

THE COMPETENCY-BASED TRAINING & ASSESSMENT, AND IMPROVEMENT OF TECHNICAL COMPETENCIES AND CHANGES IN PEDAGOGICAL BEHAVIOR

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Abstract: This research aims to analyze the improvement of technical competencies and changes in pedagogical behavior on competency-based training and assessment. We developed a modified conceptual model with the help of previous literature. We examined the impact of competency-based training & assessment on traditional teaching methodologies, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. We also incorporated behavior & psychological aspects of teachers as mediators in our modified conceptual model and examined the mediation between exogenous and endogenous variables. We have collected the data of 458 respondents using a modified structured questionnaire from public and private teachers of Sindh technical and vocational institutions online from different regions of Sindh, Pakistan. For the data analyses, we employed SEM-based multivariate techniques. The findings exhibit that the direct relationship between competency-based training & assessment (independent variable) has a significant and positive influence on traditional teaching methodologies, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. Similarly, the findings further concluded that behavior & psychological aspects are potent mediators between competency-based training & assessment and traditional teaching methodologies, teaching-learning abilities, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. Hence, the behavior & psychological aspects of teachers is a vital factor that accelerates the impact of competency-based training & assessment on the dependent variables. The outcomes of this research are imperative theoretical and practical implications, which may guide the direction of future researchers and policymakers of vocational training and education.

Keywords: Competency-based training & assessment, traditional teaching methodologies, practical teaching strategies, technical knowledge, pedagogical & technical components, behavior & psychological aspects.

JEL Classification: C12, C42, I21.

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Introduction

Teachers' training is one of the critical and sustainable development goals in technical education & vocational training (TVET) to promote employability and up-gradation of expertise and skills to increase industry-driven education practices and competencies to up-to-date quality of training and education provision (Kennedy et al., 2021). However, the competency-based training & assessment (CBT&A) approach for improvement of teacher training is based on CBT&A curricula on requisite skills. The competency-based training & assessment (CBT&A) approach allows vocational education teachers to regulate updated resources and learning requirements better and efficient manner (Ahmed & Sayed, 2021). Professional development and continuous training of the teachers are vital for the implementation of competency-based training & assessment (CBT&A) delivery in Pakistan (Ahmed & Sayed, 2021). Sudarsono et al. (2021) argue that TVET is the multidisciplinary workplace-based approach, requiring up-skilling of flexible teachers and accepting the change of industry demanded qualifications. The technical education & vocational training (TVET) graduates go directly into the labor market and industry, thus capacitating teachers only on pedagogical knowledge deficient them identical and industrial expertise (Wildeman et al., 2021). Yunos et al. (2017) found that industries are the main primary holder for teachers' professional development in vocational education because of the swift development and change within the environmental hazards of the industrial complex.

Pakistan technical education & vocational training (TVET) reform was initiated in 2011 with the German Federal Ministry of Economic Cooperation (BMZ) and the European Union to impart a dual-training-based TVET curriculum (Ahmed & Sayed, 2020). Skilling teachers need hands-on training, firstly pedagogy training on the competency-based curriculum and then mastering them on technical competencies to cascade the competencies in their students (Ahmed & Sayed, 2021). Training the teachers on a skills-based module ensures producing a highly skilled workforce to improve governance, relevance, and quality measures (Cong & Wang, 2012). Zineb et al. (2017) point out that training is the driving force of the competency-based approach for the employment of graduates, which is

linked to the world of work opportunities. The reason for introducing a competency-based approach in technical and vocational education is to ensure good training delivery parallel to industry practices. Furthermore, training of TVET teachers on new skills enables versatility and excels graduate or students on requisite industry skills (Caves et al., 2021).

Improved competency-based training & assessment (CBT&A) curriculum has become a core component of TVET (Maknun et al., 2021). Pakistan's national vocational qualification framework (NVQF) has five levels on which skill up-gradation training is imparted to teachers (Omar et al., 2020). To produce industry demanded graduates in vocational institutions, priority should be given to subject specialists. Most of the teachers employed possessed technical skills but lacked the professional capacity to undertake competency-based training & assessment (Ismail et al., 2020). Thus, this study will focus on the instructors' strategies and training outcomes to upgrade the relevancy of the technical and theoretical curriculum. Improve the teaching quality of technical education & vocational training (TVET) teachers will ultimately raise the quality of technical and vocational education (Susanti et al., 2020). Whereas national government policies have converged strong expectations in their TVET systems, they often intervene with high-level government provisions (Omar et al., 2020). Change of government context influences TVET policies, which strongly affect vocational learning and teaching practices. Changes within the system are rapid and frequent, challenging instructors (Skiba, 2020; Zinn et al., 2019).

The proposed study analyzes the teachers' behaviors on technical knowledge, professional development, pedagogical skills, teaching-learning abilities of vocational & educational teachers as reviewed in the literature (Csíkos et al., 2018). Further, the study reviews traditional teaching methodologies, technical learning abilities, practical teaching strategies, technical knowledge and pedagogical teaching components as dependent variables, and psychological and behavioral components as mediators.

1. Theoretical Background

Professional development and continuous training of the teachers are vital for the

implementation of competency-based training & assessment (CBT&A) delivery in Pakistan (Ismail et al., 2020). CBT has gained subsequent importance in both developing and industrialized nations. Teaching & learning design of competency-based training is necessary at micro and macro-level institutions (Dominguez-Valerio et al., 2019). The current research mainly focuses on the macro-level technical education & vocational training (TVET) system. Most international research shows that TVET instructors are fresh graduates or have been in the same position in an institute for ages, thus lacking industrial exposure and experience (Lai et al., 2019).

1.1 Competency-based Training & Assessment

Tran and Nyland (2013) define competency-based training in vocational and technical education as knowledge, skills, attitude, behavior, and action essential to direct competencies and acquired standards needed in the labor market. Whereas, Zineb et al. (2017) and Ahmed and Sayed (2021) comment that dual training is one of the main components of the competency-based training & assessment (CBT&A) approach, designed to fit training employees. CBT curriculum is an extensive training program for the capacity building of the informal education sector, a German module of training in the technical and vocational education system to employer-led training-oriented system (Yunos et al., 2019). Pakistan technical education & vocational training (TVET) reform started in 2011 on the OECD model, which is known as the national vocational qualification framework (NVQF) that was developed in 2013 to develop CBT qualifications (Ahmed & Sayed, 2021) from level 1–5 on industry-driven trades to assess the outcome of graduates on knowledge & skills and understanding & responsibilities of the labor market (Ismail et al., 2020; Dymock & Tyler, 2018).

