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# The Impact of Assessment Techniques on the Relationship Between Work-Based Learning and Teamwork Skills Development

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**ABSTRACT** The purpose of this study was to investigate the mediating effect of assessment techniques on the relationship between work-based learning and teamwork skills development at technical colleges in Nigeria. The sample consists of 257 technical teachers. The CFA models were developed to obtain the Chi-square values, modification indices, and standardized estimates using AMOS. Structural Equation Modeling (SEM), employing AMOS version 22 was utilized to test the mediation effect and also the relationship between work-based learning and teamwork skills development among students of technical colleges. The findings of the study revealed that work-based learning has a direct significant negative relationship with teamwork skills development among students of technical colleges, while, it has a direct insignificant positive relationship with assessment techniques. However, when the mediation hypothesis was tested, the result indicates that assessment techniques have a significant positive indirect impact on teamwork skills development, that is, it fully mediates the relationship between work-based learning and teamwork skills development among students of technical colleges. This study implies to educators that there is a need to appropriately enforce the assessment techniques for effective development of teamwork skills among TVET students. It is therefore, confirmed that teamwork skills should be enhanced when work-based learning is used in collaboration with appropriate assessment techniques.

**INDEX TERMS** Assessment techniques, structural equation modeling, work-based learning, and teamwork skills development.

## I. INTRODUCTION

Technical and vocational education and training (TVET) graduates are faced with unemployment challenges among the numerous graduates roaming the streets. Nigerian TVET graduates, however, are observed not to be equipped with the industry's employability skills and therefore, are not prepared to enter the workforce as a result [1]. The high unemployment level among TVET graduates is due to insufficient training of students resulting in a gap between the skills acquired by graduates and the skills required in the diverse working environment of the 21st century [2], [3]. We are in a competitive edge where graduates are honestly competing for the limited jobs available. It has been established that employers are

now searching for candidates with standardized employability skills that are capable of enhancing the organizations' success [4]–[6]. To cope with these challenges, therefore, TVET institutions are challenged to integrate among its students the required skills that will equip its graduates to be relevant and successful in this competitive edge. Therefore, TVET students are expected to attain competitive advantage skills in order to respond to the market requirements, prepare to make constant improvements in efficiency and performance in their various undertakings thereby enhancing their long term sustainability [7], [8]. Besides, the emphasis in the implementation of technical and vocational education and training (TVET) curriculum is eventually centered on the development of skills among its students [9].

Basically, one of the sure ways of realizing these critical objectives is by the instrument of work-based learning (WBL)

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which implies the establishment of a synergistic relationship between TVET institution, business, and industry as well as community-based resources inventory [10]. Consequently, the focus is now put on teaching methods that promote the active involvement of students in the teaching-learning process in order to acquire the required skills for the competitive advantage of TVET students. Hence concerted effort and strategies should be put in place to guarantee hand-on learning experiences for the development of skills by students of the program.

Work-based learning can be described as an organizational structure that concurrently introduces learners to both work and learning environments [11]. It is literally an attempt to expand the classroom walls to include the community as a resource for learning. WBL gives students ample opportunities to learn a variety of skills and interact synergistically between college and workplace [12]. It is an opportunity to narrow the gap between theory and practice, allowing a good assimilation of practical information. WBL implies creating experiential learning programs that make use of the working environment as an important part of the curriculum [13]. Through WBL, the students are provided with structured learning experiences through the collaborative efforts of labour and school employers [14]. Hence, [15] stress the shaping of learning climate through collaboration to allow learners develop relevant skills such as teamwork skills. It provides opportunities for learners to gain a variety of skills when they are subjected to rigorous academic and practical obligations at the same time as realistic occupational improvement experiences. WBL offers an important connection between classroom instruction, the world of work and career opportunities since neither school-based learning nor learner engagement in professional work alone (i.e. apprenticeship) assures sufficient training to the degree that the skill standards of the work-world are fulfilled [15].

