Cultivating Tomorrow's Workforce: Indicators of Manpower Potential in Vocational Education

Sukanya Boonsri[1], Watcharaporn Khuanwang[1]*, Withawat Penphu[1], Pranom Punsawai[1], Rossarin Jermtaisong[1], Pakornkiat Sawetmethikul[1]

[1] *Department of Education, Faculty of Technical Education,*
   Rajamangala University of Technology Thanyaburi, Pathum Thani, THAILAND

*Corresponding Author: watcharaporn_k@rmutt.ac.th
DOI: https://doi.org/10.30880/jtet.2025.17.01.009

Article Info

Abstract

Developing the potential of manpower in the education sector is an important issue for raising the quality of vocational education and preparing students for the labor market. Therefore, having trustworthy and effective indicators is crucial for assessing and enhancing student learning outcomes. This research therefore focuses on developing and examining the construct validity of the indicators of manpower potential outcomes in the education sector of students at vocational education institutions. The sample consists of 471 vocational college students in Thailand, obtained by a simple random method. Data were collected using a questionnaire and analyzed using confirmatory factor analysis. The results show that the indicator consists of 3 components and 16 indicators: knowledge (3 indicators), skills (5 indicators), and characteristics (8 indicators). Examination of construct validity revealed that the model was consistent with empirical data (χ^2 = 82.57, p = .069, df = 65, χ^2/df = 1.270, GFI = .978, RMSEA = .023). All indicators are statistically significant at the .01 level and have standardized component weight values between .674 and .882.

1. Introduction

Thailand 4.0 policy is part of a visionary policy aimed at transforming the Thai economy into an innovation-driven economy. Which is necessary to promote and elevate target industries to enhance the overall economy of the country, leading to increased income for the population and sustainable economic growth. The government has designated special economic zones as areas to drive grassroots economy and international trade. The Eastern Economic Corridor (EEC) is a highly important area that has received significant attention and is expected to be at the forefront of economic development (Singkorn, Klinbumrung, & Akatimagool, 2022). It is also a target area for Rajamangala University of Technology Thanyaburi (RMUTT) to collaborate in promoting, developing, and upgrading this special economic zones. However, to advance towards the industries of the future, it is essential to utilize modern technology along with highly skilled labor. Therefore, the education sector is a crucial upstream factor in driving and propelling this special economic zones forward.

Enhancing the capabilities of personnel in vocational education and related industries within Thailand's targeted economic zones, a strategic approach is being implemented. This approach is centered on vocational education institutions aligning their curriculum with the specific demands of the business sector (demand-driven education) (Singkorn, Klinbumrung, & Akatimagool, 2022). This research initiative is focused on the provinces of Pathum Thani, Nakhon Nayok, Prachinburi, Chachoengsao, and Sa Kaeo, all of which are in proximity to the Eastern Economic Corridor (EEC) special economic zone. The development of a high-level workforce capable of meeting the demands of future industries necessitates prioritizing the upskilling of vocational teachers in the

aforementioned provinces. These institutions fall within the network of Rajamangala University of Technology Thanyaburi (RMUTT), which includes Pathum Thani Technical College, Nakhon Nayok Technical College, Prachinburi Technical College, Chachoengsao Technical College, and Sa Kaeo Technical College. A critical component of this initiative is the development of innovative curricula and learning platforms that facilitate 21st-century skills and lifelong learning, particularly for the working-age population (Korneeva, et al., 2023; Nugroho & Arianto, 2023; Wulansari, et al., 2022.).

The success of enhancing manpower potential in vocational education and related industries within targeted regions linked to the nation's key industries hinges on effective evaluation. Evaluation is a critical process for assessing the effectiveness and impact of interventions aimed at developing manpower potential. Therefore, this research aims to develop indicators for manpower potential results in the education sector by examining relevant concepts in evaluation, alongside the concept of fostering future skills.

Various scholars have proposed diverse approaches to constructing or developing evaluation systems. Stufflebeam defines evaluation as "the process of delineating, obtaining, and providing useful information for judging decision alternatives." He proposes the CIPP evaluation model, which categorizes evaluation dimensions into four aspects: (1) Context, (2) Input, (3) Process, and (4) Product. Stufflebeam further expands Product Evaluation into (4.1) Impact Evaluation, (4.2) Effectiveness Evaluation, (4.3) Sustainability Evaluation, and (4.4) Transportability Evaluation of the evaluated entity (Stufflebeam, 2000; Arlen, R., Gullickson., 2018). The CIPP Evaluation Model has been extensively employed in evaluating various projects, particularly educational initiatives in Thailand (Buason, 2013; Papanai & Poolkrajang, 2023).