1.2 Competency-based Training & Assessment (CBT&A) and Traditional Teaching Methodologies

Technical education & vocational training (TVET) teachers have been the key players in the fundamental overhaul of the vocational education system in Pakistan (Ahmed & Sayed, 2020). According to Csíkos et al. (2018),

judgements of teachers in enhancing their career and progress in professional growth as examining the regulations of the system that how it can better assess the teachers. Several studies have been carried out in Malaysia on technical education & vocational training (TVET) teachers' training; for instance, Aziz et al. (2019), Yunos et al. (2019), and Ismail et al. (2017) explained that teachers' competency and skills affect students' progress in TVET training and reveal that technical and pedagogical skills training improve technical education & vocational training (TVET) teachers. Sern et al. (2018) and Mohamad et al. (2009) proved that teachers teaching traditional methodologies have limited or no exposure to work-based, project-based and blended learning concepts. The lack of pre-service and in-service training and continuous delivery on traditional curriculum created a significant gap in the learning outcome of students' performances, which are inadequate for employability (Zinn et al., 2019; Santosa & Muchlas, 2017).

H1: CBT&A has a significant & positive impact on traditional teaching methodologies (teaching).

1.3 Competency-based Training & Assessment (CBT&A) and Teaching Learning Abilities

Most international research shows that technical education & vocational training (TVET) instructors are fresh graduates or have been in the same position in an institute for ages (Reid, 2017), thus lacking industrial exposure and experience (Paryono, 2017). The incompetence of the corporate culture amongst TVET blocked practical insights of operational culture to graduates (Sari & Seniati, 2017). Omar et al. (2020) emphasized that the government focuses on skilling TVET teachers in induction programs to equip them with the latest industrial trends and demands instead of unskilled human resources. On the other hand, Ismail et al. (2017) stated that people believe TVET teachers trained on the competency-based curriculum in evaluation and assessment have the maximum ability to demonstrate skills and enhance continuous learning and knowledge. Wildeman et al. (2021) argue that basic practices suggest that teachers' perception, learning, and behavior influence classroom teaching and directly affect students' performances. Omar et al. (2020) reflect that

the TVET environment is highly practical-based and determines the skills learned by the graduates needed for the workforce in the labor market. Therefore, curricula taught in technical education & vocational training (TVET) institutions enhance their cumulative practical and theoretical knowledge (Zineb et al., 2017; Beverborg et al., 2015).

H2: CBT&A has a significant & positive impact on teaching-learning abilities (learning).

1.4 CBT&A and Technical Training and Technical Knowledge

Competency-based curriculum improvement in vocational and technical training and education has gained more attention in developing and industrialized countries (Cong & Wang, 2012). The current research in technical & vocational education and training (TVET) primarily focuses on the macrolevel TVET systems (Sari & Seniati, 2017). There is a clear difference between the pedagogical and practical resources used in the vocational institutes, which are at par with those used in the industrial sector (Zinn et al., 2019). Zineb et al. (2017) introduced competency-based training in vocational teaching for early specialization in industry-driven trades. It is based on three types of training, cooperative, work-based and institutional. Tran and Nyland (2013) and Omar et al. (2020) analyzed the relationship between knowledge, skills, and attitude (competency traits) with practical-based learning. They demonstrated that holistic traits empower technical education & vocational training (TEVT) teachers' knowledge and inculcate skills and attitude traits among students when entering the job market. Thus, two central hypotheses derived from the above discussions:

H3: CBT&A has a significant & positive impact on the effectiveness of technical training on the practical teaching strategies and attitude (practical).

H4: CBT&A has a significant & positive impact on preparedness in pedagogical style and technical knowledge (technical knowledge).

1.5 CBT&A and Pedagogical and Technical Components

A research work of Baqadir et al. (2011) has mentioned the necessary adjustments between vocational education and workplace requirements that should be focused on authentic and practical knowledge on

technological developments and trends applied in various industries. In Pakistan majority of the teachers employed possessed technical skills but lacked the professional capacity development to undertake competency-based training & assessment (Ahmed & Sayed, 2021). The workplace-based training approach aims at deviating from the traditional school-based training by integrating a competency-based training (CBT) curriculum with the workplace to create a different learning paradigm (Osman & Kamis, 2019; Powell et al., 2011). In Pakistan, technical education & vocational training (TVET) teachers are trained in industrial and classroom training through a blended life-long learning approach (Ahmed & Sayed, 2020). Agrawal (2017), and Omer et al. (2020) clearly state that competent and trained teachers are suitable to deliver competency-based training & assessment (CBT&A) curricula which are 70% practical and 30% theoretical if they have been trained.

H5: CBT&A has a significant & positive impact on pedagogical and technical components (pedagogy).

1.6 CBT&A and Psychological Behavior

As Ayiah-Mensah et al. (2014) and Freire and Giang (2012) defined, education psychology is a scientific method used to understand the variety of characteristics of teachers, learning tasks, and adaptability in educational settings to interact collective human behavior. According to American Psychological Association (APA), in 1997, behavior based on 14 learner-centered principles to judge the physical, social, learner, cognitive, and emotional factors are some factors (Obwoye et al., 2016; Siahaan et al., 2021). Ibrahim et al. (2015), Siahaan et al. (2021), and Powell et al.'s (2011) empirical investigation envisage behavior influences realistic human assumptions about social interaction, human cognition, and emotions, affecting decision-making based on various human behavior perspectives.

1.7 Mediation of Behavior & Psychological Aspects

The pre-experimental research by Kennedy et al. (2021) and Omar et al. (2020) shows that teacher well-being plays an essential role in students' well-being. It points out that social-emotional development and mental health positively affect their professional growth and

concludes that teachers' self-efficacy has a positive relationship with organizational commitment, job satisfaction, student-teacher relationship, and work relationship satisfaction. According to Sari and Seniati (2017) and Tavşancil and Yalçın (2016), professional commitment mediates positively to organizational commitment and vice versa in an educational setting. On the other hand, Yunos et al. (2018), Lavendels et al. (2012) reflect work burnout and psychological empowerment to mediate professional recognition. They partially mediate the work pressure and work stress. Reid (2017) works on the phenomenon of particular staff training procedures to analyze the performance and competency of trained people behavior on four different strategies: modeling strategies, performance practice, instruction, and feedback. Previous literature advocates the mediation of behavior & psychological aspects as a potent mediator, such as Cummings et al. (2020), Reddy et al. (2011), Yunos et al. (2017), and Stoliarchuk (2020). Thus we have framed the following hypotheses:

H6A: Behavior & psychological aspects have a significant mediation between CBT&A and traditional teaching methodologies.

H6B: Behavior & psychological aspects have a significant mediation between CBT&A and teaching-learning abilities.

H6C: Behavior & psychological aspects have a significant mediation between CBT&A, and practical teaching strategies & attitude.