Work-based learning increases the level of participant engagement, participation, and graduation; it can also strengthen the partnership between the school and the community; and thereby help students to learn how things they are taught in the classroom are connected to the real world [16]. Besides, [17] emphasized on the employability skills achievable through work experience to include: self-discipline; good work habits; time management, and planning skills. Several studies have illustrated the use of WBL as it typically reduces absenteeism, therefore, promotes timely students' participation, strengthens collaborative learning skills and improves the performance of learners in schools [18]. WBL involves deliberate arrangements and activities geared toward the development of skills through on-the-job training. The on-the-job training, therefore, should be monitored and evaluated to ensure that students are learning and acquiring relevant knowledge and skills such as teamwork skills to enhance adequate collaboration for the success of the employees and the organization.

Teamwork is an essential part of workplace success. When everyone in the workplace works together to accomplish

goals, everyone achieves more. Firms intending to remain competitive in the current business environment often require group use, thus ensuring improved productivity through the pooling of information, knowledge and skills [19]. As research has shown, through new ideas and innovation, teamwork leads to increased productivity and efficiency [20]. One of the most important skills in today's job market is the ability to work as part of a team. Employers are looking for staff who can add their own ideas and people who can collaborate with others to build and grow ventures and plans [21]. The National Research Council (NRC) study also highlighted teamwork skills as one of the valuable skills to be learned amongst learners [22]. Teamwork includes developing friendships and collaborating with others using a number of important strengths and routines, such as: Working together; sharing thoughts, feedback, effective communication with communities (both giving and receiving); sense of responsibility; Healthy tolerance for different views, practices and preferences; and ability to take part in group decision-making [22]. Application of appropriate assessment strategies for teamwork skills would result in high levels of productivity, efficiency, and creativity in the industries.

Assessment is the method of collecting evidence of student learning to make academic choices [23]. Evaluation is crucial in education and thus plays a critical role in the process of teaching and learning. Teachers identify and rate pupils, receive reviews and plan their teaching appropriately through successful assessment. Recently, assessment approaches are gaining more attention, teachers have become more involved in the requirements for evaluation processes in the field of skill development of technical or vocational education [24]. The assessment system impacts both teachers and students, which is why assessment processes in the advancement of skills in the technical and vocational education program should be given priority and consideration. The review of the literature showed that there was no major study in Nigeria to evaluate the impact of assessment techniques on the relationship between work-based learning and teamwork skills among technical and vocational students. Therefore, this is the gap that this study wants to fill. Hence, this study is designed to determine the impact of assessment techniques on the relationship between work-based and teamwork skills among students of technical and vocational institutions.

## II. METHODOLOGY OF THE STUDY

The target population for this study are technical teachers of technical colleges in Kaduna State, Nigeria. The study employed stratified random sampling to select the sample for this research. Three hundred and seventy two (372) technical teachers from public technical colleges across the study area constituted the target population for the study. In compliance with the sample size determination table [Krejcie & Morgan, 1970], the correct sample size of three hundred and two (302) participants of this study was picked by the use of stratified random sampling method, having considered the heterogeneous nature of the population. Hence,

three hundred and two (302) questionnaires were distributed. After the review of filled out questionnaires for missing data and other mistakes two hundred and fifty-seven (257) were retained, signifying a response rate of 85.1%. The teachers were requested to respond as honestly as possible to the items as they were assured of the usage of their responses only for the research purpose and as such shall be treated as strictly confidential. The CFA models were developed to obtain the Chi-square values, modification indices, and standardized estimates using AMOS. A second-generation multivariate statistical analysis measure, Structural Equation Modelling (SEM) that clusters the idea of factor analysis and multi regression analysis [25], was adopted here to determine the mediation effect of assessment techniques on work-based learning and teamwork skills.

All the items used to operationalize the constructs have been modified from previous studies validated in previous studies. Items for work-based learning construct were adapted from [26], items of assessment techniques construct were adapted from [27] while items of teamwork skills construct were adapted from [20]. To some extent, all the items were updated in order to fit in the context of the study. The items for all the scales were calculated on a scale of 5-point Likert, weighted by 1, “strongly disagree” to 5, “strongly agree.”