Several evaluation models exhibit detailed approaches that align with the CIPP model: 1) Tyler (Expanded): This objective-based or goal-attainment model prioritizes the achievement of project objectives. Its evaluation steps encompass: (1.1) Project objectives, (1.2) Learning plan, (1.3) Project development, (1.4) Implementation, (1.5) Results, and (1.6) Ongoing project monitoring (Madaus & Stufflebeam, 2012; Suri & Hariyati, 2024). 2) Cronbach: This model emphasizes the collection and utilization of data to inform decision-making. It incorporates multiple stages and diverse techniques, including: (2.1) Process studies, (2.2) General ability measurement, (2.3) Attitude measurement, and (2.4) Follow-up (Cronbach, 1980). 3) Kirkpatrick: Designed to assess training effectiveness, this model evaluates participants' knowledge acquisition, skill enhancement, and attitudinal shifts towards work. It encompasses four levels: (3.1) Reaction evaluation, (3.2) Learning evaluation, (3.3) Behavior evaluation, and (3.4) Results evaluation (Tamkin, Yarnall & Kerrin, 2002; Kirkpatrick & Kirkpatrick, 2016). 4) Scriven: This model centers on determining the value or merit of the evaluated entity. It emphasizes four key evaluation aspects: (4.1) Formative evaluation, (4.2) Summative evaluation, (4.3) Intrinsic evaluation, and (4.4) Pay-off evaluation (Scriven, 1994; Wardani, Darusuprapti, & Hajaroh, 2022). 5) Stake: This model assesses the congruence between anticipated and actual outcomes. It necessitates two types of data: (5.1) Descriptive data, encompassing expected and actual conditions, and (5.2) Judgmental data, encompassing standards and decisions (Stake, 2011; Dewantara, 2017). These diverse models offer valuable frameworks for the development of comprehensive outcome indicators within the context of manpower potential development in the education sector (Kanjanawasee, 2009; Ritcharoon, 2012).

This research aims to develop indicators for manpower potential results in the vocational education sector. Therefore, the concept of outcome-based evaluation is synthesized. According to the Ministry of Higher Education, Science, Research and Innovation's Ministerial Regulation on Higher Education Qualification Standards 2022, the learning outcomes of graduates at all levels of higher education qualification standards must have at least four aspects: (1) Knowledge, (2) Skills, (3) Ethics, and (4) Personal attributes (Ministerial Regulation, 2022). This is consistent with the concept and theory of Bloom and Gagné, which proposed three components of learning outcomes: (1) Cognitive domain, (2) Psychomotor domain, and (3) Affective domain (Phasiphol et al., 2015).

Therefore, this research aims to develop indicators for manpower potential results in the education sector, as depicted in Fig. 1. This will be achieved through the investigation, analysis, and synthesis of existing evaluation frameworks, outcome-based assessment models, and the concept of future skills development (skills for the future). This multi-faceted approach seeks to comprehensively address and align with the evolving needs of the regional industrial landscape. Furthermore, the study will examine the congruence of these indicators with empirical data to ensure the resulting information is maximally applicable and actionable.
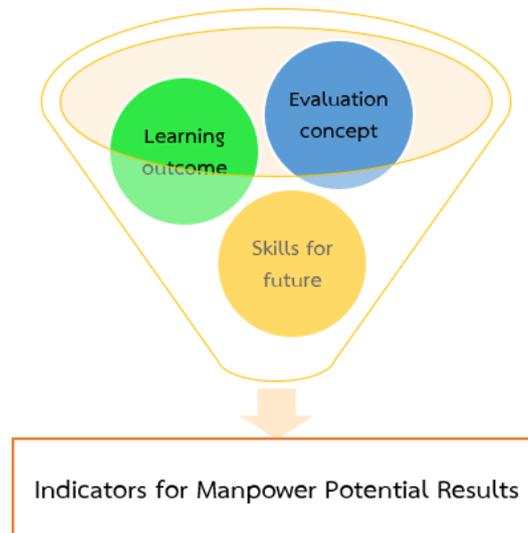
Fig. 1 *Indicators for manpower potential results*

2. Methods

This research is quantitative and divided into a two-phase research design: Phase 1: Development of indicators for manpower potential results in the education sector of vocational institute students. The researcher studies, analyzes, and synthesizes concepts and theories from related documents and research to obtain indicators for manpower potential results, and phase 2: Verification of the consistency between the indicators for manpower potential results in the education sector of vocational institute students and empirical data.

2.1 Population and Sampling

The target population comprised vocational institute students participating in manpower potential development programs across five geographical areas: Pathum Thani, Nakhon Nayok, Prachin Buri, Sa Kaeo, and Chachoengsao. Sampling followed the guidelines proposed for multivariate analysis, recommending 10-20 participants per observed variable (Schumacker & Lomax, 2010; Hair, Black, Babin, & Anderson, 2010; Hair, Black, Babin, & Anderson, 2019). With 16 observable variables in the confirmatory factor analysis (CFA) model, a minimum sample size of 320 was required. However, the sample consisted of 471 participants, obtained through simple random sampling. The increased sample size helps improve the accuracy of parameter estimation.