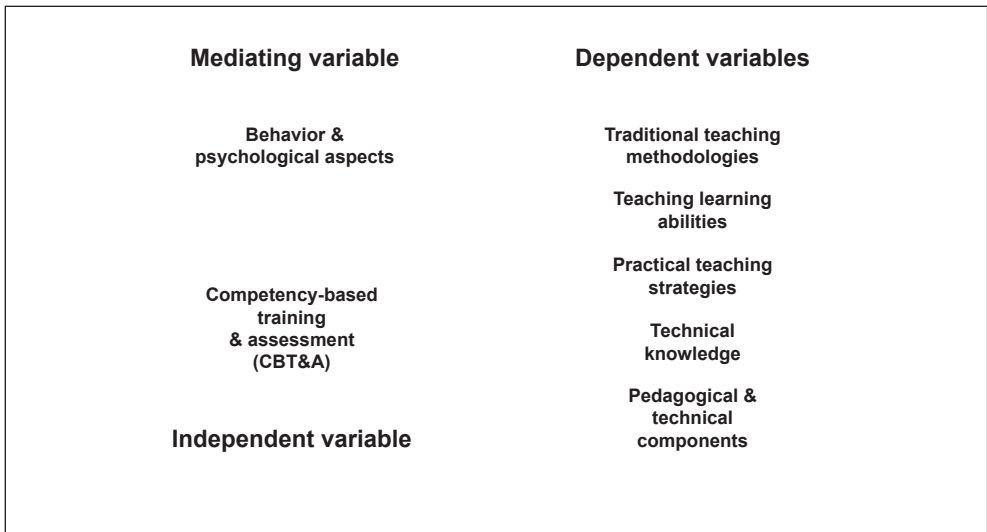
H6D: Behavior & psychological aspects have a significant mediation between CBT&A and technical knowledge.

H6E: Behavior & psychological aspects have a significant mediation between CBT&A and pedagogical and technical components.

1.8 Conceptual Framework of the Study

We have derived a modified conceptual framework and questionnaire from the previous literature. However, the modified conceptual frame is derived from previous studies, such as Zinn et al. (2019), Ahmed and Sayed (2020), Baqadir et al. (2011), Mohamad et al. (2009), Skiba (2020), Zineb et al. (2017), Ismail et al. (2017), Omar et al. (2020), Csíkos et al. (2018), and Yunos et al. (2019). Finally, items for the mediating variable behavior were extracted from the previous literature, for instance, Sari and Seniati (2017), Stoliarchuk (2020), Beverborg et al. (2015), and Yunos et al. (2017). Fig. 1 demonstrates the graphical representation of the modified conceptual framework.

Fig. 1: Modified conceptual model of the undertaken study



Source: own

2. Research Methodology

2.1 Research Design and Scaling

The study is intended to analyze the structural and behavioral changes and provide evidence on which the competency-based training & assessment (CBT&A) training program for skills up-gradation of teachers is based on the vocational education system of Pakistan and specifically in the province of Sindh. It is cross-sectional and quantitative and opted deducted technique to complete the study process. The main items were taken from the previous literature. The items of competency-based training & assessment were attained from the previous literature, such as Yunos et al. (2019), Dymock and Tyler (2018), Tran and Nyland (2013), and Ahmed and Sayed (2021). The measurement scales of traditional teaching methodologies are extracted from the previous literature, for instance, Aziz et al. (2019), Yunos et al. (2019), Sern et al. (2018), and Mohamad et al. (2009). The measurement scales of teaching-learning abilities are taken from previous studies (Paryono, 2017; Reid, 2017; Wildeman et al., 2021). Similarly, the modified items of technical training & technical knowledge were extracted from Cong and Wang (2012), Zinn et al. (2019), and Zineb et al. (2017). The measurement scales of pedagogical and technical components are taken from the previous studies, for instance, Baqadir et al. (2011), Osman and Kamis (2019), Powell et al. (2011). However, the modified items of behavior & psychological aspects are taken from previous studies such as Kennedy et al. (2021), Cummings et al. (2020), Reddy et al. (2011), Yunos et al. (2017), and Stoliarchuk (2020).

2.2 Sampling Strategy and Data Collection

We developed a modified structured five-point Likert scale to collect the data from the respondents' purposive sampling (non-probability) technique. Initially, we have contacted 700 public and private Sindh technical and vocational institutions online (email & google form) from the age bracket of 25–50 years who were teaching at least for five years. Further, we segregated the purposive sampling into Quota-sampling for better representation of the focused group. We were able to get 458 responses from different regions of Sindh,

Pakistan. However, we had disseminated 530 questionnaires to the teachers trained in the skills upgradation training program. We have only received 458 completely filled questionnaires, with a response rate of 86.63%, which is significantly favorable for the online mode.

2.3 Estimations Techniques

This research employed various statistical techniques to analyze the data; primarily, we used descriptive statistics to examine the fundamental characteristics of constructs. We used the SEM-based multivariate modeling in which we employed exploratory factor analysis and confirmatory factor analysis. The exploratory factor analysis is primarily used to examine the validation of items & constructs and suitability of the collected data. We employed several tests such as principal component analysis to measure the factor loading, reliability, and validity in exploratory factor analysis. Similarly, we used Kaiser Meyer Olkin (KMO) analysis, Bartlett's test of sphericity, and the total variance explained the technique in exploratory factor analysis. The confirmatory factor analysis is used to analyze the hypothesized measurement and structural model. Finally, we used conditional process modeling to examine the direct and indirect relationship between the independent variable constructs.

2.4 Demographic Profile

Tab. 1 shows the respondents' demographic profile, explaining that 458 teachers' responses were collected from those who participated in the training program. The rate of response is 86.63% which is categorized as satisfactory. In the data we collected, 244 (53.3%) responses are from the males, and 214 (46.7%) from the females, respectively – Tab. 1 exhibits the remaining demographic analysis.

3. Research Results

3.1 Descriptive Statistics

In the initial stage, we examine the fundamental characteristics of constructs through descriptive statistics. For this purpose, we extracted the readings of mean, standard deviation, skewness, and kurtosis. The outcomes of Tab. 2 exhibit that readings of standard deviation and skewness are between ± 1.5 , and kurtosis

Tab. 1: Demographic analysis

Demographics		Frequency	Percent
Gender	Male	244	53.3%
	Female	214	46.7%
Age (in years)	Under 30	167	36.5%
	30–40	81	17.7%
	40–50	53	11.6%
	Above 50	84	18.3%
Education	Secondary school certif.	227	49.6%
	Diploma in associate engineering (DAE)	139	30.3%
	Bachelors in technology (b. tech.)	54	11.8%
	Any other traditional degree (bachelors or masters)	38	8.3%
Experience (in years)	1–2	118	25.8%
	3–5	127	27.7%
	6–10	54	11.8%
	10–20	70	15.3%
	More than 20	89	19.4%
National vocational qualification	NVC Level 1	71	15.5%
	NVC Level 2	203	44.3%
	NVC Level 3	95	20.7%
	NVC Level 4	57	12.4%
	NVC Level 5	32	7.0%
Total – N		458	

Source: own

is ± 3 . According to Byrne (2016), if standard deviation and skewness are within the range of ± 1.5 , and kurtosis is ± 3 , the data follows the normality pattern. According to Lu et al. (2020), the normality of data is the pre-requisite for SEM-based multivariate modeling.

