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Development of a Work-Related Learning Model for Enhancing the Occupational Competencies of Vocational Education Students Based on Exploratory Factor Analysis

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Abstract

Occupational training at establishments helps students develop professional skills by emphasising direct hands-on practice together with professional skills and learning work processes before entering occupational training at an establishment. This study employed a mixed-methods design. The target group for interviews consisted of 8 people, each possessing at least 15 years of experience in the field of vocational education, and the instrument used for the qualitative study was an in-depth interview form for content analysis. The sample providing quantitative data consisted of 390 people, from the director of the vocational college, deputy director for academic affairs, head of department, and head of the dual vocational education project, under the office of the vocational education commission, and the instrument used for the quantitative study was a questionnaire for exploratory factor analysis. The data analysis results yielded a KMO value of 0.918, which is greater than 0.50, indicating that all variables were appropriate and sufficiently correlated. The analysis ultimately identified five key factors comprising a total of 50 variables. A model was then developed consisting of input factors: setting goals and analysing workplace data to enhance learning development; process factors: driving work-related learning through five key activity areas; and output factors: focusing on qualitative outcomes that reflect learners' competencies. The findings of this research have been applied to implement work-related learning management aimed at promoting occupational training for vocational education students so that they gain knowledge and skills that meet labour market demands and are effectively prepared before entering occupational training at establishments.

Keywords: factor analysis, work-related learning management, occupational training, vocational education, professional competency

1. Introduction

At present, the world of work is changing rapidly, which affects the preparedness of students entering the labor market and requires the development of employability for both workers and organizations, particularly in the context of students who are about to enter the real world of work. The office of the vocational education commission has adopted the vocational education qualification standards framework for the higher vocational certificate level for educational institutions to use as a guideline for developing or improving curricula, learning management, and educational quality development so as to produce quality graduates and to benefit from supporting the accreditation of graduates' qualification standards. The higher vocational certificate qualification must be consistent with the identity of the curriculum, professional institutions, the nation, and the global context, comprising at least four learning outcome domains: 1) morals, ethics, and desirable characteristics; 2) knowledge; 3) craft skills; and 4) the ability to apply knowledge and responsibility to develop the competencies of the technical workforce, including morals, ethics, professional codes of conduct, and appropriate work habits, in line with the workforce needs of the labor market, community, society, and national development, as well as the ability to pursue self-employment. This framework is consistent with Billett's (2023) concept that work-related learning management should develop learners holistically in

terms of knowledge, skills, values, and real practical work competencies.

In the Thai context (Suttirak, 2022), the educational administration of the office of the vocational education commission, ministry of education, has a systematic operational model involving cooperation between educational institutions and establishments. This framework is consistent with Tangpradit et al. (2024), who state that professional experience training currently requires educational institutions to adjust the dimensions and adapt their teaching and learning management approaches to keep pace with rapidly changing technologies, and that effective learning management, according to McRae and Johnston (2016), requires designing a learning structure that integrates work alongside study, using it as a tool to drive education workplace experiences as a means of supporting and enhancing education. The office of the vocational education commission has adopted policies, goals, and strategies for producing and developing vocational manpower to an international standard, effectively producing and developing vocational manpower through four areas of operation: 1) increasing the number of vocational students; 2) expanding opportunities for vocational education and occupational training; 3) raising the quality of educational management; and 4) increasing management efficiency, with the aim of building and producing a professional workforce by organizing vocational education under the context of society, politics, economy, and technology (Office of the Vocational Education Commission, 2024). In line with the concept of Sudibya and Prasojo (2025), technology has been incorporated into the monitoring and evaluation of occupational training to drive the organization toward its goals of success, with a primary focus on quality. In managing the vocational education system, occupational training at establishments has been organized as an important mechanism for driving the economy and the country's competitiveness. However, the skills of the workforce produced are inconsistent with the needs of the industrial sector. Many vocational institutions still organize learning in a fragmented manner that emphasizes theory rather than allowing students to directly practice skills related to their field of study, resulting in students lacking the necessary competencies when they enter employment at establishments after graduation.

The concept of work-related learning is an important approach for managing the relationship between educational institutions and establishments to integrate real work. Aarkrog (2020) points out that the role of learning management set in the real world of work within educational institutions significantly increases knowledge and skills without creating a gap between theoretical and practical learning. Jackson and Meek (2021) indicate that embedding employability skills into vocational curricula through the work-related learning (WRL) process is critically important for preparing students before graduation. Vlachopoulos and Pachni-Tsitiridou (2026) state that educational institutions must prepare learners with diverse work skills and collaborate with the industrial sector to increase readiness for entering employment. Decius et al. (2023) found that learners who have gone through the work-related learning process have higher levels of competency and a greater ability to obtain employment effectively.