### III. DATA ANALYSIS

Preceding to the SEM process, it is critical to assess the measures of the constructs, principally the one-dimensionality of the scale if the items assemble to a discrete construct [35]. The study acquired and applied the results of exploratory factor analysis (EFA) of the independent variables (work-based learning); mediating variable (assessment techniques), and dependent variable (teamwork skills). The 17 items were subjected to a principal component analysis (EFA) with varimax normalized rotation. Consequently, each of the 17 items had factor loading value above 0.5 therefore, they are considered good and statistically significant. Hair *et al.*, [25] characterized these loadings by means of another rule of thumb as  $\pm 0.30$  = minimal,  $\pm 0.40$  = important, and  $\pm 0.50$  = practically significant. Moreover, validity of the data and sampling consistency using Kaiser-Meyer-Olkin (KMO) and Bartlett’s test further shows the value of KMO to be 0.786 which exceed the recommended KMO value of  $>0.5$  and Bartlett’s test ( $\text{Chi} = 10260.868$ ,  $p < 0.05$ ) found is ideal for a sound variable study [28]. Besides, only constructs that achieved eigenvalues greater than one were considered as significant.

A very strong multivariate methodology, structural equation modeling (SEM) was used to evaluate the mediation results of this study. The use of the SEM method in the context of mediation analysis has many benefits. When a model includes latent variables such as work-based learning, assessment techniques, and teamwork development, SEM makes it easy to measure and estimate. SEM simplifies mediation hypothesis research because it is designed to test more

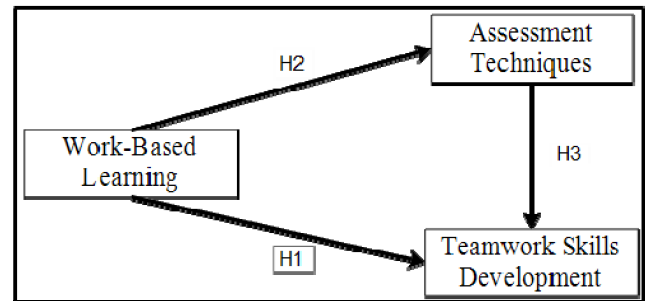


FIGURE 1. Path diagram describing the causative relationships between the variables.

complex types of mediation in a single experiment [29]. Fig. 1 describes a path diagram of fundamental relationships among the three variables in this study: work-based learning, assessment techniques, and teamwork development.

The following are the hypotheses to be tested in this study as described in Figure 1:

$H_1$ : Work-based learning has a direct and significant effect on teamwork skills development (direct Effect).

$H_2$ : Work-based learning has a direct and significant effect on Assessment Techniques.

$H_3$ : Assessment techniques have a positive and significant effect on teamwork skills development (indirect).

#### A. CONFIRMATORY FACTOR ANALYSIS (CFA)

In this study, both the initial and modified confirmatory factor analysis of each construct of the study were considered. For every fitted model, all the factor loadings must be equal to or above 0.5; the modification indices such as CFI, ITI, TLI must be above 0.90, while the Ratio of the Chi-square and the Degree of freedom (df) must be  $<3$  and  $\text{RMSEA} < 0.08$  respectively. Revised models of all the three constructs of the study were performed as their initial CFAs did not meet up with the stated criteria.

