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Development and Validation of an Instrument to Measure Quality and Benefits for Work-based Learning Implementation

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Abstract

This study aimed to develop and validate a measurement instrument to assess students' experiences of the quality and benefits of Work-Based Learning (WBL) implementation within Malaysia's Technical and Vocational Education and Training (TVET) sector. Given the need for a psychometrically robust tool capable of producing interval-level measurement and ensuring item-level diagnostic precision, the Rasch measurement model was employed to evaluate construct validity, reliability, unidimensionality, and item functioning. A total of 68 students enrolled in Ministry of Higher Education WBL programs participated in the study by responding to an online questionnaire. Data was analyzed focusing on person and item reliability indices, separation statistics, item polarity, fit statistics, standardized residual correlations, and the alignment between item difficulty and respondent ability. The analysis demonstrated excellent internal consistency and satisfactory item polarity across all items. Fourteen items initially indicated misfit; following diagnostic evaluation, one item was removed and one revised, resulting in a final 50-item instrument. The validated instrument satisfies Rasch model assumptions of unidimensionality and local independence, confirming its suitability for measuring students' perceptions of WBL quality and benefit dimensions. This instrument provides educators, researchers, and policymakers with a reliable evaluative tool to strengthen WBL implementation and industry engagement in the Malaysian TVET context.

1. Introduction

The Twelfth Malaysia Plan (RMK-12) emphasizes the need to strengthen the Technical and Vocational Education and Training (TVET) agenda to develop a highly skilled national workforce. Although there has been highlights progress in expanding access and mainstreaming TVET, ongoing challenges such as a shortage of skilled job opportunities, slow wage growth, low labor force participation, and rising youth unemployment highlight the need for systematic mechanisms to ensure the effectiveness of TVET initiatives, especially in improving students' learning experiences and employability outcomes through meaningful industry engagement (Baharuddin et al., 2024; Economic Planning Unit, 2015; Eden et al., 2024; UNESCO, 2023). Work-Based Learning (WBL) has emerged globally as a critical pedagogical approach that integrates structured academic learning with authentic workplace experiences, enabling students to construct knowledge, develop occupational competencies, and internalize professional values. This model enhances students' employability by bridging the gap between theory and practice, often facilitated through partnerships with industry (Jamalludin et al., 2022). A recent comparative study between Thailand and Malaysia found that international work-integrated learning (WIL), a subset of WBL, helped graduates develop valuable employability skills, such as decision-making and adaptability, which are crucial for sustainable career readiness (Sa-Nguanmanasak & Khampirat, 2019). Additionally, stakeholder engagement, particularly with industry, is instrumental in shaping students' experiences of WBL quality, as effective collaboration ensures meaningful task allocation, mentoring support, and the transfer of relevant skills aligned with industry standards.

Within the Malaysian context, the expansion of WBL across polytechnics, community colleges, and universities under the Ministry of Higher Education (MOHE) presents an opportunity to empirically examine how students perceive the quality and benefits of their WBL experiences, in alignment with the Quality-Return-Cost (QRC) theoretical framework. By operationalizing these dimensions from the students' experiential standpoint, focusing on perceived learning quality, skill acquisition, professional growth and perceived benefits, this study seeks to develop and validate robust empirical indicators to guide institutional improvement and inform national policy. Accordingly, this research aims to measure the quality and benefits of WBL programs through a validated instrument using the Rasch Measurement Model. The findings are expected to support evidence-based strategies to enhance students' learning experiences, strengthen industry engagement, and improve the sustainability and effectiveness of WBL implementation across Malaysian TVET institutions.

This study is theoretically anchored in the Quality–Return–Cost (QRC) framework developed by Hauschildt and Brown, which conceptualizes vocational education effectiveness as a value-based relationship between the quality of training provision and the returns generated for stakeholders (Rauner & Heinemann, 2010; Hauschildt & Brown, 2011). Within the QRC model, quality is defined as the pedagogical and structural characteristics of training processes, including experience-based learning, professional training standards, autonomous learning, learning embedded in business processes, professional competence, and occupational commitment. Empirical findings from QRC applications demonstrate a positive correlation between higher training quality and improved return outcomes, indicating that value creation in vocational training is structurally linked to implementation quality. Adapting this theoretical logic to the Work-Based Learning (WBL) context, the present study focuses specifically on the quality–benefit nexus. Quality is operationalized as the structured implementation of industry engagement within WBL, while benefit represents the student-perceived returns in terms of skill acquisition, workplace readiness, and employability enhancement. By foregrounding the quality–return dimension of QRC and contextualizing it within Malaysian TVET, this study provides a theoretically coherent foundation for evaluating the educational value of WBL implementation.