The gap analysis conducted for this research found that cooperation between educational institutions and establishments lacks continuous follow-up. Educational institutions organize development plans and training plans that are inconsistent and do not align with the competency needs of establishments. Teachers emphasize teaching theory in the classroom rather than allowing students to provide opportunities to practice skills directly related to their field of study. Learners' foundational knowledge and professional skills do not match the needs of establishments. Students lack discipline, safety awareness, responsibility, patience, and understanding of organizational culture. Measurement and evaluation do not align with the occupational competencies required at establishments, which overall affects the quality development of learners. Therefore, the researcher aimed to study and conduct an exploratory factor analysis to develop a work-related learning management model appropriate to vocational education. Exploratory Factor Analysis (EFA) was employed to examine and group interrelated variables or indicators, thereby identifying the core components of the proposed model, reducing variable redundancy, and selecting the most appropriate variables within the context of vocational education. Administrators and workplace trainers collaborate in designing a learning process that emphasizes direct hands-on practice together with professional skills and learning of work processes before students enter occupational training at establishments. This approach includes appropriate morals, ethics, and professional codes of conduct that are consistent with the workforce needs of establishments, communities, and society and that enable self-employment, thereby making the learning management process effective.

2. Literature Review

2.1 The Concept of Work-Related Learning (WRL)

Work-related learning management refers to a learning process that uses the context of work as a foundation for developing an individual's competency, encompassing learning both in educational institutions and at establishments, with the aim of enabling students to connect theory with real practice (theory-to-practice). Work-Related Learning

(WRL) is any form of learning that occurs in a real work environment, which helps individuals acquire the skills necessary for entering the job market, retaining employment, and advancing in their careers, with its distinguishing feature being learning by doing. The concept originated early in the Federal Republic of Germany and led to national approaches to learning development in which instruction is integrated within the same cycle as learning referenced from the workplace. Instruction is integrated with workplace-based learning, drawing on concepts and theories from researchers consistent with work-related learning (WRL). This approach is consistent with Kolb's (2014) experiential learning theory, which states that effective learning arises from a cycle of doing and reflecting. Billett (2023), through the concepts of workplace affordances and individual agency, points out that learning depends on the opportunities that establishments offer for hands-on practice and on individuals' eagerness to seize those opportunities. Dehnbostel (2009) proposed the German dual system approach, which emphasizes building a vocational identity through diverse learning settings, both in the factory and on the job site.

The researcher summarizes the main organizational formats, which are classified according to the relationship between learning locations and work locations, into three models as follows: 1. Work-integrated learning, in which the place of learning and the place of work are the same location, and learning occurs and takes place at the workplace or within the work process itself. Examples include Communities of Practice (CoP), work tasks related to learning, traditional apprenticeships, and adaptive training. 2. Work-connected learning, in which the place of learning and the place of work are separate but linked spatially and organizationally in practice. For example, a learning area located near the production line, focused on training related to the production section, is known as a “Learning Bay.” Other examples include quality circles, learning stations, and internships. 3. Work-oriented learning, which occurs in formal learning settings such as vocational schools, colleges, training centers, or universities. Learning here involves simulating organizational structures and work processes, with the primary goal being learning rather than actual production; therefore, the difference between a simulated workplace and a real workplace cannot be fully compensated for and cannot be fully solved. All three models can be applied in combination to create diversity in preparing students before entering actual occupational training at establishments. In the present era, these models interrelate and mutually reinforce each other in terms of theory, teaching methods, approaches, and learning management.

2.2 Promoting Occupational Training at Establishments

Professional experience training is a form of cooperation between educational institutions and establishments to provide students with direct experience in a real environment. The success of training does not depend solely on the curriculum alone but also on the participation of establishments in designing the evaluation process. In addition, technology is now being applied to monitor and evaluate occupational training (technology-enhanced assessment) to make learning management more flexible. Consistent with this, Aarkrog (2020) found that work-based learning helps vocational students gain confidence in their professional skills and significantly reduces the gap between theory and practice. Jackson and Meek (2021) point out that embedding employability skills into vocational curricula through the WRL process is critically important for students' success. Decius et al. (2023) confirm that learners who have completed the WRL process have demonstrated higher levels of competency and a greater ability to obtain secure employment effectively.

Internship training organizes a learning process to develop skills, thinking processes, management, coping with situations, and the application of knowledge to prevent and solve problems, conducted through cooperation between educational institutions and the production and service sectors. This process takes place after learners have studied theory and undergone preliminary practice or basic hands-on training at the educational institution for a period of time. The purpose of internship training is to provide learners with the opportunity to experience actual occupational work, use modern tools, machinery, and equipment, and engage in a competitive business atmosphere that requires maintaining quality and work standards, as well as teamwork. This helps learners learn from real experience, develop the ability to practice, think critically, and act competently, and fosters continuous eagerness to learn, as well as confidence and a positive attitude toward work and self-employment.