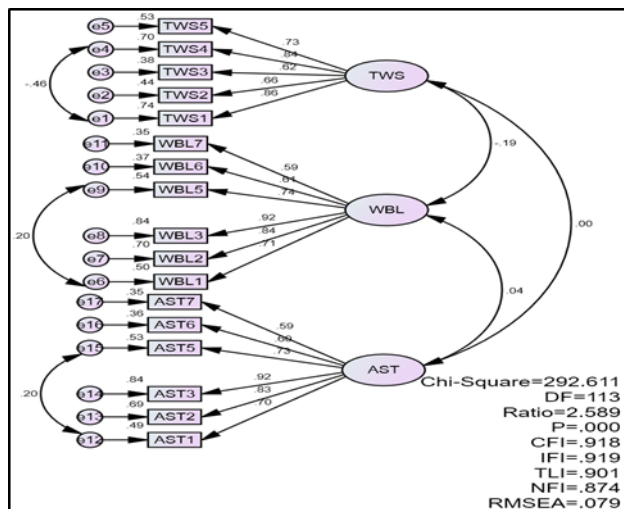
The initial CFAs of the constructs of the study: work-based learning, assessment techniques and teamwork skills did not comply with goodness model fit criteria. Work-based learning had Chi-square = 63.045,  $\text{DF} = 14$ , Ratio = 4.503,  $P = .000$ , CFI = .951, IFI = 951, TLI = .926, NFI = .938 and  $\text{RMSEA} = 117$ . Assessment techniques had Chi-square = 62.458,  $\text{DF} = 14$ , Ratio = 4.461,  $P = .000$ , CFI = .950, IFI = 951, TLI = .925, NFI = .937 and  $\text{RMSEA} = 116$ . While teamwork skills had Chi-square = 17.416,  $\text{DF} = 4$ , Ratio = 4.354,  $P = .002$ , CFI = .974, IFI = 975, TLI = .936, NFI = .967 and  $\text{RMSEA} = 114$ .

After sequential trimming and covariance of certain items based on the manifestation of values of modification indices of the models, the satisfactory values obtained for Work-based learning were: Chi-square = 20.508,  $\text{DF} = 8$ , Ratio = 2.564,  $P = .009$ , CFI = .984, IFI = 984, TLI = .970, NFI = .974 and  $\text{RMSEA} = .078$ . Assessment techniques had Chi-square = 19.626,  $\text{DF} = 8$ , Ratio = 2.453,  $P = .012$ , CFI = .984, IFI = 985, TLI = .971,

NFI = .974 and RMSEA = .075. While teamwork skills had Chi-square = 5.803, DF = 3, Ratio = 1.934, P = .122, CFI = .995, IFI = .995, TLI = .982, NFI = .989 and RMSEA = .060. Consequently, the adequacy of the individual measurement models were found to be well fitted for analysis.

**B. HYPOTHESIZED MODEL OF RELATIONSHIP BETWEEN WORK-BASED LEARNING, ASSESSMENT TECHNIQUES, AND TEAMWORK SKILLS DEVELOPMENT BASED ON TECHNICAL TEACHERS’ RESPONSES**

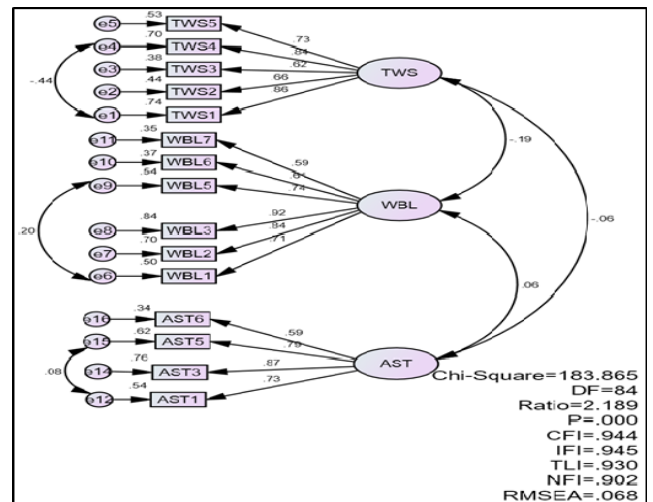
Measurement model, similar to the structural model, is an important step that is carried out so as to effectively analyze data through AMOS [30]. Furthermore, he considered the measurement model as discriminant validity typically implies the validity of the construct. To obtain the validity of constructs, all the redundant items in the constructs should either be trimmed or effect covariance for the observed variables in order for the items in the construct to be well correlated. The measurement model retains some important components of the goodness-of-fit model requirement.



**FIGURE 2.** Hypothesized initial measurement model of relationship between work-based learning, assessment techniques and teamwork skills development constructs.

Fig. 2 presents the hypothesized measurement model of the relationship among the three major constructs of the study: work-based learning, assessment techniques, and teamwork skills development. The values obtained for the initial measurement model as seen in Figure 4 are: Chi-Square = 292.611, DF = 113, Ratio = 2, 589, P = 000, CFI = .918, IFI = .919, TLI = .901, NFI = .874, RMSEA = .079. Based on these values attained, the model did not meet the requirements for the goodness of fit. Hence, modification of the model became crucial in order to improve the model to meet the standards for the goodness of fit.