3.2 Exploratory Factor Analysis (EFA)

The exploratory factor analysis is initially applied for condensation and reducing redundant items and constructs for the SEM-based multivariate analysis. Hence, the principal component analysis is employed with Varimax rotation to extract the rotated component matrix, which shows the factor loading of each item. The considered hypothesized model has one independent variable, i.e., competency-based training & assessment with five measures.

However, traditional teaching methodology (4 items), practical teaching strategies (5 items), technical knowledge (4 items), pedagogical & technical components (3 items), and teaching-learning abilities are taken as dependent variables (3 items). We have also incorporated behavior & psychological aspects as a mediating variable with four measures. The findings of Tab. 3 exhibit that the factor loading of each item is more significant than 0.70. Thus, we can retain all the items and constructs (Ahmed et al., 2021).

3.3 Principal Component Analysis

We employed principal component analysis with the Varimax rotation method to extract the rotated component matrix, which helps analyze reliabilities and validates the items and

Tab. 2: Descriptive analysis

Constructs	N	Mean	Std. dev.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. error	Statistic	Std. error
Competency-based training & assessment	458	3.8406	1.07015	-0.938	0.114	0.371	0.228
Traditional teaching methodologies	458	3.8210	1.07825	-0.870	0.114	0.215	0.228
Teaching learning abilities	458	3.9629	1.09341	-0.996	0.114	0.403	0.228
Practical teaching strategies	458	3.9105	0.96246	-1.033	0.114	1.426	0.228
Technical knowledge	458	3.9891	1.10593	-1.012	0.114	0.364	0.228
Pedagogical & technical components	458	3.8253	1.05849	-0.825	0.114	0.288	0.228
Behavior & psychological aspects	458	3.9039	1.06236	-0.973	0.114	0.530	0.228

Source: own

constructs (Ahmed et al., 2020). The findings of Tab. 3 exhibit that each item's readings of factor loading are between 0.74 to 0.95, which meets the pre-requisite of discriminant validity (Hair et al., 2019). According to Fornell and Larcker (1981), the reading of each construct's average variance extracted (AVE) is higher than 0.50, which fulfills the requirement of convergent

validity. Similarly, the readings of Cronbach's alpha and composite reliability of each construct are higher than 0.70, which is a pre-requisite for the SEM-based multivariate modeling. Hence, it is established that reliabilities and validities of items and constructs followed the pre-requisites of the SEM-based multivariate approach. Thus, we can proceed with further analysis.

Tab. 3: Reliability and validity of constructs – Part 1

Factors	Items	FL	CA	CR	AVE
Competency-based training & assessment	CBTA1	0.930	0.887	0.872	0.789
	CBTA2	0.883			
	CBTA3	0.934			
	CBTA4	0.714			
	CBTA5	0.783			
Traditional teaching methodologies	TTM1	0.930	0.889	0.904	0.795
	TTM2	0.905			
	TTM3	0.865			
	TTM4	0.940			
Teaching learning abilities	TLA1	0.932	0.926	0.947	0.857
	TLA2	0.906			
	TLA3	0.944			

Tab. 3: Reliability and validity of constructs – Part 2

Factors	Items	FL	CA	CR	AVE
Practical teaching strategies	PTS1	0.931	0.883	0.902	0.783
	PTS2	0.783			
	PTS3	0.841			
	PTS4	0.902			
	PTS5	0.943			
Technical knowledge	TK1	0.931	0.902	0.837	0.814
	TK2	0.892			
	TK3	0.869			
	TK4	0.935			
Pedagogical & technical components	PTC1	0.928	0.910	0.935	0.829
	PTC2	0.896			
	PTC3	0.932			
Behavior & psychological aspects	BPA1	0.933	0.895	0.885	0.804
	BPA2	0.747			
	BPA3	0.902			
	BPA4	0.947			

Source: own

Note: Rotation method: Varimax with Kaiser normalization;
Rotated method: Principal component analysis.

3.4 Kaiser-Meyer Olkin (KMO) and Bartlett's Sphericity Techniques

As suggested in Kaiser (1974), Bartlett's sphericity test and KMO analysis are employed to examine the fitness and suitability of the data. The findings of Tab. 4 exhibit that the reading of KMO is well ahead, i.e., 0.702, against the recommended limits of 0.50. Similarly, the value of Bartlett's sphericity shows $p < 0.05$. Thus both Bartlett's sphericity test and KMO analysis validated the fitness and suitability of the data.

3.5 Total Variance Explained

The outcomes of Tab. 5 confirmed that the initial eigenvalues of each construct are more significant than one, and the cumulative total variance is 77.022 (77.02%), which validates the showing trustworthiness of the data, and considered variables. According to Hair et al. (2019), if the total cumulative variance is higher than 0.50, it is considered satisfactory. Hence, the total cumulative variance is 77.022, which is considered good, and each eigenvalue is

Tab. 4: KMO and Bartlett's techniques

Kaiser-Meyer-Olkin measure of sampling adequacy		0.702
Bartlett's test of sphericity	Approx. chi-squared	7,605.728
	Df	378
	Sig.	0.000

Source: own

Tab. 5: Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.071	10.968	10.968	3.071	10.968	10.968	2.639	9.426	9.426
2	2.684	9.587	30.946	2.684	9.587	30.946	2.612	9.330	28.096
3	2.233	7.977	57.499	2.233	7.977	57.499	2.578	9.205	55.869
4	2.172	7.757	65.256	2.172	7.757	65.256	2.552	9.113	64.982
5	1.164	4.158	69.414	1.164	4.158	69.414	1.190	4.250	69.232
6	1.100	3.928	73.343	1.100	3.928	73.343	1.119	3.997	73.228
7	1.030	3.679	77.022	1.030	3.679	77.022	1.062	3.793	77.022

Source: own

Note: Extraction method: Principal component analysis.

higher than one. Therefore, the reliability of data and constructs are established.

3.6 Confirmatory Factor Analysis (CFA)

According to Ahmed et al. (2020) and Hair et al. (2019), the CFA is a direct method to evaluate the considered hypothesized measurement model. The considered hypothesized measurement model has seven constructs and twenty-eight measures. The considered hypothesized measurement model has 5 competency-based training & assessment items as an independent variable and 4 items of traditional teaching methodologies. However, 5 items of practical teaching strategies, 4 technical knowledge items, and 3 pedagogical & technical components are incorporated as dependent variables. We have also incorporated behavior & psychological aspects as a mediating variable with 4 measures. The findings of Fit-indices measures are within the the acclaimed range, for instance, χ^2/df : 4.01; GFI: 0.97; NFI: 0.93; IFI: 0.98; TLI: 0.99; CFI: 0.96; RMSEA: 0.033; RNI: 0.97; PCFI: 0.85; and PNFI: 0.84 (Hair et al., 2019; Ahmed et al., 2021). Thus, it is finally established that the considered hypothesized measurement model is suitable for the dependent variables.