2.3 Analysis of Literature Data

A synthesis of literature regarding Work-Related Learning (WRL) and the promotion of workplace-based vocational training reveals a systematic relationship between the two concepts. They share a common goal: to develop vocational students’ competencies, enabling them to effectively apply the knowledge, skills, and experience gained at educational institutions to real-world work situations. Moreover, this approach is essential for connecting theoretical learning with practical application in the workplace. The essence lies not merely in sending students out for internships but in designing a learning process that transforms both educational institutions and business enterprises into interconnected learning spaces that mutually reinforce one another. The Work-Related Learning (WRL) allows for the application of

three interrelated learning models—Work-Integrated Learning (WIL), Work-Connected Learning (WCL), and Work-Oriented Learning (WOL)—to prepare students for actual vocational training. Such professional experience training represents a collaboration between educational institutions and the manufacturing or service sectors, providing students with exposure to modern tools and equipment, as well as a realistic work environment characterized by the need for high-quality standards and effective collaboration with others.

2.4 Conceptual Framework

For the research on the development of a work-related learning model to enhance the occupational competencies of vocational education students based on exploratory factor analysis, the researcher studied related documents and research and synthesized them to derive the conceptual framework used in this study, as follows:

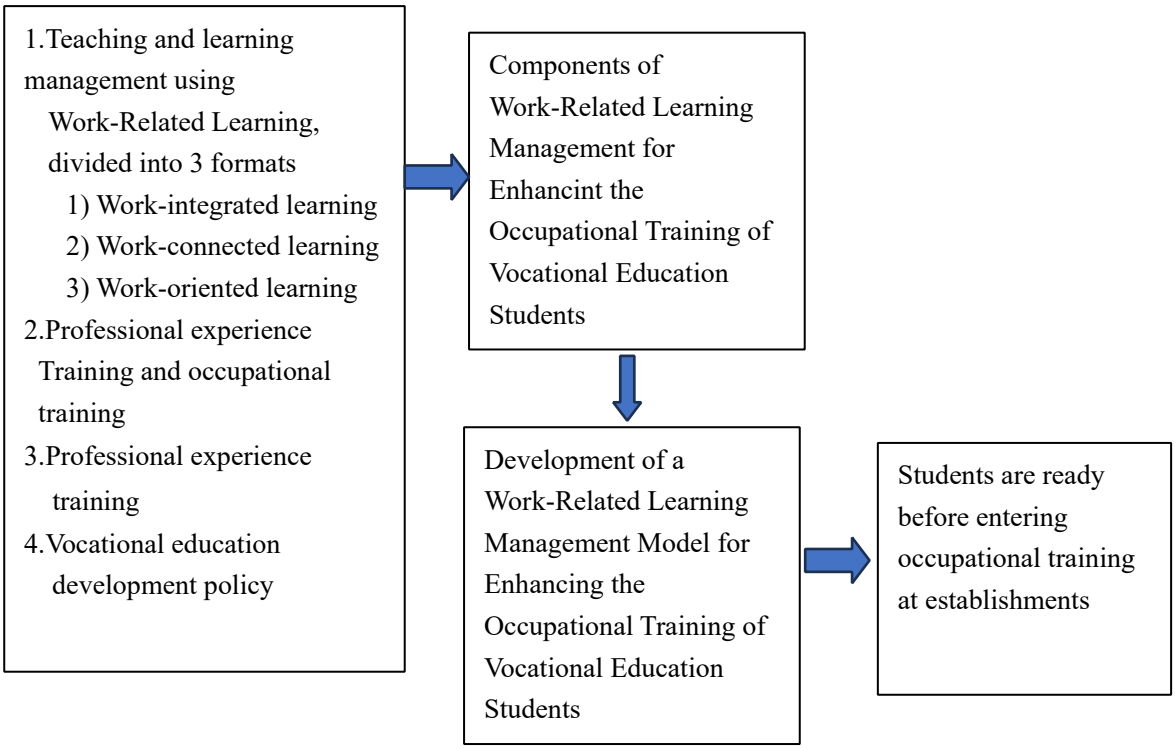


Figure 1. Conceptual Framework of the Research

3. Research Methodology

3.1 Research Design

The research design employed a mixed-methods research approach, using both qualitative and quantitative research. The qualitative research focused on occupational training for vocational education students, collecting and analyzing their responses as well as content data from in-depth interviews with experts who have experience in organizing such training for learners. The quantitative research involved surveying the opinions of stakeholders engaged in occupational training for vocational education students and then collecting and analyzing their responses. data from respondents.