2.2 Research Instrument

The research instrument developed is a 5-point rating scale questionnaire that has undergone quality checks for content validity by 3 experts. The analysis results for the Index of Item-Objective Congruence (IOC) range between .80 – 1.00. The reliability quality was assessed using Cronbach's alpha coefficient, which ranges between .95 - .97.

2.3 Data Collection

Data for this study will be gathered from samples at least two weeks following their completion of manpower potential development in the field of vocational education. Coordination and collaboration requests are made first, and then data is gathered online. Following that, the study samples' responses are examined, and the data is arranged in order to facilitate additional analysis.

2.4 Data Analysis

The analytical procedures were as follows: 1) Descriptive statistics, including frequencies and percentages, were employed to analyze respondents' demographic information. 2)Confirmatory Factor Analysis (CFA) was conducted utilizing statistical software to examine the underlying structure of the measured variables.

3. Results

Indicators for the results of manpower potential in the education sector of students at vocational institutes consist of 3 components, 16 indicators as follows: Component 1: knowledge potential (K) consisting of 3 indicators, including industry knowledge goals (K1), knowledge about new learning processes (K2), and knowledge about research and innovation development in the industry 4.0 era (K3), component 2: skill potential (S) consisting of 5

indicators, including improving skills and develop your own learning (S4), innovation creation skills (S5), entrepreneurial skills (S6), knowledge transfer skills (S7), and knowledge sharing skills (S8) and component 3: attribute potential (A) consisting of 8 indicators, including liking for teaching methods (A9), motivation for learning (A10), working with others (A11), creative communication (A12), time management (A13), Solving problems in work (A14), seeking knowledge/learning (A15), and creative thinking (A16), details are shown in Table 1. All tables should be numbered with Arabic numerals. Every table should have a caption. Headings should be placed above tables. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which the authors may find useful.

Table 1 *Indicators for the results of manpower potential in the education sector of students at vocational institutes*

Output factors	Evaluation concept						Skills for future		
	Stufflebeam	Ralph W. Tyler	Cronbach	Kirkpatrick	Scriven	Robert E. Stake	Reskilling	Upskilling	New skilling
1. knowledge potential (K)									
1.1 industry knowledge goals (K1)	✓	✓		✓	✓	✓	✓	✓	✓
1.2 knowledge about new learning processes (K2)	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.3 knowledge about research and innovation development in the industry 4.0 era (K3)	✓	✓		✓	✓	✓	✓	✓	✓
2. skill potential (S)									
2.1 improving skills and develop your own learning (S4)	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.2 innovation creation skills (S5)	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.3 entrepreneurial skills (S6)	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.4 knowledge transfer skills (S7)	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.5 knowledge sharing skills (S8)	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. attribute potential (A)									
3.1 liking for teaching methods (A9)			✓	✓	✓		✓	✓	✓
3.2 motivation for learning (A10)			✓	✓	✓		✓	✓	✓
3.3 working with others (A11)			✓	✓	✓		✓	✓	✓
3.4 creative communication (A12)			✓	✓	✓		✓	✓	✓
3.5 time management (A13)			✓	✓	✓		✓	✓	✓
3.6 Solving problems in work (A14)			✓	✓	✓		✓	✓	✓
3.7 seeking knowledge/ learning (A15)			✓	✓	✓		✓	✓	✓
3.8 creative thinking (A16)			✓	✓	✓		✓	✓	✓

The results of examining the structural validity of the indicators of workforce potential outcomes in the education sector of students at vocational education institutions with empirical data. Verify the harmony between the research model and empirical data through the first order confirmatory factor analysis. Correlation coefficient analysis is used to determine whether the observed variables are sufficiently correlated for analyzing composition and analysis values. KMO and Bartlett's sphere test, which is a statistical value, tests the hypothesis that the correlation matrix is the identity matrix.

The results of the analysis of the correlation coefficient between the observed variables regarding the 3 components of the indicators for the results of manpower potential in the education sector of students at vocational education institutions, totaling 16 observable variables. The correlation coefficient ranges from .478 to .826, with the correlation coefficient between the variables being significantly different from zero at the .01 level. Considering Bartlett's sphere test statistics, this is a hypothetical test statistic: this correlation matrix is a unique matrix. The discovered value of the identity matrix is 6863.075 (p=. 000), indicating a significant difference in the correlation matrix between the observed variables compared to the identity matrix in statistics. According to the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), the KMO is. 960, indicating that the variables in the data are sufficiently correlated. And suitable for analyzing elements, details are shown in Table 2.