3.7 Structural Equation Modeling (SEM)

According to Hair et al. (2019), confirmatory factor analysis (CFA) is the right approach

to examine the structural model; thus, we considered CFA to validate the structural modified model in SEM-based multivariate modeling. The hypothesized structural model has one independent variable, i.e., competency-based training & assessment, with five measures. However, traditional teaching methodology (4 items), practical teaching strategies (5 items), technical knowledge (4 items), pedagogical & technical components (3 items), and teaching-learning abilities are taken as dependent variables (3 items). We have also incorporated behavior & psychological aspects as a mediating variable with four measures. The findings of Fit-indices values for the structural model exhibit that all the fit-indices measures are within the recommended range, for instance, χ^2/df : 4.11; GFI: 0.96; NFI: 0.92; IFI: 0.97; TLI: 0.98; CFI: 0.97; RMSEA: 0.037; RNI: 0.96; PCFI: 0.84; and PNFI: 0.83 (Ahmed et al., 2021). Thus, it is finally established that the considered hypothesized structural model is suitable for the dependent variables.

3.8 Hypothesized Direct Relationship

The conditional process modeling is used for the direct hypothesized relationship. The standardized regression weights are measured between independent variables and outcome variables. The outcomes of Tab. 6 exhibit that the direct relationship between independent and dependent variables are substantiated and hypotheses $H1$ to $H5$ are validated ($T > \pm 1.96$

& $p < 0.05$). Thus, it is finally concluded that that competency-based training & assessment have a significant and positive influence on traditional teaching methodologies, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. Furthermore, The direct hypothesized relationship showed an individual construct's impact. Thus, it exhibited that the competency-based training & assessment has the highest impact on traditional teaching methodologies, i.e., 0.8043, then pedagogical & teaching components, and teaching-learning abilities have impacts of 0.7552 and 0.7510, respectively. Thus, it is confirmed the competency-based training & assessment has a more significant and positive impact on traditional teaching methodologies, pedagogical & teaching components, and teaching-learning abilities. However, competency-based training & assessment has the most negligible impact on practical teaching strategies and technical knowledge. The classifications of the finding revealed that competency-based training & assessment positively impact the transformation

of traditional teaching habits on the professional development of teaching and learning abilities of vocational and technical teachers. The pedagogy and technical components have a significant positive impact on competency-based training & assessment (CBT&A) delivery. However, a recent study in the Philippines also validates that technical education & vocational training (TVET) teachers demonstrated positive change in using proactive classroom teaching practices when provided in-service training. Their knowledge of learning activities, preparations, and importance has a positive impact on their preparedness. It further expanded their classroom and laboratory teaching (Ahmed & Sayed, 2021; Kharkivska, 2020). The study further exhibits that hands-on training (practical) on equipment and technical understanding. However, relevance has the most negligible influence due to limited materials, minimum industrial experience, and practical exposure to modern technologies and industrial machinery (Alkhodary et al., 2020; Skiba, 2020; Zinn et al., 2019; Havercamp, 2021). The findings of the undertaken study

Tab. 6: Hypothesized direct relationship

Hypotheses	Independent variables	Dependent variables	Regression paths	Standardized regression weights (β)	SE	T	P	Decision
<i>H1</i>	Competency-based training & assessment	Traditional teaching methodologies	CBTA† → TTM	0.8043	0.028	28.30	0.000	Supported
<i>H2</i>	Competency-based training & assessment	Teaching learning abilities	CBTA† → TLA	0.7510	0.034	22.09	0.000	Supported
<i>H3</i>	Competency-based training & assessment	Practical teaching strategies	CBTA† → PTS	0.2934	0.033	8.86	0.000	Supported
<i>H4</i>	Competency-based training & assessment	Technical knowledge	CBTA† → TK	0.3577	0.034	10.35	0.000	Supported
<i>H5</i>	Competency-based training & assessment	Pedagogical & teaching components	CBTA† → PTC	0.7552	0.029	25.24	0.000	Supported

Source: own

Note: † = Predictor: CBTA = Competency-based training & assessment; Dependent variables: TTM = Traditional teaching methodologies; TLA = Teaching learning abilities; PTS = Practical teaching strategies; TK = Technical knowledge; PTC = Pedagogical & technical components.

reveal the professional teaching development plan has been successful in improving and strengthening teaching practices (pedagogy), vocational and technical competencies, learning attitude in the context of competency-based training & assessment (CBT&A) curricula and also measured that previously possessed technical knowledge and practical teaching strategies have influenced and enhanced when undertake professional training (Lee & Park, 2021; Ismail et al., 2017; Stoliarchuk, 2020).

3.9 Mediation Analysis

The conditional process analysis is applied for measuring the influence of mediating variables, for instance, behavior & psychological aspects in an association between competency-based training & assessment as an independent variable, and traditional teaching methodologies, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. Tab. 7 exhibits the outcomes of two different methods to examine the mediation. The first method, the bootstrapping method, was suggested by Hayes and Rockwood (2020). However, the second method, which is known as the Normal theory method. The findings exhibit that zero does not lie between Boot LLCI and Boot ULCI. Thus, the bootstrapping method

confirmed the perfect mediation of behavior & psychological aspects between exogenous and endogenous constructs. Similarly, the Normal theory method confirmed the perfect mediation because $Z > \pm 1.96$ & $p < 0.05$ (Štreimikienė & Ahmed, 2021). Therefore, it is concluded that behavior & psychological aspects are potent mediators between the exogenous and endogenous variables, and it is finally concluded that hypotheses *H6A* to *H6E* are substantiated. It is established that behavior & psychological aspects have a significant and positive mediator between competency-based training & assessment as an independent variable. However, traditional teaching methodologies, teaching-learning abilities, practical teaching strategies, technical knowledge, and pedagogical & technical components as outcome variables. The study's outcome depicts complex learning behaviors and psychological aspects that positively influence pedagogical, methodological, subject didactic training on modular curricula (Lastovets, 2020; Štreimikienė & Ahmed, 2021; Ahmed & Sayed, 2020; Clawson, 2021). The study also revealed that behavior & psychological factors also act as positive mediators on competency-based training and teaching practices, learning, practical knowledge, pedagogy, and technical components. Teachers feel empowered during

Tab. 7: Mediation analysis

Hypotheses	Mediation	Bootstrapping method				Normal theory method				Decisions
		Indirect effect	Boot SE	Boot LLCI	Boot ULCI	Indirect effect	SE.	Z*	Prob.**	
<i>H6A</i>	CBTA → BPA → TTM	0.5719	0.031	0.511	0.633	0.5719	0.032	17.52	0.000	Supported
<i>H6B</i>	CBTA → BPA → TLA	0.1609	0.023	0.117	0.209	0.1609	0.027	5.84	0.000	Supported
<i>H6C</i>	CBTA → BPA → PTS	0.4240	0.030	0.367	0.486	0.4240	0.030	13.95	0.000	Supported
<i>H6D</i>	CBTA → BPA → TK	0.4910	0.030	0.432	0.551	0.4910	0.032	15.05	0.000	Supported
<i>H6E</i>	CBTA → BPA → PTC	0.6140	0.030	0.554	0.672	0.6140	0.034	17.98	0.000	Supported

Source: own

Note: Predictor: CBTA = Competency-based training & assessment; Dependent variables: TTM = Traditional teaching methodologies; TLA = Teaching learning abilities; PTS = Practical teaching strategies; TK = Technical knowledge; PTC = Pedagogical & technical components; Mediating variable: BPA = Behavior & psychological aspects; * denotes $Z > \pm 1.96$; & ** $p < 0.05$.

training, and their attitude, skills, and knowledge are enhanced, increasing motivation and commitment in the workplace (Stynska et al. 2021; Horokhivska, 2020; Omar et al., 2020; Gasteratos et al., 2021; Andrienko, 2020; Kennedy et al., 2021).