3.2 Target Group

The target group for providing opinions for the factor analysis of the work-related learning management model to enhance the occupational training of vocational education students was selected through interviews using purposive sampling, consisting of 8 individuals, with at least 15 years of work experience in vocational education, divided into two groups: 1) five vocational education experts and expert-level college directors; and 2) three experts in industrial workforce development. The exploratory factor analysis was conducted using data collected via questionnaires from vocational college directors, deputy directors for academic affairs, heads of academic departments, and heads of dual vocational education units under the Office of the Vocational Education Commission. The total target population comprised 15,600 individuals. A sample size of 390 was determined using simple random sampling based on Taro

Yamane's (1973) table at a 95% confidence level, with stratified random sampling employed to cover four regions: central, northern, northeastern, and southern. The selection of the sample focused on work-related learning initiatives designed to foster vocational training for students. The research findings will be utilized to develop a vocational training ecosystem within educational institutions, thereby preparing students for practical, hands-on training in actual workplace settings. The researchers selected the target group for the focus group discussion through purposive sampling, consisting of 11 individuals, to evaluate and confirm the components of the work-related learning management that enhance the occupational training of vocational education students based on exploratory factor analysis.

3.3 Research Procedures

Step 1: Study documents, textbooks, and academic articles related to work-related learning management for enhancing the occupational training of vocational education students. The result obtained from this study was a conceptual framework for developing a work-related learning model to enhance the occupational training of vocational education students, which was derived using exploratory factor analysis and included key questions that informed the creation of an in-depth interview form for experts. The results of this study provided a conceptual framework for developing a work-related learning model to enhance the occupational training of vocational education students using exploratory factor analysis, as well as the key questions that led to the development of an in-depth interview form for experts.

Step 2: Study opinion data regarding the development of a work-related learning management model to enhance occupational training at establishments, using in-depth interviews with a semi-structured interview form. To ensure the quality of the research instrument, the draft interview guide was submitted to language and subject-matter experts for review prior to conducting interviews with experts and using a questionnaire on the components of the work-related learning management model to enhance occupational training at establishments with the predetermined sample group.

Step 3: Development of the opinion questionnaire. The researcher analyzed and transcribed the data obtained from the in-depth interviews and considered it together alongside theoretical concepts from the study of related documents and textbooks, using these findings to develop a draft of the questionnaire items. A 5-point Likert scale was used, with score levels defined as follows: highest importance = 5 points, high importance = 4 points, moderate importance = 3 points, low importance = 2 points, and lowest importance = 1 point. To develop the quality of the instrument, the researcher submitted the draft questionnaire items for quality verification by 5 experts to determine the Index of Item Objective Congruence (IOC). It was found that all items had an IOC value of no less than 0.80, indicating that all items met the acceptable criteria. To determine the reliability of the instrument, the researcher tried out the revised questionnaire with a group of 30 individuals who were not part of the sample and analyzed the statistical values using Cronbach's Alpha Coefficient. The reliability results showed an overall reliability coefficient of 0.92, which falls within the high-reliability range, indicating that the instrument could be used effectively to collect data on the condition and components of work-related learning management to enhance the occupational training of vocational education students through exploratory factor analysis.

Step 4: Data collection to analyze the components of work-related learning management designed to enhance vocational training in workplace settings. This involved interviewing eight vocational education experts, each with at least 15 years of professional experience in the field of vocational education. Additionally, opinions were gathered via an online questionnaire (Google Forms) from vocational college directors, deputy directors for academic affairs, heads of academic departments, and heads of dual-vocational training units under the office of the vocational education commission. The completeness of the questionnaires was then checked, and it was found that 390 questionnaires were returned complete and accurate, representing 100 percent. The data obtained were then analyzed to determine the components to be used as data for further model development. The second step involved evaluating the work-related learning management model designed to enhance occupational training in establishments; 11 experts participated in a focus group discussion to assess the model's appropriateness, which was subsequently used to organize readiness activities for preparing vocational education students to enter the workforce.

Step 5: Data analysis. The researcher analyzed the data obtained from the questionnaires. For the respondents' general information, frequency, percentage frequencies, percentages, means, and standard deviations were calculated. For the items regarding the management of work-related learning, Exploratory Factor Analysis (EFA) was used. The appropriateness of using factor analysis techniques was verified using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test (Kaiser & Rice, 1974). Communalities were determined as correlation coefficients between variables, and Total Variance Explained was calculated to observe the clustering of variables by extracting components using principal component analysis together with orthogonal rotation via the Varimax method. The criteria set for considering a component must have an eigenvalue of 1.0 or greater (Kaiser, H. F., 1960), and each variable within a

component must have a factor loading of 0.50 or greater (Hair et al., 2019).

4. Research Results

4.1 Results of Interviews Regarding Work-Related Learning to Promote Vocational Training for Vocational Education Students

In-depth interviews were conducted with eight experts to gather qualitative data for establishing the framework of variables for the questionnaire. Through content analysis of the semi-structured interview data, key issues and actual needs regarding work-related learning aimed at promoting vocational training for students were identified as follows:

1) Regarding vocational instruction within educational institutions: Experts highlighted a lack of continuous coordination and follow-up on cooperation with business establishments. Furthermore, college curricula and internship plans were found to be misaligned with the actual competency requirements of the business sector.