2. Quality and Benefit in WBL

Work-Based Learning (WBL) has been rapidly garnering attention as a strategic approach to enhancing alignment between industry and education in technical vocational education training (TVET) systems. Modern literature stresses that placement length is not the only determinant of successful WBL; structured supervision, competency-based tasks, feedback-looping and meaningful integration in business processes must be delivered through WBL (Billett 2011; OECD 2020). Recent studies help to realize that high-quality WBL also enriches students' employability, formation of professional identity and workplace adaptability, especially in industry-led systems (Jackson, 2015; World Bank, 2022). The growing emphasis on value-based evaluation in vocational education underscores the need to assess not only participation rates but also the qualitative characteristics that determine outcome effectiveness. The Quality–Return–Cost (QRC) framework developed by Hauschildt and Brown provides a robust theoretical lens for examining this relationship. The QRC method integrates cost–benefit analysis with pedagogically grounded quality criteria, including experience-based learning, professional standards of training, autonomous learning, learning within business processes, professional competence, and occupational commitment. Empirical findings from QRC applications demonstrate that higher-quality apprenticeship training is positively associated with stronger return outcomes, reinforcing the proposition that implementation quality directly influences value creation. Recent vocational research similarly confirms that structured workplace mentoring, and authentic task engagement significantly predict skill acquisition and long-term employment outcomes (Caves & McDonald, 2023; CEDEFOP, 2023). Within the WBL context, therefore, quality and benefit are interdependent constructs: structured industry engagement (quality) shapes students perceived gains in technical competence, workplace readiness, and employability (benefit). Despite this theoretical and empirical alignment, validated instruments capable of systematically measuring both dimensions remain limited. This gap necessitates the development of a psychometrically robust tool grounded in the QRC value-based perspective and adapted to contemporary WBL implementation in TVET. WBL has increasingly been recognised as a strategic mechanism for strengthening industry–education alignment within TVET systems. Contemporary studies emphasise that effective WBL extends beyond placement duration and requires structured supervision, competency-aligned tasks, feedback mechanisms, and meaningful integration into business processes (Billett, 2011; OECD, 2020). Recent research further highlights that high-quality WBL enhances students' employability, professional identity formation, and workplace adaptability, particularly in industry-driven systems (Jackson, 2015; World Bank, 2022).

3. Methodology

This study employed a quantitative research design to develop and validate an instrument for assessing the Quality and Benefits of Work-Based Learning (WBL) in strengthening industry engagement. The methodology comprised of research instrument, the selection of the research sample and the application of Rasch measurement analysis for the data validation.

3.1 Research Instrument

The development of the instrument for this study was conducted in two phases. In the first phase, a qualitative approach was used to develop and refine the items, while in the second phase a quantitative approach was taken and an online questionnaire using Google Forms was used as the research instrument. This instrument is divided into three parts, namely part A (Demographics), part B (Quality) and part C (Benefits). Part A collects the demographic data of the respondents, including institution name, level of WBL program, name of the training company, industry category and training duration. Part B focuses on respondents' perception of quality of work-based learning emphasizing curriculum design and delivery, program implementation, assessment practices, student readiness, institutional and industry support, as well as overall program quality assurance. Finally, Part C focuses on respondents' perceptions of the benefits of Work-Based Learning (WBL), with an emphasis on employability, manpower contribution, industry recognition, networking opportunities, and innovation outcomes. The structure of the instrument is shown in Table 1. In this instrument, a 7-point Likert Scale was used to obtain responses from respondents ranging from 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), 5 (slightly agree), 6 (agree) to 7 (strongly agree). The use of Likert scales in questionnaires is appropiate for measuring respondent's perceptions.

Table 1 *Questionnaire items*

Domains	Items	No. of Items	Total Items
A) Quality	1) Curriculum design and delivery	CDD1-CDD6	6
	2) Program implementation	PI1-PI5	5
	3) Program assessment	PA1-PA5	5
	4) Student attitude and readiness	AR1-AR5	5
	5) WBL educational resources and support	ERS1-ERS3	3
	6) WBL program quality assurance	PQA1-PQA3	3
	7) Industry readiness	IR1-IR4	4
B) Benefits	1) Employability	E1-E9	9
	2) Manpower	M1-M4	4
	3) Recognition	R1-R5	5
	4) Innovation	IN1-IN3	3
	Overall		52

3.2 Research Sample

The population of this study consists of students who are ongoing the work-based learning in industry. In this study, 68 respondents were included in the pilot study, which was sufficient for this study as a minimum number of 30 respondents is required to ensure adequate reliability of the pilot study (Bujang et al., 2024).