Conclusions

The putative study concluded that teachers' training in technical education & vocational training (TVET) is an integral part of the development of technical education & vocational training (TVET) institutions. The competency-based training & assessment (CBT&A) model approach provided a sharp edge on traditional pedagogical methodologies and enhanced teaching-learning practices that combat modern teaching aids. The practical knowledge with current industrial demands reflects vocational teachers for training trainers ready to market. It can be strengthened through solid industry penetration and involvement of the private sector. The study further explored that the pedagogical and curricula capacity and preparedness of technical education & vocational training (TVET) professionals are at par compared to the teachers who have not been given in-service professional training. However, pre and in-service training of teachers and public sector employees is limited due to the financial and infrastructure resources and the continuously changing political environment. The change in teaching behavior, learning abilities, and increased knowledge of technical components enhanced through the program supported pre-service training on new and advanced curricula. The study also concluded that a professional training development program on competency-based training & assessment also positively influenced the behavior, attitude, motivation, and roles and responsibilities of technical education & vocational training (TVET) teachers. They can take over inspirational leadership in classrooms to strengthen the trainees' well-feeling, motivation, and learning. This research provided imperative practical and theoretical implications. The modified studied model of teachers' training provided unique measurements to the practitioners of technical education & vocational training (TVET) for future research and implementation in the TVET and participation of the industrial sector. Whereas technical education & vocational training

(TVET) authorities, development partners, and the central government should develop a digital learning platform for teachers to share knowledge and professional development. The current COVID-19 has severely affected the TVET sector due to its dual practical nature. Teachers face significant issues in digitization in the TVET sector lack access to learning resources and ICT tools and equipment. Digital and ecosystem approach for capacity will optimize time management and gain ROI. The 4.0 industry revolution has become a challenge for technical education & vocational training (TVET) teachers to continuous skills up-gradation. It can be processed by inducting new instructional design, content curation, learning architecture, and experience design by introducing a virtual TVET system for a blended learning approach. Thus reinforcement and acceleration of the digital transformation of TVET teachers and trainers supported with industrial readiness are necessary. Therefore, government and development sector working in technical education & vocational training (TVET) reform around the world initiated TVET digitalization with developing economies to cater to the increasing demand for competent and trained technical education & vocational training (TVET) teachers.

References

- Agrawal, T. (2017). Vocational education and training in India: a labour market perspective. *Journal of Vocational Education & Training*, 69(2), 246–265. <https://doi.org/10.1080/13636820.2017.1303785>
- Ahmed, A., & Sayed, K. (2020). Development of competency-based training system in Assiut-ITEC: A case study. *The Journal of Competency-Based Education*, 5(3), e01217. <https://doi.org/10.1002/cbe2.1217>
- Ahmed, A., & Sayed, K. (2021). An extensive model for implementing competency-based training in technical and vocational education and training teacher training system for Assiut-Integrated Technical Education Cluster, Egypt. *The Journal of Competency-Based Education*, 6(2), e01245. <https://doi.org/10.1002/cbe2.1245>
- Ahmed, R. R., Kyriakopoulos, G. L., Streimikiene, D., & Streimikis, J. (2021). Drivers of Proactive Environmental Strategies: Evidence from the Pharmaceutical Industry of

Asian Economies. *Sustainability*, 13(16), 9479. <https://doi.org/10.3390/su13169479>

Ahmed, R. R., Qureshi, J. A., Štreimikienė, D., Soomro, R. H., & Vveinhardt, J. (2020). Guerrilla marketing trends for sustainable solutions: Evidence from SEM-based multivariate and conditional process approaches. *Journal of Business Economics and Management*, 21(3), 851–871. <https://doi.org/10.3846/jbem.2020.10730>

Alkhodary, M. A., Farah, R. I., & Ghobashy, A. I. (2020). Competency-based education in undergraduate clinical prosthodontics: A paradigm shift in training. *The Journal of Competency-Based Education*, 5(3), e01220. <https://doi.org/10.1002/cbe2.1220>

Andrienko, E. V. (2020). The Professionalism of a Teacher-Educator: A Competency-Based Approach. *Siberian Pedagogical Journal*, 6, 44–52. <https://doi.org/10.15293/1813-4718.2006.04>

Ayiah-Mensah, F., Mettle, F. O., & Ayimah, J. C. (2014). Modelling the factors that influence career choice of technical and vocational students (a case study of Takoradi and Ho Polytechnics). *International Journal of Mathematics and Statistics Studies*, 2(5), 62–80. Retrieved from <https://www.eajournals.org/wp-content/uploads/Modelling-The-Factors-That-Influence-Career-Choice-Of-Technical-And-Vocational-Students.pdf>

Aziz, N. F. A., Ahmad, H., & Nashir, I. M. (2019). Validation of technical and vocational teachers' competency evaluation instrument using the Rasch model. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, 9(1), 18–25. <https://doi.org/10.37134/jpsmm.vol9.1.3.2019>

Baqadir, A., Patrick, F., & Burns, G. (2011). Addressing the skills gap in Saudi Arabia: does vocational education address the needs of private-sector employers? *Journal of Vocational Education & Training*, 63(4), 551–561. <https://doi.org/10.1080/13636820.2011.589533>

Beverborg, A. O. G., Slegers, P. J. C., & van Veen, K. (2015). Promoting VET teachers' individual and social learning activities: the empowering and purposeful role of transformational leadership, interdependence, and self-efficacy. *Empirical Research in Vocational Education and Training*, 7(1), 5. <https://doi.org/10.1186/s40461-015-0018-4>

Byrne, B. M. (2016). *Structural Equation Modeling with AMOS, Basic Concepts, Application and Programming* (3rd ed.), London: Routledge.