2) Regarding student behaviour and adaptability: Experts consistently noted that interns often lacked essential social skills and work habits such as discipline, responsibility, patience, safety awareness, and the ability to adapt to organisational culture.

3) Regarding cooperation in professional experience training: Experts advocated for learning models that integrate work with business establishments. They emphasised that educational institutions should prepare students with foundational practical skills such as industrial work habits, basic operational procedures, and the use of IE Technique tools before sending them to undergo vocational training at business establishments.

The researchers synthesised and developed 13 empirical items, resulting in a draft questionnaire comprising 78 variables. This synthesis was grounded in in-depth interviews and a review of theories concerning work-based learning, work-related learning, professional experience training, and vocational training. These 78 variables ensured that the research instrument intended for statistical testing with a sample of 390 individuals possesses content validity and genuinely aligns with the in-depth research context prior to the subsequent stage of Exploratory Factor Analysis (EFA).

4.2 Results of the Factor Analysis of Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis

The researcher verified the appropriateness of the data for using factor analysis techniques with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test, using a total of 78 variables. The data analysis results are shown in Table 1.

Table 1. Results of the Measurement of Variable Appropriateness Using KMO and Bartlett's Test Values

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.919
Approx. Chi-Square		33614.007
Bartlett's Test of	df	3003
Sphericity	Sig.	0.000

From Table 1, it was found that the data analysis yielded a KMO value of 0.919, which is greater than 0.50 and close to 1, indicating that the variables were appropriate for using factor analysis techniques in developing the work-related learning management model to enhance the occupational training of vocational education students through exploratory factor analysis. As for Bartlett's Test, the approximate Chi-Square value is 33614.007 with 3003 degrees of freedom (df) and a significance level of 0.000. Since this value is less than 0.05, it indicates that the variables are sufficiently correlated to be suitable for factor analysis.

The results of the extraction communality analysis of the variables, after component extraction, showed that the extraction The communality values of the variables were appropriate and could be clearly classified into specific components. their respective components. For the Total Variance Explained, which is used to observe the clustering of variables, components were extracted using principal component analysis along with orthogonal rotation through the Varimax method. The criterion set for considering a component was that the component must have an eigenvalue of 1.0

or greater. When considering the loading of each variable within each component to determine which component each variable belonged to, the factor loading of each variable was required to be no less than 0.50, with at least 3 variables required in each component. The results of the factor analysis are shown in Table 2.

Table 2. Eigenvalues, Percentage of Variance, and Cumulative Percentage of Variance before and after Rotation

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	33.725	43.238	43.238	33.725	43.238	43.238	11.744	15.057	15.057
2	4.397	5.637	48.874	4.397	5.637	48.874	8.766	11.238	26.295
3	2.590	3.320	52.195	2.590	3.320	52.195	7.841	10.052	36.347
4	2.314	2.967	55.162	2.314	2.967	55.162	6.856	8.790	45.138
5	2.158	2.767	57.928	2.158	2.767	57.928	4.874	6.248	51.386
6	1.932	2.477	60.406	1.932	2.477	60.406	4.360	5.589	56.975
7	1.696	2.174	62.580	1.696	2.174	62.580	3.093	3.966	60.941
8	1.640	2.103	64.683	1.640	2.103	64.683	2.919	3.742	64.683
.	.	.	.						
78	0.017	0.021	100.000						

From Table 2 shows the factor analysis results from orthogonal factor rotation using the varimax method for component extraction. The analysis classified the variables into 8 components. The analysis identified 8 components from the variables, all of which had eigenvalues greater than 1, with a cumulative percentage of variance of 64.683. Once the 8 components were determined, the loading of each variable within those components was analysed to establish its component membership, based on the principle that each variable is assigned to the component with the highest factor loading. The criteria established require a factor loading must be no less than 0.50 and a minimum of three variables per factor. In summary, five components consisting of 50 variables met the established criteria, as shown in Table 3.

As shown in Table 3, the factor analysis of work-related learning management for enhancing the occupational training of vocational education students was conducted based on component loadings and the number of variables and found that five components met the criteria: 1) Development of Cooperation for Learning Management; 2) Development of Student Competency; 3) Organization of a Work-Related Learning Environment; 4) Development of Work Skills to Build Industrial Habits; and 5) Assessment of Readiness for Career Entry, with a total of 50 variables. These evaluation items are comprehensive, consistent, and appropriate for the context of vocational education in Thailand and can be used to appropriately develop a work-related learning management model for enhancing the occupational training of vocational education students based on exploratory factor analysis.