3.3 Data Analysis

The Winsteps software, version 3.69.1.11, was used to analyze the questionnaire. Rasch analysis was used due to its ability to convert Likert scale data into linear item and person measurements, which facilitates the assessment of an individual's ability and the degree of difficulty of the items (Tesio et al., 2023). Furthermore, the researcher assessed at the items' functionality from the standpoints of statistical fit, the standardised residual correlation value, and the respondent's items' reliability and isolation.

4. Results and Discussion

To ensure methodological rigor and strengthen the validity and reliability of the measurement domains related to the Quality and Benefits of Work-Based Learning (WBL) among students, the main goal of this analytical approach is to validate the independence of the constructs within the research scope. Rasch Measurement Model Analysis will be used to analyze the results, and the process will be thoroughly explained.

4.1 Reliability and Item-Respondents Separation

The analysis revealed Cronbach's Alpha (α) value was 0.99, indicating excellent internal consistency of the questionnaire items. This result demonstrated that the instrument is highly reliable, effective and suitable for use in actual study. Furthermore, the Rasch analysis produced an item reliability value of 0.96 and an item separation index of 5.01. According to Bond & Fox (2007), reliability values above 0.8 reflect strong measurement quality, while Linacre (2005), notes that a separation index exceeding 2.0 demonstrates sufficient item discrimination. Therefore, the obtained values demonstrate excellent reliability and strong separation, confirming the reliability of the instrument. Table 2 presents detailed reliability and separation results.

Table 2 *Reliability and item separation values of pilot study*

Cronbach Alpha (α)	Reliability	Item Separation
0.99	0.96	5.01

In addition, the analysis produced a respondent reliability value of 0.88 and a respondent separation index of 2.67, as presented in Table 3. According to Bond & Fox (2007), a reliability value above 0.80 is considered strong and acceptable, indicating that the respondents demonstrated a high level of consistency.

Table 3 *Reliability and separation values*

Respondent Reliability	Respondent Separation
0.88	2.67

4.2 PTMEA CORR Value for Detecting Item Polarity

Item polarity analysis was conducted to determine the extent to which each item aligned with the study objectives. The Point Measure Correlation (PTMEA CORR) statistic was employed to assess item validity in representing the intended construct. As suggested by Bond & Fox (2007), positive PTMEA CORR values indicate that an item effectively measures the construct, whereas negative values suggest poor alignment and need revision or removal due to irrelevance. The results presented in Table 4 show that all items recorded positive PTMEA CORR values.

Table 4 *Point Measure Correlation (PTMEA CORR) values for all items*

Entry Number	Point Measure Corr.	Item
39	0.53	E8
38	0.53	E7
49	0.55	R5
42	0.63	M2
20	0.63	AR4
23	0.63	ERS2
24	0.65	ERS3
9	0.66	PI3
3	0.66	CDD3
19	0.67	AR3

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Entry Number	Point Measure Corr.	Item
2	0.68	CDD2
51	0.68	IN2
41	0.69	M1
8	0.70	PI2
31	0.71	IR4
47	0.71	R3
1	0.71	CDD1
21	0.72	AR5
34	0.72	E3
50	0.72	IN1
17	0.72	AR1
45	0.72	R1
33	0.73	E2
22	0.73	ERS1
32	0.73	E1
28	0.73	IR1
18	0.73	AR2
6	0.73	CDD6
11	0.74	PI5
35	0.74	E4
13	0.74	PA2
44	0.74	M4
46	0.74	R2
4	0.75	CDD4
37	0.75	E6
7	0.75	PI1
25	0.76	PQA1
48	0.76	R4
43	0.76	M3
5	0.76	CDD5
52	0.77	IN3
14	0.77	PA3
40	0.77	E9
29	0.77	IR2
30	0.77	IR3
27	0.77	PQA3
36	0.79	E5
15	0.79	PA4
10	0.79	PI4
26	0.80	PQA2
16	0.83	PA5
12	0.83	PA1

4.3 Fit of Items Measuring Constructs

Construct validity was assessed using the Outfit Mean Square (MNSQ) index derived from the item fit statistics (Bond & Fox, 2015). For an item to be considered appropriate in measuring the intended domain, its Outfit MNSQ value should range between 0.60 to 1.40. The value above 1.40 indicates that the item does not adequately represent the construct, while values below 0.60 suggest that the item is overly predictable and may not contribute meaningful information (Bond & Fox, 2007). Items falling outside this range require revision or removal to enhance the accuracy of measurement. Table 5 presents the misfit order, highlighting 7 items with the highest MNSQ values and 7 items with the lowest MNSQ values.