Table 2 *Composition of results indicators for semester human resources potential of vocational college students by observing relative values of variables*

variables	K1	K2	K3	S4	S5	S6	S7	S8	A9	A10	A11	A12	A13	A14	A15	A16
K1	1															
K2	.674**	1														
K3	.681**	.704**	1													
S4	.669**	.643**	.688**	1												
S5	.659**	.597**	.684**	.787**	1											
S6	.625**	.576**	.654**	.772**	.787**	1										
S7	.563**	.558**	.592**	.717**	.727**	.755**	1									
S8	.586**	.575**	.645**	.728**	.733**	.759**	.826**	1								
A9	.520**	.623**	.596**	.591**	.549**	.522**	.609**	.608**	1							
A10	.579**	.609**	.623**	.646**	.619**	.612**	.626**	.658**	.704**	1						
A11	.580**	.551**	.575**	.573**	.523**	.522**	.559**	.579**	.623**	.662**	1					
A12	.541**	.554**	.568**	.588**	.553**	.566**	.615**	.621**	.598**	.662**	.762**	1				
A13	.525**	.507**	.560**	.634**	.634**	.629**	.645**	.651**	.587**	.635**	.657**	.708**	1			
A14	.544**	.507**	.540**	.632**	.578**	.665**	.655**	.663**	.549**	.630**	.656**	.722**	.788**	1		
A15	.537**	.532**	.524**	.619**	.559**	.602**	.606**	.619**	.510**	.605**	.612**	.667**	.699**	.705**	1	
A16	.518**	.498**	.504**	.583**	.599**	.589**	.594**	.608**	.478**	.542**	.578**	.667**	.686**	.744**	.736**	1

KMO : Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .960 ; Bartlett's Test of Sphericity = 6863.075 , p = .000, df = 120

** p < .001

    The results of the structural validity analysis of the components of the indicator of workforce potential results in the education sector of students at vocational institutions found that the model is consistent with the empirical data. By considering the criteria for checking the harmony of the confirmatory elements from the statistics used in the test according to Table 3. References must be listed at the end of the paper. Do not begin them on a new page unless this is absolutely necessary. Authors should ensure that every reference in the text appears in the list of references and vice versa.

Table 3 *Consistency analysis of the composition structure of semester human potential indicators for vocational college students and consistency verification criteria in the analysis results*

Statistics used in testing	Criteria	computed value	Judgment result
1. χ^2	p >.05	.069	Passed
2. χ^2/df	< 2	1.270	Passed
3. Goodness of Fit Index (GFI)	>.90	.978	Passed
4. Adjusted Goodness of Fit Index (AGFI)	>.90	.955	Passed
5. Normed Fit Index (NFI)	>.95	.996	Passed
6. Non-Normed Fit Index (NNFI)	>.95	.998	Passed
7. Comparative Fit Index (CFI)	≥.95	.999	Passed
8. Root Mean Square Error of Approximation (RMSEA)	<.05	.023	Passed
9. Root Mean Square Residual (RMR)	<.05	.018	Passed
10. Standardized RMR (SRMR)	<.05	.019	Passed

    From Table 3, it was found that the Chi-square value was 82.57, which has a probability value of .069 at 65 degrees of freedom (df = 65). The chi-square ratio to degrees of freedom is 1.270, which is less than 2, i.e., the chi-square value is statistically significantly different from zero at the .05 level. This indicates that the null hypothesis that the measurement model has a good fit with the empirical data is accepted, with the Goodness of Fit Index (GFI) of .978, the Adjusted Goodness of Fit Index (AGFI) of .955, the Criterion-Referenced Goodness of Fit Index (NFI) of .996, the Non-Normed Fit Index (NNFI) of .998, the Comparative Goodness of Fit Index (CFI) of .999, the Root Mean Square Error of Approximation (RMSEA) of .023, the Root Mean Square Residuals (RMR) of .018, and

the Standardized Root Mean Square Residuals (SRMR) of .019, which complies with the criteria for verifying the model's consistency with empirical data (Hoyle, 2023) as detailed in Table 4.