The number of variables decreased from 78 to 50, reflecting a reduction of 28 variables through a quality screening process based on specific criteria: low factor loading variables with factor loading coefficients below the 0.5 threshold were excluded; cross-loading redundant variables were removed; and the number of factors was also reduced from eight to five because some factors contained fewer than three variables.

Table 3. Results of the Factor Analysis for Each Variable

Component	Variable	Factor Loading
1. Development of Cooperation For Learning Management	1.1 Workplace trainers from establishments participate in sharing their experience in the classroom	0.791
	1.2 Learning materials and activities are relevant to the actual work context at establishments	0.775
	1.3 Teachers plan learning activities jointly with establishments	0.774
	1.4 Learning plans are designed using problems or scenarios from establishments	0.753
	1.5 Establishments participate in designing learning together with educational institutions	0.725
	1.6 The roles and responsibilities of educational institutions and establishments are clearly defined	0.712
	1.7 The competencies necessary for the occupation are clearly defined	0.682
	1.8 Establishments jointly plan learning activities with educational institutions	0.672
	1.9 Evaluation reflects the competencies required at establishments	0.654
	1.10 Teachers and workplace trainers coordinate occupational training continuously	0.643
	1.11 Learning activities emphasize skills in using new tools or technologies used at establishments	0.634
	1.12 Establishments participate in setting learning goals together with teachers	0.616
	1.13 There is systematic integration between academic and professional subjects	0.610
	1.14 Course content is integrated with skills used at establishments	0.583
	1.15 Teachers and workplace trainers systematically evaluate and reflect on learning outcomes together	0.539
	1.16 Students are assigned tasks that match their field of study	0.517
2. Development of Student Competency	2.1 Students can clearly reflect on the knowledge or experience gained from real work	0.673
	2.2 Students have increased responsibility and discipline in their work	0.643
	2.3 Learning at establishments helps students understand course content better	0.640
	2.4 Work-focused learning clearly helps develop occupational skills	0.620
	2.5 Students are confidently ready to enter the work system at establishments	0.598
	2.6 Experience gained from learning through real work is beneficial for future careers	0.567
	2.7 Students can effectively apply knowledge to solve problems at work	0.550
	2.8 Students can effectively apply theoretical knowledge to practical work	0.536
	2.9 Students receive guidance or supervision from workplace trainers at establishments	0.512
	2.10 Students have improved problem-solving skills in real situations	0.510
	2.11 Students have improved skills in working with others	0.503
	2.12 Establishments have a good system for supervising and supporting students	0.500
3. Organization of a Work-Related Learning Environment	3.1 Students develop analytical thinking and decision-making skills from real work	0.662
	3.2 Students can better adapt to teamwork	0.651
	3.3 Students are given opportunities to express opinions or propose work approaches	0.649
	3.4 Students have increased confidence in performing tasks in their professional field	0.634
	3.5 The work environment is conducive to learning	0.633
	3.6 Workplace trainers provide continuous advice and feedback	0.614

Table 3. Results of the Factor Analysis for Each Variable (continued)

Component	Variable	Factor Loading
3. Organization of a Work-Related Learning Environment	3.7 Students can manage time and prioritize tasks well	0.557
	3.8 Students have developed improved communication skills in the workplace	0.546
	3.9 Students can connect work experience with academic content	0.540
	3.10 Working helps students better understand the real context of their profession	0.528
	3.11 Students receive orientation and training before starting work	0.502
4. Development of Work Skills to Build Industrial Habits	4.1 Teaching emphasizes students learning through hands-on practice rather than theory	0.671
	4.2 Students understand teamwork and organizational culture	0.628
	4.3 Work-connected learning helps promote continuous career development	0.609
	4.4 Students have a positive attitude toward work and their profession	0.559
	4.5 Learning activities simulate real work situations and roles for students	0.509
5. Assessment of Readiness for Career Entry	5.1 Students are regularly supervised, monitored, and advised	0.639
	5.2 Establishments are well-prepared to accept students for internships	0.630
	5.3 Establishments give students the opportunity to demonstrate their work potential	0.535
	5.4 Students have a greater understanding of real working conditions	0.524
	5.5 Internships help students develop real work skills	0.514
	5.6 Students have a positive attitude toward working within an organization	0.503