Having gone through the modification indices, it was observed that the model could be further adjusted to obtain the quality of fit of the model. Therefore, the trimming of



**FIGURE 3.** Hypothesized modified measurement model of relationship between work-based learning, assessment techniques, and teamwork skills development constructs.

AST2 in Fig. 3 was effected and the model values obtained are Chi-Square = 183.865, DF = 84, Ratio = 2, 589, P = 000, CFI = .944, IFI = .945, TLI = .930, NFI = 902 RMSEA = .068. The measurement model is estimated for the determination of confirmatory factor analysis (CFA) with the primary objective of confirming the model fit and validity. The specification achieved in Fig. 3 agreed with the laid down principles [30]; hence satisfied the criterion of the model’s goodness of fit.

To avert the issues of multicollinearity, the discriminant validity of the latent constructs of the study was assessed. For discriminant validity to be achieved, each construct AVE (highlighted values in the diagonal direction, Figure 1) must be higher than its correlation with other constructs and each item should load more highly on its assigned construct than on the other constructs [31]. Therefore, based on the achieved values in Table 1, the discriminating validity for these concepts has been reached.

**TABLE 1.** Correlation matrix for the research constructs.

	WBL	AST	TWS
WBL	0.76		
AST	0.06	0.75	
TWS	-0.19	-0.06	0.6

**C. FACTORS LOADINGS, COMPOSITE RELIABILITY, AND AVERAGE VARIANCE EXTRACTED**

Average Variance Extracted is the measurement to be scrutinized which reveals the whole amount of variance in the observed variables accounted by the latent variable relative measurement error [32]. By screening the data through exploratory factor analysis (EFA), the reliability test



**TABLE 2. Factors loadings, composite reliability, and average variance extracted.**

Code	Construct Items	Factor Loading	CR	AVEs
<b>Work-Based Learning</b>			0.87	0.58
WBL1	Develops sound and realistic work habits among students	0.71		
WBL2	Develop entry-level skills among students for an occupation.	0.84		
WBL3	Improves students retention	0.92		
WBL5	Reduces training/recruitment costs	0.74		
WBL6	The workplace is used to provide students with knowledge and skills	0.64		
WBL7	Connects school experiences to real-life work activities	0.59		
<b>Assessment Techniques</b>			0.50	0.88
AST1	Self-Assessment	0.73		
AST3	Portfolio	0.87		
AST5	Workplace assessment	0.59		
AST6	Oral Presentation	0.79		
<b>Teamwork Skills</b>			0.86	0.84
TWS1	Ability to work cooperatively with others	0.86		
TWS2	Ability to contribute ideas in a team	0.66		
TWS3	Ability to acquire and share resources among others	0.62		
TWS4	Ability to work with others regardless of differences in culture and otherwise	0.84		
TWS5	Ability to have regard for the opinions of others	0.73		
1. Composite Reliability (CR) = (square of the summation of the factor loadings) / ((square of the summation of the factor loadings) + (square of the summation of the error variances)) 2. Average Variance Extracted (AVE) = (square of the summation of the factor loadings) / ((square of the summation of the factor loadings) + (summation of the error variances))				
<b>2 AVE = <math>\sum \xi^2 / n</math></b>		<b><math>\xi^2</math> = Factor loading of every item</b>		
<b>2 2 CR = <math>(\sum \xi^2) / (\sum \xi^2 + (\sum 1 - \xi^2))</math></b>		<b>n = Number of items in a model</b>		