Table 5 *Item fit table*

Entry Number	Infit		Outfit		Items
	MNSQ	ZSTD	MNSQ	ZSTD	
38	2.15	5.2	2.39	4.6	E7
39	2.34	5.9	2.24	4.7	E8
23	1.61	3.0	2.32	3.9	ERS2
49	2.11	5.2	2.26	4.7	R5
42	1.92	4.4	1.86	3.3	M2
24	1.33	1.9	1.66	2.6	ERS3
20	1.65	2.9	1.37	1.2	AR4
14	0.52	-3.1	1.57	1.8	PA3
9	1.44	2.1	1.18	0.6	PI3
6	0.87	-0.07	1.40	1.5	CDD6
51	1.35	2.0	1.30	1.4	IN2
2	1.30	1.6	1.22	0.9	CDD2
3	1.27	1.4	1.25	0.9	CDD3
31	1.15	0.9	1.22	0.9	IR4
50	1.19	1.1	1.05	0.3	IN1
1	1.17	0.9	0.94	-0.01	CDD1
8	1.08	0.5	0.92	-0.02	PI2
47	1.07	0.4	1.03	0.02	R3
45	1.05	0.3	0.95	-0.1	R1
41	1.01	0.1	1.02	0.2	M1
19	1.01	0.1	0.83	-0.3	AR3
28	1.01	0.1	0.90	-0.3	IR1
46	0.96	-0.2	0.89	-0.4	R2
13	0.93	-0.3	0.77	-0.8	PA2
18	0.91	-0.4	0.83	-0.5	AR2
11	0.90	-0.5	0.79	-0.7	PI5
44	0.85	-0.9	0.89	-0.4	M4
22	0.85	-0.8	0.77	-0.8	ERS1
27	0.84	-0.9	0.80	-0.8	PQA3
17	0.82	-0.9	0.71	-0.8	AR1
52	0.82	-1.1	0.72	-1.2	IN3
48	0.80	-1.2	0.73	-1.1	R4
7	0.79	-1.2	0.75	-1.0	PI1
35	0.78	-1.2	0.71	-0.9	E4
37	0.72	-1.6	0.78	-0.8	E6
21	0.77	-1.2	0.69	-0.9	AR5
43	0.76	-1.4	0.75	-1.1	M3
34	0.74	-1.4	0.71	-0.8	E3
33	0.68	-1.8	0.74	-0.7	E2
5	0.72	-1.6	0.64	-1.3	CDD5
32	0.66	-2.0	0.71	-0.9	E1
25	0.70	-1.7	0.69	-1.1	PQA1
40	0.69	-1.8	0.61	-1.6	E9
29	0.65	-2.1	0.64	-1.4	IR2
30	0.63	-2.2	0.60	-1.5	IR3
15	0.61	-2.4	0.56	-1.7	PA4
10	0.61	-2.4	0.58	-1.7	PI4
4	0.58	-2.5	0.59	-1.3	CDD4

Entry Number	Infit		Outfit		Items
	MNSQ	ZSTD	MNSQ	ZSTD	
26	0.57	-2.7	0.51	-2.2	PQA2
36	0.44	-3.7	0.42	-2.2	E5
16	0.38	-4.4	0.36	-3.1	PA5
12	0.34	-4.8	0.33	-3.3	PA1

The analysis identified 14 items falling outisde the acceptable Outfit MNSQ range, indicating the need for revision or removal.

Items that exceeded the upper threshold of 1.40 were E7 (2.39), E8 (2.24), ERS2 (2.32), R5 (2.26), M2 (1.86), ERS3 (1.66) and PA3 (1.57). Conversely, items below the lower threshold were PA4 (0.56), PI4 (0.58), CDD4 (0.59), PQA2 (0.51), E5 (0.42), PA5 (0.36) and PA1 (0.33). Following the expert review and methodological considerations, 1 item was removed, and 2 items were revised to improve the accuracy and alignment of the instrument with the study objectives.

4.4 Standardized Residual Correlation Value in Determining Dependent Items

An evaluation of standardized residual correlation was performed to identify potential item redundancy within the instrument. High residual correlation suggest that certain items may be measuring overlapping dimensions, thereby reducing the independence of the items. According to Linacre (2007), a correlation value above 0.70 indicates a strong association and potential redundancy. Hence, retaining only one of the correlated items is recommended to minimize duplication and enhance the precision of construct measurement. Table 6 presents the items with the highest standardized residual correlation.