Caves, K. M., Ghisletta, A., Kemper, J. M., McDonald, P., & Renold, U. (2021). Meeting in the Middle: TVET Programs' Education–Employment Linkage at Different Stages of Development. *Social Sciences*, 10(6), 220. <https://doi.org/10.3390/socsci10060220>

Clawson, S. (2021). Special issue: The future of learning & work: How focusing on competencies will support equitable economy recovery. *The Journal of Competency-Based Education*, 6(1), e1243. <https://doi.org/10.1002/cbe2.1243>

Cong, S., & Wang, X. (2012). A Perspective on Technical and Vocational Education and Training. In D. Zeng (Ed.), *Advances in Computer Science and Engineering. Advances in Intelligent and Soft Computing* (Vol. 141, pp. 67–75). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-27948-5_10

Csikos, C., Kovács, Z., & Kereszty, O. (2018). Hungarian vocational education teachers' views on their pedagogical knowledge and the information sources suitable for their professional development. *Empirical Research in Vocational Education and Training*, 10(1). <https://doi.org/10.1186/s40461-018-0063-x>

Cummings, K., Stephens, T., & Horne, O. (2020). Evolving practices to improve student performance and efficiency in competency-based postsecondary technical training. *The Journal of Competency-Based Education*, 5(2), e01208. <https://doi.org/10.1002/cbe2.1208>

Domínguez-Valerio, C. M., Moral-Cuadra, S., Medina-Viruel, M. J., & Orgaz-Agüera, F. (2019). Attitude as a Mediator between Sustainable Behaviour and Sustainable Knowledge: An Approximation through a Case Study in the Dominican Republic. *Social Sciences*, 8(10), 288. <https://doi.org/10.3390/socsci8100288>

Dymock, D., & Tyler, M. (2018). Towards a more systematic approach to continuing professional development in vocational education and training. *Studies in Continuing Education*, 40(2), 198–211. <https://doi.org/10.1080/0158037x.2018.1449102>

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.2307/3151312>

Freire, A. D., & Giang, H. T. (2012). The role of family in vocational education and training choices: a case study in Vietnam. *International*

Studies in Sociology of Education, 22(3), 237–257. <https://doi.org/10.1080/09620214.2012.737692>

Gasteratos, K., Paladino, J. R., Murray, W. B., & Goverman, J. (2021). Video-Assisted Simulation Training in Burn Management: A Comparative Cohort Study on the Assessment of Technical and Non-technical Competencies. *Injury*, 52(8), 2154–2159. <https://doi.org/10.1016/j.injury.2021.03.032>

Hair, J., Risher, J., Sarstedt, M., & Ringle, C. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/eb-11-2018-0203>

Havercamp, S. M. (2021). Competency-Based Curriculum Development: Essential Disability Competencies for Medical Education. *Academic Medicine*, 96(2), 168–169. <https://doi.org/10.1097/acm.0000000000003825>

Hayes, A. F., & Rockwood, N. J. (2020). Conditional Process Analysis: Concepts, Computation, and Advances in the Modeling of the Contingencies of Mechanisms. *American Behavioral Scientist*, 64(1), 19–54. <https://doi.org/10.1177/0002764219859633>

Horokhivska, T. M. (2020). On issue of Modelling the Development of Professional-Pedagogical Competency in Lecturers from Technical Universities. *Innovate Pedagogy*, 27, 128–133. <https://doi.org/10.32843/2663-6085/2020/27.26>

Ibrahim, W. N. A., Bakar, A. R., Mohamed, A. S., & Zakaria, N. S. (2015). Impact of Entrepreneurship Education on the Entrepreneurial Intentions of Students in Technical and Vocational Education and Training Institutions (TVET) in Malaysia. *International Education Studies*, 8(12), 141–156. <https://doi.org/10.5539/ies.v8n12p141>

Indoshi, F. C., Wagah, M. O., & Agak, J. O. (2010). Factors that determine students and teachers attitudes towards art and design curriculum. *International Journal of Vocational and Technical Education*, 2(1), 9–17. Retrieved from https://academicjournals.org/article/article1379329644_Indoshi%20et%20al.pdf

Ismail, K., Nopiah, Z. M., Mohamad, S. R., & Pang, C. L. (2020). Technical Competency Among Vocational Teachers in Malaysian Public Skills Training Institutions: Measurement Model Validation Using PLS-SEM. *Journal of Technical Education and Training*, 12(1). <https://doi.org/10.30880/jtet.2020.12.01.017>

Ismail, K., Nopiah, Z. M., Rasul, M. S., & Leong, P. C. (2017). Malaysian teachers' competency in technical vocational education and training: A review. In *Regionalization and Harmonization in TVET* (pp. 59–64). London: Routledge. <https://doi.org/10.1201/9781315166568-12>

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39(1), 31–36. <https://doi.org/10.1007/BF02291575>

Kennedy, Y., Flynn, N., O'Brien, E., & Greene, G. (2021). Exploring the Impact of Incredible Years Teacher Classroom Management Training on Teacher Psychological Outcomes. *Educational Psychology in Practice*, 37(2), 150–168. <https://doi.org/10.1080/02667363.2021.1882944>

Kharkivska, A. (2020). The Competency-Based Approach as Methodology of Professional Training of Future Teachers in the Conditions of Education Informatization. *Problems of Engineer-pedagogical Education*, 67, 27–36. <https://doi.org/10.32820/2074-8922-2020-67-27-35>

Lai, C. S., Hamisu, M. A., & Salleh, K. M. (2019). Development of Competency Framework for Nigerian TVET Teachers in Tertiary TVET Institutions. *Journal of Technical Education and Training*, 11(1), 011–018. <https://doi.org/10.30880/jtet.2019.11.01.002>

Lastovets, Y. M. (2020). Formation of social-economic competencies in the students of technical and technological colleges. *Pedagogical Sciences Reality and Perspectives*, 76, 112–116. <https://doi.org/10.31392/npu-nc.series5.2020.76.24>

Lavendels, J., Sitikovs, V., & Uhanova, M. (2012). Influence of socio-demographic characteristics to attractiveness and success of initial vocational education and training in Latvia. *Procedia – Social and Behavioral Sciences*, 55, 756–765. <https://doi.org/10.1016/j.sbspro.2012.09.561>

Lee, H., & Park, S. (2021). Analysis of Needs for Core Competencies and the Development Competencies-based Extracurricular Educational Program for Outstanding Students through FGI Analysis: Focusing on the Case of S-university. *The Korea Association for Care Competency Education*, 6(1), 23–27. <https://doi.org/10.52616/jccer.2021.6.1.23>

Lu, J., Ren, L., Zhang, C., Rong, D., Ahmed, R. R., & Streimikis, J. (2020). Modified Carroll's Pyramid of Corporate Social Responsibility to