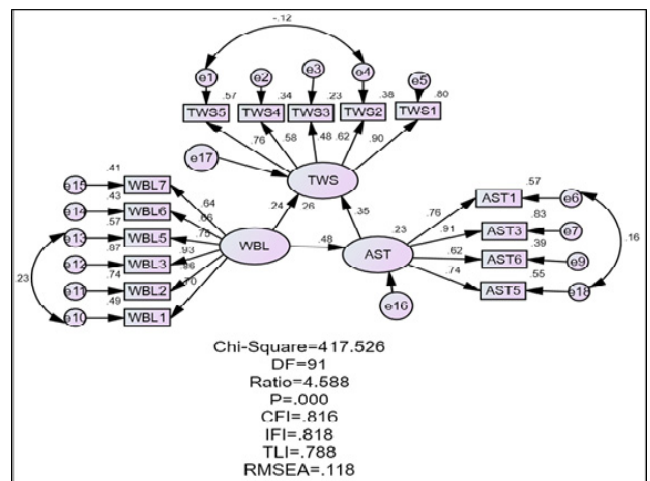
(Cronbach alpha) and the AVE of all reflective factors (constructs) in Table 2 lie between 0.54-0.84, which is higher than the recommended value of 0.50 [33]. In addition, the composite reliability (CR) values of all reflective concepts ranging from 0.86-0.88 which are above the recommended value of 0.6 [25], hence, considered suitable in exploratory studies. Therefore, the results of the measurement model illustrated in Fig. 3 shows that the constructs, based on their parameter estimates are statistically significant at  $p < 0.05$ .

**D. HYPOTHESIZED MODEL OF ASSESSMENT TECHNIQUES MEDIATION IMPACT ON THE RELATIONSHIP BETWEEN WORK-BASED LEARNING AND TEAMWORK SKILLS DEVELOPMENT**

Rising the structural model of assessment techniques' impact on the relationship between work-based learning and

teamwork skills development involved the application of analysis moment of structures (AMOS) so as to bring all the constructs together into a single structural model. This is important in order to show the relationship between the constructs in agreement with the stated hypothesis for the study. The full structural model is understood when both models are combined [34].

Models describing the CFA usually show how the variables are interpreted by the indicators. This is usually employed in multivariate research models using a combination of factor analysis and multiple regression as well as path analysis [35], [36]. Consequently, it helps to clearly state the relationship trend between variables (latent or observable variables). Unidimensionality, validity, and reliability are usually applied as an effective technique to validate the model. Therefore, these processes were adequately considered before modeling their interrelationship. The procedures for construct validity to include initial and revised (modified) measurement models' goodness of fit for the constructs were adequately considered. This has to do with the level of suitability of the parameter estimates for normality, modification indices, standardized residual and factor loadings of the CFA outcome [37].



**FIGURE 4. Initial modeling of the impact of assessment techniques on the relationship between work-based learning and teamwork skills development.**

Fig. 4 presents the initial modeling of the impact of assessment techniques on the relationship between work-based learning and teamwork skills development. However, after obtaining the reliability and validity of the constructs, the initial model has the following values: Chi-Square = 417.526, DF = 91, Ratio = 4, 588, P = 000, CFI = .816, IFI = .818, TLI = .788, RMSEA = .118. Hence, it did not meet the requirements for the goodness of fit.

The modified structural model of this study is presented in Fig. 5. The model has been updated to enhance the modification indices in compliance with the specifications of SEM / AMOS. To address the problem, the redundant items

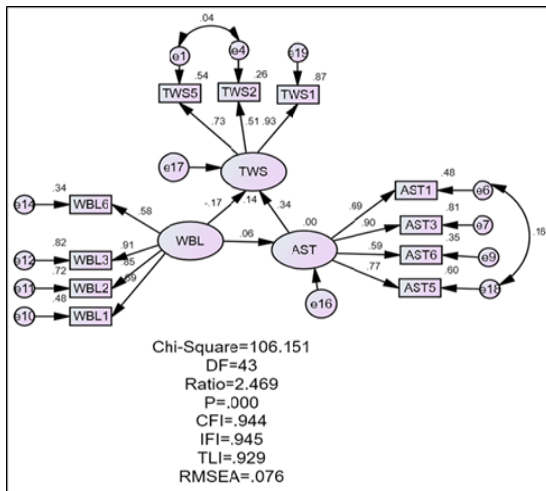


FIGURE 5. Modified modeling of the impact of assessment techniques on the relationship between work-based learning and teamwork skills development.