Table 6 *Largest standardized residual correlations on items*

Correlation	Entry Number	Items	MNSQ Outfit	Result	Entry Number	Items	MNSQ Outfit	Result
0.80	45	R1	0.95	Revised	46	R2	0.89	Removed
0.73	46	R2	0.89	Removed	47	R3	1.03	Revised

Table 6 indicates that 2 pairs of items recorded residual correlation value exceeding the 0.70 threshold, specifically the items of R1 and R2 (0.80) and R2 and R3 (0.73), suggesting potential redundancy. As outlined by Linacre (2007), when two items demonstrated correlations above 0.70, only one item should be remained to preserve construct validity, where the other item requires removal. To direct this decision, the Outfit MNSQ statistics, ideally close to 1.00, was considered as items in the list should be remained (Abdul Aziz et al., 2017). Based on these values, item R2 was identified for removal, while item R1 and R3, with MNSQ values closer to 1.00, remained in the instrument.

The refinement of the instrument was guided by the validity and reliability criteria established under the Rasch measurement model. Decisions regarding item remained or removal were further supported by expert judgment and evaluation. Findings from the pilot study indicated that one item did not align with the study objectives and was therefore excluded. A summary of the final set of items retained for the study is presented in Table 7.

Table 7 *Summary of items dropped and remained*

Domains	Remained Items	Total Remained Items	Removed Items	Total Removed Items
B) Quality	CDD1-CDD6, PI1-PI5, PA1-PA5, AR1-AR5, ERS1-ERS3, PQA1-PQA3, IR1-IR4	31	-	-
C) Benefit	E1-E9, M1-M4, R1, R3-R5, IN1-IN3	20	R2	1
	Total	51		1

The pilot study results led to the removal of a single item from the Benefits of Work-Based Learning domain. After this refinement, the finalized instrument for the main study consisted of 51 items in total. The validated structure was organized into two domains consisting of 11 components, represented by the remaining 51 items. This study successfully developed a validated instrument for Quality and Benefits of Work-Based Learning (WBL) to Strengthen Industry Engagement, especially designed to address students' perception towards the WBL program, with Cronbach's alpha of 0.99, indicating excellent internal consistency. The instrument was developed to strengthen the WBL model in the Malaysian Technical University Network (MTUN) by evaluating indicators, impacts, challenges, and policy implications. This study aligns with Malaysia's national agenda under RMK12 to strengthen TVET by developing high-quality, industry-relevant human capital through Work-Based Learning (WBL) (Mohd Yusoff et al., 2024). The research highlights persistent challenges, including limited creation of skilled employment, slow wage growth, low labor force participation, and high youth unemployment, which reinforce the need to evaluate WBL from the perspectives of quality, cost, and benefits. To address these issues, the study applies the QRC (Quality, Return, Cost) framework, adapted from international best practices, to capture comprehensive indicators that reflect curriculum design, employability outcomes, and cost-effectiveness of WBL implementation (Hauschildt & Brown, 2011). By incorporating input from industry coaches, students, and higher education institutions, the study emphasizes the role of collaborative engagement in ensuring program sustainability. The findings are expected to inform policymakers with empirically validated indicators that strengthen industry involvement in WBL, improve graduate employability, and enhance organizational productivity. However, as the research focuses primarily on institutions under the Ministry of Higher Education (MOHE) including polytechnics, community colleges, and public universities, the outcomes are context-specific and not immediately generalized across all education systems. Future research should broaden the scope to include diverse training models and sectors, ensuring wider applicability of the proposed indicators.

5. Conclusion

This study developed and validated an instrument to measure students' experiences of the Quality and Benefits of Work-Based Learning (WBL) using the Rasch Measurement Model. The final instrument, comprising 51 items across two domains and 11 components, demonstrated excellent reliability and strong item separation, confirming its psychometric robustness. By capturing students' perceptions of workplace learning quality, skill development, and employability-related benefits, the instrument provides a practical tool for educators, researchers, and policymakers to better understand and enhance students' WBL experiences. The findings support efforts to improve the alignment between workplace learning practices and students' developmental needs, thereby strengthening industry engagement and graduate employability. Although the study is limited to institutions under the Ministry of Higher Education (MoHE), it establishes a strong empirical foundation for future research. Broader application across diverse sectors and training ecosystems is recommended to enhance generalizability and inform evidence-based improvements in WBL implementation.

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Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Mohamad, MM;* ***data collection:*** *Mohd Samshul, SN; Mohamad, MM; Miskon, MF; Khalid Khan, NL SS;* ***analysis and interpretation of results:*** *Mohd Samshul, SN; Mohamad, MM;* ***draft manuscript preparation:*** *Mohd Samshul, SN; Mohamad, MM.. All authors reviewed the results and approved the final version of the manuscript.*

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