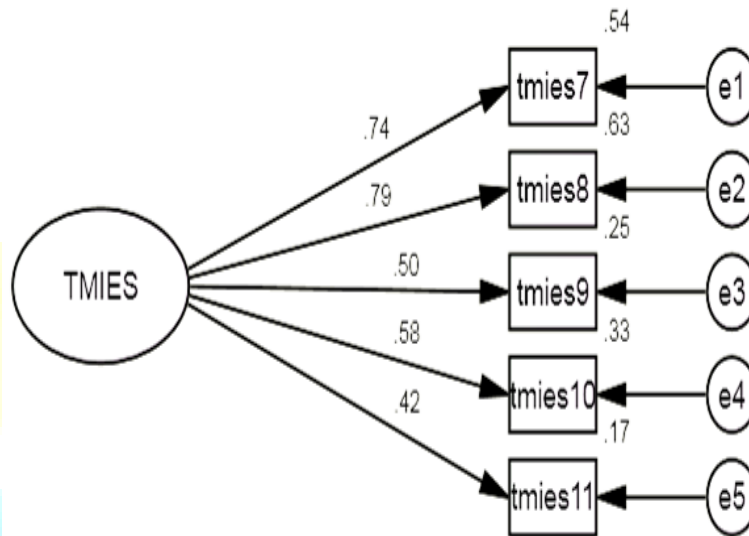


Figure 2: Modified Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

Table 6: Standardized Estimates of the Initial Modified Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

No	Model Fit Indices	Computed Values	Range Values	P
1.	Chi- square (X^2)/df	2.27	< 3.00	
2	Goodness of Fit (GFI)	0.97	≥ 0.9	
3	Incremental Fit Index (IFI)	0.96	≥ 0.9	
4	Tukers- Lewis Index (TLI)	0.92	≥ 0.9	0.45
5	Comparative Fix Index (CFI)	0.96	≥ 0.9	
6	Root Mean Square Error of Approximation (RMSEA)	0.09	≥ 0.9	
7	Non-normed Fix Index (NFI)	0.93	≥ 0.9	

Figure 2 shows the modified measurement model where all the values fit well to the empirical data (CHI-SQUARE (X^2) = 11.323, DF = 5, RATIO = X^2/DF = 2.265, P = 0.45, GFI = .969,

IFI=.960, TLI = .918, CFI = .959, RMSEA = .094 and NFI = .931) Standardized estimates indicate that these items were converged to the teaching methods that influence the acquisition of employability skills of METs students in the technical colleges. The strongest factor loading, or the most useful indicator of teaching methods that influence the acquisition of employability skills of METs students in the technical colleges is tmies8 (simulation), tmies7 (computer based instruction), tmies10 (context based learning), tmies9 (fieldtrip) and tmies11 (the use of student centred method of teaching) in which the maximum likelihood estimate in the text output showed the regression weights and variances had significant t-value.

Table 7: Cronbach's Alpha Reliability Results of the the Teaching Methods that Influence the Acquisition of Employability Skills

		Mean	Std. Deviation	Cronbach's Alpha
tmies7	Simulation	3.26	1.14	0.74
tmies8	Computer based instruction	2.74	1.10	
tmies9	Context based is learning	2.54	1.24	
tmies10	Fieldtrip	2.63	1.12	
tmies11	Student centred method	2.41	1.23	

Table 7 shows the comprehensive features of such measures which were based on the data collected from 99 METs teachers in the technical colleges. The reliability of the particular variables that converged to the teaching methods that influence the acquisition of employability skills of METs students in the technical colleges was tested using SPSS for Windows Version 20. The result showed that the value of Cronbach's Alpha was 0.74 and the standard deviation was greater than 1.00. This result shows that the items have good internal consistency and were capable of measuring the teaching methods that influences the acquisition of employability skills.