Table 4 *The results of the factor analysis confirm the first rank of the indicator components of the workforce potential in the education sector of vocational institute students*

Variables	Factor loading		t	r^2
	b (SE)	β		
knowledge potential (K)				
K1	.804 (.039)	.834	20.608**	.697
K2	.768 (.038)	.795	20.037**	.632
K3	.836 (.037)	.881	22.571**	.776
skill potential (S)				
S4	.816 (.034)	.875	23.865**	.766
S5	.850 (.035)	.882	24.230**	.779
S6	.856 (.035)	.882	24.183**	.779
S7	.815 (.036)	.834	22.079**	.695
S8	.844 (.037)	.844	22.533**	.713
attribute potential (A)				
A9	.657 (.040)	.674	16.294**	.455
A10	.778 (.039)	.770	19.511**	.594
A11	.730 (.038)	.766	19.142**	.587
A12	.789 (.036)	.837	21.965**	.701
A13	.816 (.036)	.846	22.387**	.716
A14	.800 (.035)	.853	22.592**	.728
A15	.780 (.037)	.804	20.700**	.647
A16	.740 (.037)	.785	19.886**	.616

Chi-square =82.570, df=65, p-Value = .069, χ^2/df = 1.270, GFI = .978, AGFI =.955,

NFI =.996, NNFI = .998, CFI = .999, RMSEA = .023, RMR = .018, SRMR = .019

**p<.001, The numbers in parentheses are standard deviation values.

From Table 4, the results of the first-order confirmatory factor analysis of the components of the outcome indicators of human resource potential in the education sector of vocational institute students are presented, which consist of component weights in the form of raw scores (b), component weights in the form of standard scores (β), standard error (SE), and prediction coefficient (r^2).

When considering the results of the first-order factor analysis, which is the result of the model analysis showing the relationship between the outcome indicators of the potential of the workforce in the education sector of vocational institute students and the three components: 1) knowledge potential, 2) skills potential, and 3) characteristics potential, it was found that the component weights of all variables were statistically significant (p<.01). This shows that all 16 variables have characteristics that are indicators according to the structure of the indicators of the potential of the workforce in the education sector of vocational institute students. The said variables have component weights in the form of standard scores between .674 and .882, with the significant weights as follows:

Knowledge potential components: the results of data analysis found that all indicators had a statistically significant component weight at the .01 level and accounted for approximately 63.2 to 77.6 percent of the variance explained by the knowledge potential component. The observed variable with the most significant weight was knowledge of research and development of innovation in Industry 4.0 (K3), followed by knowledge of target industries (K1) and knowledge of new learning processes (K2), respectively.

Skill potential components: the results of data analysis found that all indicators had statistically significant component weights at the .01 level and accounted for approximately 69.5 to 77.9 percent of the variance explained by skill potential components. The observed variables with the highest weights were innovation creation skills (S5) and entrepreneurial skills (S6), followed by self-learning improvement and development skills (S4), knowledge sharing skills (S8), and knowledge transfer skills (S7), respectively.

Attribute potential component: the results of the data analysis found that all indicators had a statistically significant component weight at the .01 level and the proportion of variance explained by the components of trait

potential was approximately 45.5 to 72.8 percent. The observed variables with the highest significance weight were problem solving in work (A14), followed by time management (A13), creative communication (A12), seeking knowledge/learning (A15), creative thinking (A16), learning motivation (A10), working with others (A11), and liking for teaching methods (A9), respectively.

In conclusion, the indicators of the components of the indicators of the potential of the workforce in the education sector of vocational institute students developed in this research are all statistically significant indicators at the .01 level, with all indicators having positive component weights. This means that if students have high characteristics according to these indicators, it will result in students having higher potential as a workforce in the education sector of vocational education institute students. There are details of the first-order analysis model of the outcome indicators of potential as a workforce in the education sector of vocational education institute students as shown in Fig. 2
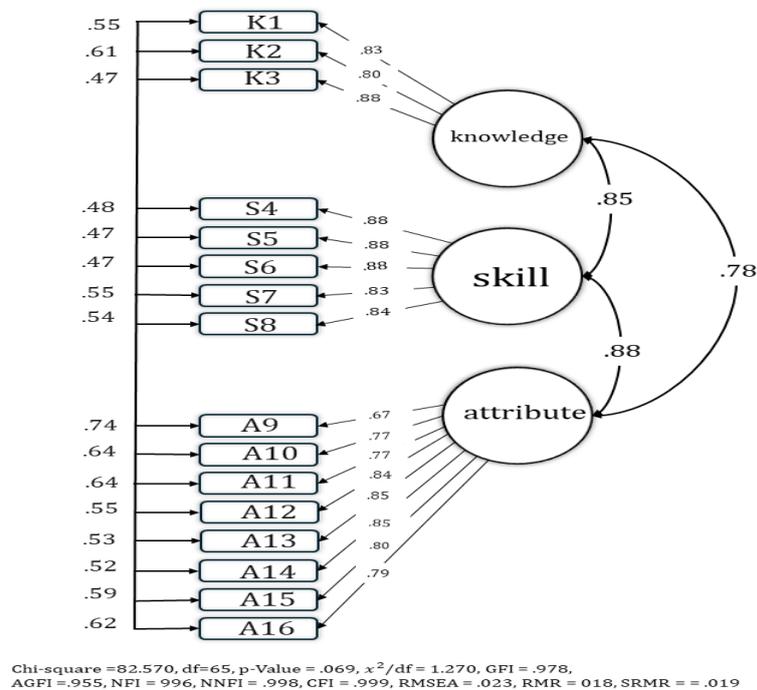