- Enhance Organizational Performance of SMEs Industry. *Journal of Cleaner Production*, 271, 1–18. <https://doi.org/10.1016/j.jclepro.2020.122456>
- Maknun, J., Barliana, M. S., Rahmawati, Y., & Wahyudin, D. (2021). Teacher Competency of Vocational High School (SMK) in the Era of Industrial Revolution 4.0. In *Proceedings of the 6th UPI International Conference on TVET 2020 (TVET 2020)*. <https://doi.org/10.2991/assehr.k.210203.110>
- Mohamad, M. M., Saud, M. S., & Ahmad, A. (2009). The Need In Training And Retraining For TVET Teachers In Malaysia. *Journal of Technical Education and Training*, 1(1), Retrieved from <https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/281>
- Obwoye, M. E., & Kwamboka, O. S. (2016). E-Learning in TVET: An Opportunity for Developing Countries. *IRA International Journal of Education and Multidisciplinary Studies*, 3(3). <https://doi.org/10.21013/jems.v3.n3.p8>
- Omar, M. K., Zahar, F. N., & Rashid, A. M. (2020). Knowledge, skills, and attitudes as predictors in determining teachers' competency in Malaysian TVET institutions. *Universal Journal of Educational Research*, 8(3C), 95–104. <https://doi.org/10.13189/ujer.2020.081612>
- Osman, N. W., & Kamis, A. (2019). The Innovation Leadership Skills for Middle-Vocational Leader of Technical and Vocational Education and Training (TVET) in Malaysia. *International Journal of Psychosocial Rehabilitation*, 23(4), 930–942. <https://doi.org/10.37200/ijpr/v23i4/pr190421>
- Paryono. (2017). The importance of TVET and its contribution to sustainable development. In *AIP Conference Proceedings* (Vol. 1887, 020076). <https://doi.org/10.1063/1.5003559>
- Powell, T. C., Lovallo, D., & Fox, C. R. (2011). Behavioral strategy. *Strategic Management Journal*, 32(13), 1369–1386. <https://doi.org/10.1002/smj.968>
- Reddy, P. A., Devi, D. U., & Reddy, E. M. (2011). A study of the vocational education preferences and interests of the Indian undergraduate students. *Bulgarian Journal of Science and Education Policy*, 5(1), 94–114. Retrieved from <http://bjsep.org/getfile.php?id=91>
- Reid, D. H. (2017). Competency-Based Staff Training. In *Applied Behavior Analysis Advanced Guidebook* (pp. 21–40). Amsterdam: Elsevier. <https://doi.org/10.1016/b978-0-12-811122-2.00002-4>
- Santosa, B., & Muchlas, M. (2017). Integrated competency-based assessment and certification in vocational high school in Indonesia. In *Regionalization and Harmonization in TVET* (pp. 3–8). London: Routledge. <https://doi.org/10.1201/9781315166568-1>
- Sari, R. L., & Seniati, A. N. L. (2017). The role of professional commitment as a mediator in the relationship between job satisfaction and organizational commitment among lecturers in higher education institutions. In *Diversity in Unity: Perspectives from Psychology and Behavioral Sciences* (pp. 397–404). London: Routledge. <https://doi.org/10.1201/9781315225302-50>
- Sern, L. C., Hamisu, M., & Salleh, K. M. (2018). Determining the Elements of TVET Teachers Competency for Nigerian Higher Learning Institutions. *Journal of Physics: Conference Series*, 1049, 012078. <https://doi.org/10.1088/1742-6596/1049/1/012078>
- Siahaan, A., Handayani, Y., & Aji, S. (2021). Perception of Tertiary Vocational Students on Developing English Speaking Skills through Live vs. Recorded Presentation. In *Proceedings of the 2nd International Conference on Applied Economics and Social Science – ICAESS* (pp. 359–365). <https://doi.org/10.5220/0010356703590365>
- Skiba, R. (2020). Graded Assessment Models for Competency-Based Training in Vocational Education and Training. *World Journal of Education*, 10(3), 106. <https://doi.org/10.5430/wje.v10n3p106>
- Stoliarchuk, L. B. (2020). Competency-based approach to future lawyers' professional training at Canadian universities. *Pedagogical sciences reality and perspectives*, 78, 211–215. <https://doi.org/10.31392/npu-nc.series5.2020.78.45>
- Štreimikienė, D., & Ahmed, R. R. (2021). The integration of corporate social responsibility and marketing concepts as a business strategy: evidence from SEM-based multivariate and Toda-Yamamoto causality model. *Oeconomia Copernicana*, 12(1), 125–157. <https://doi.org/10.24136/oc.2021.006>
- Stynska, V. V., Yashchshyn, Z. M., & Klishch, I. P. (2021). Competency-based approach in Ukrainian vocational training. *Pedagogical sciences reality and perspectives*, 2(79), 139–142. <https://doi.org/10.31392/npu-nc.series5.2021.79.2.30>
- Sudarsono, B., Santosa, B., & Sofyan, H. (2021). Improving The Competency

of Automotive Vocational Teachers with partnership-based Training Model (PBK). *JTP - Jurnal Teknologi Pendidikan*, 22(3), 200–208. <https://doi.org/10.21009/jtp.v22i3.18690>

Susanti, S., Harti, H., & Pratiwi, V. (2020). The readiness of teacher candidates for vocational high school in the 4th industrial era viewed from teaching skill and capability in technology. *Jurnal Pendidikan Vokasi*, 10(1). <https://doi.org/10.21831/jpv.v10i1.28057>

Tavşancıl, E., & Yalçın, S. (2016). Attitudes of primary school prospective teachers towards art education. *New Trends and Issues Proceedings on Humanities and Social Sciences*, 2(1), 667–674. <https://doi.org/10.18844/gjhss.v2i1.1009>

Tran, L. T., & Nyland, C. (2013). Competency-based training, global skills mobility and the teaching of international students in vocational education and training. *Journal of Vocational Education & Training*, 65(1), 143–157. <https://doi.org/10.1080/13636820.2012.755215>

Wildeman, E., Koopman, M., & Beijgaard, D. (2021). Content and language integrated learning in technical vocational education: teachers' practical knowledge and teaching behaviour. *Journal of Vocational Education & Training*, 1–22. <https://doi.org/10.1080/13636820.2021.1899269>

Yunos, J. M., Sern, L. C., & Hamdan, N. H. (2019). Criteria for Sustainable Curriculum of TVET Teacher Education Programme in Malaysia. *Journal of Technical Education and Training*, 11(3). <https://doi.org/10.30880/jtet.2019.11.03.007>

Yunos, J. M., Sern, L. C., Hamdan, N. H. (2017). Sustainability of TVET TE Programme: An Exploratory Sequential Mixed Method Design. *Advanced Science Letters*, 23(1), 220–222. <https://doi.org/10.1166/asl.2017.7138>

Yunos, J. M., Sern, L. C., Hamdan, N. H. (2018). The Roles of Government and Leadership Towards the Sustainability of TVET Teacher Education Program. *Advanced Science Letters*, 24(1), 353–355. <https://doi.org/10.1166/asl.2018.12006>

Zineb, A. H., Soumia, B., Souad, A., & Karim, G. (2017). The Application of the Competency-Based Approach to Assess the Training and Employment Adequacy Problem. *International Journal of Education*, 5(1), 1–18. <https://doi.org/10.5121/ije.2017.5101>

Zinn, B., Raisch, K., & Reimann, J. (2019). Analysing training needs of TVET teachers in South Africa: An empirical study. *International Journal for Research in Vocational Education and Training*, 6(2), 174–197. <https://doi.org/10.13152/ijrvet.6.2.4>