Table 8: Standardized Residual Covariance of the Modified Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

	tmies11	tmies10	tmies9	tmies8	tmies7
tmies11	.000				
tmies10	.824	.000			
tmies9	1.819	.374	.000		
tmies8	-.774	-.059	-.149	.000	
tmies7	-.146	-.316	-.545	.309	.000

Table 8 shows the standardized residual covariance of the modified measurement model of the teaching methods that influence the acquisition of employability skills. All the absolute values were less than 2.000 which imply that the measurement model fits well to the empirical data and was appropriately developed.

Table 9: Normality of the Modified Measurement Model of the Teaching Methods that Influence the Acquisition of Employability Skills.

Variable	min	max	skew	c.r.	kurtosis	c.r.
tmies11	1.000	5.000	.639	3.140	-.479	-1.178
tmies10	1.000	5.000	.593	2.913	-.530	-1.302
tmies9	1.000	5.000	.672	3.303	-.549	-1.350
tmies8	1.000	5.000	.581	2.855	-.520	-1.279
tmies7	1.000	5.000	.203	1.000	-1.000	-2.514
Multivariate					10.093	7.263

Table 9 shows the value of the critical ratio and kurtosis of the raw data. Ideally, every variable should be approximately normal in univariate distribution when the skewness and kurtosis coefficient ranges between -1 to +1. Therefore, the critical ratio for the multivariate normalities was far beyond the cut-off of (1.96) of multivariate normal distribution. This analysis is required as part of an effort to ensure high reliability of the variables before testing any measurement model. Most of the variables converged to the teaching methods that influence the acquisition of employability skills were considered as having good skewness and kurtosis for univariate normality.