4.3 Results of the Development of the Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis

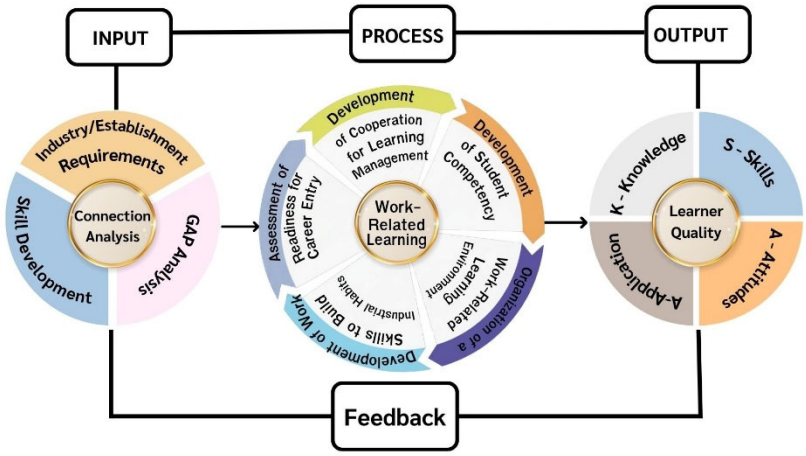


Figure 2. The Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis

In developing the work-related learning management model to enhance the occupational training of vocational education students, the five components were synthesized into a model using a systems model approach designed for use in the context of vocational education management that emphasizes real-world work competencies. The model is divided into three parts: 1. INPUT: Setting goals and analyzing establishment data to be used for supporting learning

development; 2. PROCESS: Driving work-related/work-based learning, surrounded by 5 activity areas comprising 1) Development of Cooperation for Learning Management, 2) Development of Student Competency, 3) Organization of a Work-Related Learning Environment, 4) Development of Work Skills to Build Industrial Habits, and 5) Assessment of Readiness for Career Entry; and 3. OUTPUT: Qualitative outcomes primarily reflecting vocational education standards and student competencies. This model helps ensure that students have the readiness and competency that effectively meet the needs of today's labor market and can be illustrated as shown in Figure 2.

The results of the experts' evaluation of the appropriateness, accuracy, feasibility, and usefulness of the Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis are shown in Figure 3.

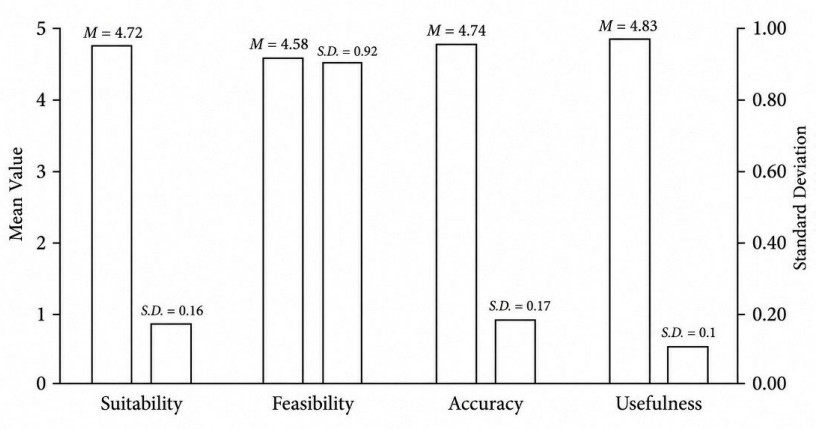


Figure 3. Results of Experts' Opinion Evaluation of the Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis

From Figure 3, a summary of the opinion evaluation results of all 11 experts from the Focus Group Discussion regarding the appropriateness, accuracy, feasibility, and usefulness of the Work-Related Learning Management for Enhancing the Occupational Training of Vocational Education Students Based on Exploratory Factor Analysis shows that the evaluation results were at the highest level in every aspect, with usefulness having the highest mean score of 4.83 (SD=0.10), followed by accuracy with a mean score of 4.74 (SD=0.17).

5. Discussion of Research Findings

The results of the factor analysis of the 78 variables related to work-related learning management showed a KMO value of 0.9189, and Bartlett's Test indicated sufficient correlation among the variables. After Varimax rotation, to reflect an overall picture of work-related learning for enhancing more effective occupational training at establishments so that it could be used to define models and development guidelines in a more comprehensive and systematic manner, consistent with the research of Gul et al. (2022), which enabled the analysis of factors to measure the structure of learning management through service in order to verify the appropriateness of the data with reliability and accuracy. The elements were:

Component 1, Development of Cooperation for Learning Management, involves analyzing the context and capabilities of partners, assessing labor demands from business establishments, aligning curricula with real-world work requirements, and establishing cooperation agreements (MOUs) that define the roles, duties, and responsibilities of each party through the formation of a joint committee, is in line with the research of Suttirak (2022), who studied the administration of dual vocational education systems with concrete cooperation systems between educational institutions and establishments. As stated by Zegwaard and Pretti (2020), "WIL entails co-design between educational institutions and establishments to ensure learning with clear objectives." Winberg et al. (2021) emphasize the active role that teachers and mentors in the establishments have to play together in helping students to "bridge theory to real-world practice."