Chi-square =82.570, df=65, p-Value = .069, x^2/df = 1.270, GFI = .978,
AGFI =.955, NFI = 996, NNFI = .998, CFI = .999, RMSEA = .023, RMR = 018, SRMR = = .019

Fig. 2 *Results of the first-order confirmatory factor analysis of the indicators of workforce potential outcomes in the education sector of vocational institute students*

4. Discussion

Indicators are developed through study, analysis and synthesis from the evaluation concept includes: CIPP Evaluation Model by Stufflebeam (Stufflebeam, 2000; Arlen, R., Gullickson., 2018), objective-based or goal attainment by Ralph W. Tyler (Madaus & Stufflebeam, 2012; Suri & Hariyati, 2024), data collection and decision-making information by Cronbach (Cronbach, 1980), evaluate the trainees to assess their knowledge, improve their work skills and change their attitude towards work by Kirkpatrick (Tamkin, Yarnall & Kerrin, 2002; Kirkpatrick & Kirkpatrick, 2016), value judgment process or the benefits of the thing intended to be evaluated by Scriven (Scriven, 1994; Wardani, Darusuprapti, & Hajaroh, 2022), Evaluate the consistency between what is expected and what actually happened by Robert E. Stake (Stake, 2011; Dewantara, 2017). And the concept of evaluating learning outcomes according to higher education qualification standards, 4 areas are: (1) knowledge (2) skill (3) ethics and (4) attribute (Ministerial Regulation, 2022). According to Bloom and Ganye's concepts and theories, the elements of learning outcomes include three aspects: (1) Cognitive Domain (2) Psychomotor Domain and (3) Affective Domain (Phasiphol et al., 2015). Together with the concept of creating manpower with Skills for the future, including reskilling upskilling and new skilling (Poláková, et al., 2023; Yi & Park, 2024; Đajić, et al., 2024; Li, 2022; Xu, 2011; Xu, Xu & Li, 2018). As a result, the indicators are interrelated, and the model is consistent with the empirical data, as depicted in Fig. 3.
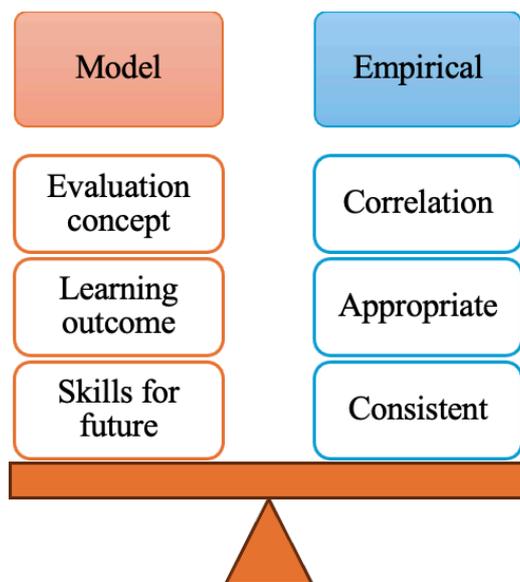
Fig. 3 *Consistency between model and empirical data*

Therefore, educational institutions can use the developed outcome indicators to plan educational management to develop the manpower potential in the next education sector. Educational institutions and enterprises work together to plan education by using the developed outcome indicators to develop manpower potential according to national policy.

From study, analysis, and synthesis of the evaluation concept, concept of evaluating learning outcomes, and concept of creating manpower with skills for the future, there are 3 elements: 1) knowledge potential consisting of 3 indicators 2) skill potential consisting of 5 indicators and 3) attribute potential consisting of 8 indicators, with all indicators having positive component weights. This means that if students have high characteristics according to these indicators, it will result in students having higher manpower potential in the education sector of vocational education institute students. This is in line with the national development policy of the 4.0 era aimed at cultivating highly skilled talents, which will lead to the cultivation of talents with future skills (Poláková, et al., 2023; Yi & Park, 2024; Đajić, et al., 2024; Li, 2022; Xu, 2011; Xu, Xu & Li, 2018). The discussion is as follows:

Components of knowledge potential: A person must possess intelligence or brain abilities related to expressing knowledge or ideas in various ways, which are knowledge skills used in work (hard skills) (Poláková, et al., 2023; Li, 2022). Therefore, students must have knowledge about research and innovation development in the industry 4.0 era, industry knowledge goals, and knowledge about new learning processes.