Discussion

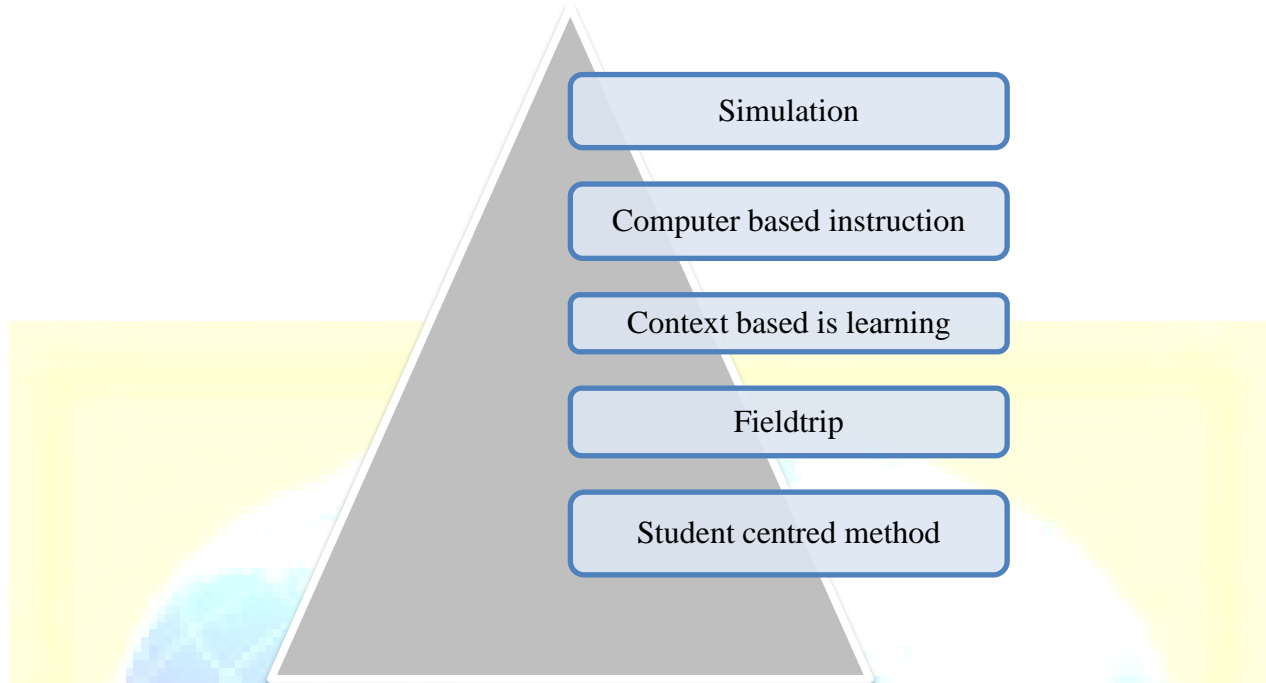


Figure 3: Conceptual Model for the Teaching Methods that Influence the Acquisition of Employability Skills

Five important teaching methods were found worthy of consideration as the most important teaching methods that influence the acquisition of employability skills of mechanical engineering trades at technical college level. Employability skills are referred to the basic skills and capabilities that are needed from an individual to enable him get, operate and function in any job. The skills are complementary to technical skills that are required for a particular job. Employability skills are basically not related to technical or academic performance but are more attached to traditional notion of intelligence and emotional intelligence (Down, 2012). However, the findings of the study revealed that simulation, computer based instruction, context based is learning, fieldtrip and student centred method of teaching are the most significant predictor of teaching methods that influence employability skills of mechanical engineering trades students. Zaharim, *eta'*(2009) expressed the need of TVE graduates to acquire such skills for them to effectively fit in into the modern industries. Therefore, suggested the use of suitable teaching methods in order to develop and enhance the employability skills of the students worldwide. Similarly, Wye and Lim (2009) also supported the importance of having equipping the graduates of TVE programs with appropriate generic skills and personal qualities for employment through

the efforts of adequate and proper teaching methods in combined with the efforts of the industries, academics as well as students themselves.

However, the main goal of teaching TVE subjects is to impart knowledge and skills to students through theoretical and practical means for the purpose of training individuals for the world of work. In spite of this, it is unfortunate that in Nigeria the trend has always been negative due to several factors such as ineffective teaching methods by the teachers and inadequate instructional materials which affect the real concepts of methods of teaching and learning negatively (Omo-Ojugo and Ohiwerei, 2008). The most common approach to teaching in TVE institutions especially in technical colleges in Nigeria is a situation whereby the teacher stands in the front of the class and gives verbal explanations to the students while the students become listeners and take note from the board, this type of approach is usually practice in all subjects that even needed group or team work (Osakinle, *eta*'l, 2010).

Alseddiqi and Mishra (2010) reported that, in recent years in TVE, the teaching and learning processes are still being traditional without any amendment in the teaching approaches. The mechanical engineering trades teachers in technical colleges are entrusted with the duty of preparing and training students to acquire the necessary skills so as to assume some specific roles in their workplace which should be focused and directed towards the development of skills, attitudes and work-related knowledge. Similarly, in a study conducted by Rau, *eta*'l, (2006) who believed that in a knowledge-based economy, teaching approaches must be geared towards developing students' ability to "learn to re-learn"; to apply, to use, to disseminate and be innovative; to be able to adapt, synchronize information and respond to various changes. Therefore, the teachers should explore approved methods and practices for the teaching of TVE subjects especially mechanical engineering trades in technical colleges in Nigeria.

Conclusion

The acquisition of employability skills in TVE especially mechanical engineering trades is a major factor in the design of TVE programs. TVE is knowledge, skill and technology driven. It empowers students with employable skills and job creation potentials leading to poverty

reduction. The acquisition of employable skills empowers the students with competence to practice, create, develop and establish self in the work place. Skills acquisition by students can only be achieved where the training institutions have competent and experienced teachers that adopt effective and efficient instructional methods. In conclusion, the conceptual model is recommended for proper adoption to various technical colleges that offered mechanical engineering trades in Nigeria for effective teaching and learning to take place to enable the students to acquire the employability skills for gainful employment in the labor market by using the identified teaching methods highlighted in the model such as simulation, computer based instruction, context based is learning, fieldtrip and student centred method of teaching.

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