Component 2, Student Competency Development, which involves conducting a competency analysis to identify core professional competencies based on professional standards and industry requirements, designing a competency development plan, creating an integrated learning plan, and organizing learning activities that link academic content

taught within the educational institution to actual work practices in the workplace, is in line with the research of Chantragatrawi et al. (2021) on the development of student competency using the work-based education learning model. An educational quality driver is a quality work-integrated learning (WIL) framework based on the work of McRae and Johnston (2016), which is work-based learning (WBL), an educational approach that promotes engagement in education and Technical and Vocational Education and Training (TVET) to facilitate improvements in employability and skill upgrading for a more competitive market (Harish, 2024).

Component 3, Organization of work-related learning environment, this involves analysing the context and requirements of the workplace including an assessment of the actual work environment, job characteristics, tools, technology, and workplace atmosphere guidelines for organising the environment can be developed to effectively meet the profession's specific needs, is in line with the research of Sellberg et al. (2026) who argue that experiential training combines theoretical teaching with real work practice by creating an environment where students from different professions experience uncertainty. It is important to develop a learning environment that strengthens the confidence and self-awareness to apply knowledge. Thammawat (2021) studied the guidelines for the development of workplace trainers which is considered to be an important part of the learning environment. It was also emphasized that the trainer competence is directly related to the quality of the occupational training environment in the dual system. Billett (2023) introduces the concept of an enabled work environment, arguing that learning is not just about teaching, but about creating opportunities for learners to participate in real, practical work.

Component 4, The Work Skills Development, which involves analyzing essential industrial skills and work habits, studying occupational standards and industry requirements, fostering an industrial atmosphere and culture, and configuring the educational environment to resemble an actual factory, is aligned with the research of García-Fuentes and Navarro-Granados (2024), who reflect on the challenges in the dual-system learning environment. They note that students must face pressures in the real world of work. The environment must therefore be designed to help students develop industrial behaviors and characteristics and adapt to organizational culture. This approach aligns with the consistent findings of Maun et al. (2025), which indicate that developing the attitudes and habits necessary for self-directed learning, along with fostering positive habits that focus on creating positive attitudes, better prepares students for the evolving demands of the labor market. According to Radhikha Kapur (2025), having effective work habits is crucial for successfully fulfilling all duties and responsibilities, as well as for developing career advancement opportunities.

The fifth component is Assessment of Readiness for Career Entry, which involves conducting readiness assessments both prior to and during the vocational training preparation phase using methods such as interview simulations and practical demonstrations, enhances the effectiveness of the learning process, with instructors and business establishments collaborating to analyse the assessment results, is in line with the research of Rowe and Zegwaard (2017) argued that the assessment of occupational training should be based on reflection to enable learners to monitor their progress continuously. Decius et al. (2023) argued that the WRL process will improve learners' competency and higher capability to successfully getting a job in a fast-changing labour market. Assessing and enhancing of students' preparedness to face challenges after graduation can enhance curricula and processes to prepare students for their career paths (Izbassar et al., 2024).

The evaluation results from the focus group discussion indicated that the developed work-related learning management model significantly enhanced the occupational training of vocational education students, achieving the highest level in every aspect. The findings indicate a consensus among the experts participating in the focus group discussion: the developed work-related learning approach enables educational institutions to provide instruction that equips learners with practical skills fostering the ability to think and act effectively, as well as cultivating professional attributes. Through strong collaboration with business establishments, learners acquire competencies that align with the needs of employers and the labor market. The approach is deemed appropriate, accurate, and beneficial, offering a practical model for implementation within educational institutions. Fatmawati et al. (2025) found that real-world experiential internships help increase opportunities for employment; career readiness plays an important role in improving outcomes, and future skill development helps reduce the gap between academic learning and labor market needs. Stefaniak (2020) found that service-learning experiences allow instructors to better understand what is discovered, and service-learning experiences enable instructors to gain insights into fostering students' understanding and applying 'learning to authentic, real-world contexts.' Foster and Yaoyuneyong (2016) showed that creating an appropriate learning environment demonstrates that students recognize the value of the process of developing practical skills that prepare them for work in the real world, serving as a starting point for further developing real-world experiences in the classroom.

6. Research Conclusions

The research results on developing a work-related learning management system to enhance the occupational training of vocational education students, based on exploratory factor analysis, indicate that effective management of workplace-based training requires a comprehensive support system that systematically interconnects various aspects. This approach blends and integrates classroom theory with practical, hands-on training, focusing on developing competencies that align with labor market demands through experiential learning. Consequently, students are better prepared for the workforce, acquiring the necessary knowledge and skills in critical thinking, task execution, and problem-solving, while employers gain confidence in the employees' performance. The model comprises five key elements aimed at ensuring students can perform actual work, think critically, execute tasks effectively, and embody and demonstrate professional attributes aligned with occupational standards and labor market needs. It emphasizes designing and managing learning processes that mirror real-world work environments to develop students who meet employer requirements and are ready to enter the workforce as high-quality professionals. Furthermore, it prioritizes instilling systematic work habits, discipline, and professionalism, ensuring that vocational students are fully prepared for effective performance in the workplace.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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