Components of skill potential: Creating manpower potential with future skills requires learning new skills, or skills similar to new skills, to complete different tasks or train a person to work on different tasks. By promoting skill development while attempting practical work and applying and learning new technologies, it is necessary to work or improve productivity in the future world (this is called reskilling.). Then, develop and enhance the work skills of existing personnel to make them more effective. This is a continuous education that helps to develop skills on the current work path. This includes strengthening digital technology expertise for individuals, thereby further improving labor productivity (this is called upskilling). This includes creating new skills in learners according to the situation or industry needs, which is the direct role and function of the vocational education committee responsible for vocational education management and developing labor capacity according to changing technologies (called new skills) (Poláková, et al., 2023; Yi & Park, 2024; Đajić, et al., 2024; Li, 2022; Xu, 2011; Xu, Xu & Li, 2018). This is consistent with the results of the study that found innovation creation skills and entrepreneurial skills are the most important weight indicators, followed by improving skills and developing your learning, knowledge sharing skills, and knowledge transfer skills.

Components of attribute potential: Developing manpower potential requires paying attention to a person's emotions and feelings regarding values, appreciation, attitudes, beliefs, and the ability to get along with others. Including self-development towards working in the organization (called soft skills). The study found that solving problems at work is the indicator with the most importance, followed by time management, creative communication, seeking knowledge/learning, creative thinking, motivation for learning, working with others, and liking for teaching methods. This is consistent with the results of the study that suggested that the soft skills required for the Industrial 5.0 labor market include critical and analytical thinking, problem-solving, communication skills, and creativity with flexibility (Poláková, et al., 2023). Continuously developing leadership and teamwork skills, increasing employment opportunities, and raising salaries (Li, 2022). Emphasizes the need

for a balanced skill set that includes technical expertise, managerial competencies, communication skills, leadership qualities, and technological and methodological competencies to achieve successful project outcomes (Xu, 2011; Xu, Xu & Li, 2018).

However, this research can investigate the causal model of manpower potential development. To obtain comprehensive information on input, processes, and outcomes.

In addition, stakeholders in the education and industrial sectors can utilize indicators of manpower potential development achievements to plan and formulate strategies under national policies to strongly and sustainably meet the needs of the labor market. Equations and formulae should be typed in Mathtype, and numbered consecutively with Arabic numerals in parentheses on the right hand side of the page (if referred to explicitly in the text). They should also be separated from the surrounding text by one space. The equations and formulae should be placed in the table. Then, the table border needs to be adjusted to no border.

5. Conclusion

The study revealed a comprehensive framework for evaluating student potential in vocational education, comprising three essential components with 16 distinct indicators. The framework encompasses knowledge potential (3 indicators), skill potential (5 indicators), and attribute potential (8 indicators), providing a holistic approach to student assessment. Statistical analysis demonstrated strong correlations between variables (.478 to .826), with all relationships proving significant at the .01 level. The model's robust alignment with empirical data is further supported by substantial component weights (ranging from .674 to .882) across all indicators. Notably, the positive nature of these weights suggests that students who excel in these indicators demonstrate enhanced overall vocational capabilities. These findings not only validate the model's effectiveness but also provide valuable insights for educational institutions to develop targeted strategies for improving student outcomes and workforce readiness in vocational education.

Acknowledgement

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm their contribution to the paper as follows: **study conception and design:** *Sukanya Boonsri, Watcharaporn Khuanwang, Pranom Punsawai, Rossarin Jermtaisong;* **data collection:** *Sukanya Boonsri, Watcharaporn Khuanwang;* **data analysis and interpretation of results:** *Sukanya Boonsri, Watcharaporn Khuanwang;* **draft manuscript preparation and editing:** *Sukanya Boonsri, Watcharaporn Khuanwang, Withawat Penphu, Pakornkiat Sawetmethikul. All authors reviewed the results and approved the final version of the manuscript.*

References

Arlen, R., Gullickson. (2018). In Memory of Daniel L. Stufflebeam (1936–2017). *American Journal of Evaluation, 39*(1):146-149. doi: 10.1177/1098214017739151

Buason, R. (2013). CIPP and CIPPIEST Evaluation Models: Misconceptions and Correct Usage. *Silpakorn Educational Research Journal.* 5(2): 2-9. July - December.

Cronbach, L. J., et al. (1980). *Toward reform of program evaluation.* In: Jossey-Bass Publishers.

Đajić, M. J., Lalic, D. C., Vujičić, M. D., Stankov, U., Petrovic, M., & Đurić, Ž. (2024). Development and validation of the project manager skills scale (PMSS): An empirical approach. *Heliyon*, *10*(3), e25055-e25055.

Dewantara, I. P. M. (2017). Stake evaluation model (countenance model) in learning process bahasa indonesia at Ganesha university of educational. *International Journal of Language and Literature, 1*(1), 19-29.