(TWS3, TWS4, and WBL5 were deleted for having values of modification indices more than 15.0. The following values were derived after the modification: Chi-Square = 106.151, DF = 43, Ratio = 2.469, P = .000, CFI = .944, IFI = .945, TLI = .929, RMSEA = .076. The output of the revised model indicates that all the fit indexes have achieved a satisfactory level of fitness.

IV. HYPOTHESES TESTING

In order to determine the hypothesized relationship between the exogenous variable (work-based learning), mediating variable (assessment techniques) and the endogenous variable (teamwork skills development), SEM/AMOS version 20 was employed. Kyriazos [38] suggested the standard decision rule for a relationship between constructs to be significant as: (t-value ≥ 1.96 and p-value is ≤ 0.05). This was used here to determine the significance of the path coefficient between independent variables, mediating variables and the dependent variable.

The result of the path analysis shows that 1) the possibility of attaining a critical ratio as large as -2.563 in absolute value is less than 0.010, as shown in the AMOS estimates in Table 2. In other words, the work-based learning has a significant negative relationship with teamwork skills development among students of technical colleges. Meanwhile, 2) the likelihood of obtaining a critical ratio as large as 0.813 in absolute value is 0.416, as shown in the AMOS estimates in Table 2. This implies that the work-based learning have an insignificant positive relationship with assessment techniques among students of technical colleges. However, 3) the possibility of attaining a critical ratio as large as 8.570 in absolute value is less than 0.00, as shown in the AMOS estimates in Table 2. This indicates that the assessment techniques have a significant (indirect effect) positive mediation impact on teamwork skills among students of technical colleges.

TABLE 3. Standardized regression weight and its significance for the entire path in the model.

			Estimate	S.E.	C.R.	P	Label
TWS	<--	WBL	-.245	.095	-2.563	.010	W2
AST	<--	WBL	.057	.070	.813	.416	W1
TWS	<--	AST	.484	.056	8.570	***	W3

V. FINDINGS AND DISCUSSION

From the hypotheses tested, the relationship among the variables of the study was determined, hence, the impact of assessment techniques on the relationship between work-based learning and teamwork skills development was determined. Work-based learning has an insignificant direct negative relationship on teamwork skills development, while, work-based learning has a direct insignificant positive relationship on assessment techniques. On the other hand, assessment techniques have a significant positive mediation impact on teamwork skills development. Consequently, assessment techniques have severally been used to predict the development of soft skills among students. Besides, based on the analyzed data in this study, assessment techniques have been found to have a significant indirect effect on teamwork skills development. The above findings are in line with the outcome of [39] and [40] who, in their separate studies confirmed the significance of assessment techniques in the development of skills. Assessment techniques are said to have one of the most critical influences on students' learning, therefore, assessment techniques have a deep impact on what and how students study, how much they study and how efficiently they study [41]. Apparently, the findings of this study imply that work-based learning would have a significant positive impact on teamwork skills development through the application of suitable assessment techniques at technical colleges in Nigeria.

VI. CONCLUSION

The purpose of this study was to examine the impact of assessment techniques on the relationship between work-based learning and teamwork skills development among students of technical colleges in Nigeria. This study has raised the issue that the assessment techniques are significant to the success of teamwork skills development among students of technical colleges. Assessment techniques were found to significantly mediate the relationship between work-based learning and teamwork skills development.

By the findings of this study, it would therefore, be anticipated that teamwork skills should be enhanced when work-based learning is used in collaboration with appropriate assessment techniques. Therefore, technical teachers should adapt the assessment techniques that are appropriate, fair, support active and experiencing learning, and easily understood by both faculty and students. Hence, curriculum planners should review the curriculum of technical colleges

to gear more toward the application of activity-based learning in collaboration with appropriate assessment techniques for effective integration of teamwork skills. Difficulties and drawbacks exist while conducting research; nevertheless, the objective of the study also needs to be achieved simultaneously without jeopardizing the credibility and quality of the study. Consequently, this research was limited by numerous factors, such as; participation in the research was voluntary, the study group was restricted to technical teachers from public technical colleges, Kaduna state, Nigeria, and the results of the study may not be applicable to institutions outside the study group

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