Hair, J. F., Black, W. C., & Babin, B. J. (2010). *Multivariate Data Analysis: A Global Perspective.* Pearson Education.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis (Eighth edition).* Cengage.

Hoyle, R. H. (Ed.). (2023). Handbook of structural equation modeling (2nd ed.). The Guilford Press.

Kanjanawasee, S. (2009). Evaluation Theory (7th edition). Bangkok: Samlada Limited Partnership.

Kirkpatrick, J. D., & Kirkpatrick, W. K. (2016). *Kirkpatrick's four levels of training evaluation*: Association for Talent Development.

Korneeva, N., Uvarina, N., Gnatyshina, E., & Korneev, D. (2023). Creative and Predictive Management of Vocational Education in the Context of Social Partnership Development. *Journal of Technical Education and Training*, *15*(4), 23-36.

Li, L. (2022). Reskilling and upskilling the future-ready workforce for industry 4.0 and beyond. *Information Systems Frontiers*, 1-16.

Madaus, G. F., & Stufflebeam, D. L. (Eds.). (2012). *Educational evaluation: classic works of Ralph W. Tyler*. Springer Science & Business Media.

Ministerial Regulation: Higher Education Qualifications Framework B.E. 2565. (2022). *Royal Thai Government Gazette*. 139(Special Section 20A), 28-31.

Nugroho, W., & Arianto, F. (2023). Twenty-first century instructional design: Guiding vocational instructors designing e-module. *Journal of Technical Education and Training*, *15*(1), 28-39.

Papanai, R., & Poolkrajang, A. (2023). The High Vocational Innovation Scholarship Program: A TVET Curriculum Continuous Quality Improvement Using Feedback from Stakeholders. *Journal of Technical Education and Training*, *15*(4), 1-10.

Phasiphol, C., et al. (2015). *Learning Measurement and Assessment*. Chulalongkorn University Press.

Poláková, M., Suleimanová, J. H., Madzík, P., Copuš, L., Molnárová, I., & Polednová, J. (2023). Soft skills and their importance in the labour market under the conditions of Industry 5.0. *Heliyon*, *9*(8).

Ritcharoon, P. (2012). *Project Evaluation Techniques.* House of Kermist.

Schumacker, R. E. & Lomax, R. G., (2010). *A beginner's guide to structural equation modeling.* (3rd ed.). Lawrence.

Scriven, M. (1994). Evaluation as a discipline. *Studies in educational Evaluation*, *20*(1), 147-166.

Singkorn, S., Klinbumrung, K., & Akatimagool, S. (2022). *Development of Innovation-Based Learning and Teaching Model for Technology Education in Thailand 4.0 Era.* Paper presented at the 2022 7th International STEM Education Conference (iSTEM-Ed).

Stake, R. E. (2011). Program evaluation particularly responsive evaluation. *Journal of MultiDisciplinary Evaluation*, *7*(15), 180-201.

Stufflebeam, D. L. (2000). The CIPP Model for Evaluation. In D. L. Stufflebeam, G. F. Madaus, & T. Kellaghan (Eds.), *Evaluation Models: Viewpoints on Educational and Human Services Evaluation* (pp. 279-317). Springer Netherlands. https://doi.org/10.1007/0-306-47559-6_16

Suri, S., & Hariyati, N. (2024). Cipp evaluation model in the educational evaluation: a literature study. *Cahaya pendidikan, 10*(1), 20-30.

Tamkin, P., Yarnall, J., & Kerrin, M. (2002). *Kirkpatrick and Beyond: A review of models of training evaluation*. Institute for Employment Studies Brighton, England.

Wardani, H. K., Darusuprapti, F., & Hajaroh, M. (2022). Model-Model Evaluasi Pendidikan Dasar (Scriven Model, Tyler Model, dan Goal Free Evaluation). *Jurnal Pendidikan: Riset dan Konseptual, 6*(1), 36-49.

Wulansari, R. E., Nabawi, R. A., Safitri, D., & Kiong, T. T. (2022). The effectiveness of project-based learning on 4Cs skills of vocational students in higher education. *Journal of Technical Education and Training*, *14*(3), 29-37.

Xu, L. (2011). Enterprise Systems: State-of-the-Art and Future Trends. *IEEE Transactions on Industrial Informatics*, 7(4), 630–640. https://doi.org/10.1109/TII.2011.2167156

Xu, L., Xu, E., & Li, L. (2018). Industry 4.0: state of the art and future trends. *International Journal of Production Research*, 56(8), 2941–2962.

Yi, E., & Park, D. H. (2024). The effect of core competencies of university students on employment and first year salary level based on school activity log. *Heliyon*, *10*(7).