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Development of an entrepreneurship system instrument to enhance the employability skills of Vocational High School (SMK) students

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ABSTRACT

This study aimed to create an instrument for an entrepreneurship system that aids in improving the employability skills of Vocational High School (SMK) students. The background of the study stems from the persistent issue of unemployment that SMK graduates, in particular, face relative to graduates from other institutions, and the lack of a single instrument that can comprehensively assess the school entrepreneurship system's performance. The adopted methodology is the research and development (R&D) technique, which aims to create an instrument, as outlined by Djemari Mardapi. The steps involved creating definitions, designing frameworks, drafting content, and undergoing validation to assess the expert viewpoint, followed by Aiken's V index, the analysis of internal consistency using Cronbach's alpha, and construct validity through Confirmatory Factor Analysis (CFA). The results indicate that the instrument developed has high content validity (Aiken's V index from 0.85–1.00), excellent reliability (Cronbach's alpha = 0.900), and adequate construct validity with a KMO of 0.948 and CFA model fit indices within the standard range. These indicators affirm that the instrument can be used to assess the entrepreneurship system in vocational schools.

Keywords: instrument, entrepreneurship, employability skills, vocational high school, development

1. INTRODUCTION

Graduates of vocational high schools (SMK) are expected to be work-ready while simultaneously adaptable to changes in the business and industrial sectors, including through entrepreneurship empowerment, which enables students to create and expand employment opportunities (Abdurrahman & Mahmudah, 2023). The curriculum transformation (the Merdeka Curriculum) and revitalization of vocational education in Indonesia emphasize the relevance of learning, industry partnerships, and the cultivation of character and cross-disciplinary work competencies as prerequisites for employability—a combination of technical skills, soft skills, and an entrepreneurial mindset (Wang et al., 2025; Suyitno et al, 2025). These policies signal the need for valid and reliable instruments to monitor the quality of the "entrepreneurship system" at the school level (covering planning, learning, ecosystems, partnerships, career support, and graduate outcomes) as a basis for continuous improvement (Ramadhan et al., 2025). This study introduces the development of such an instrument to strengthen evidence-based improvements in vocational high schools.

The Indonesian normative framework mandates education that is both high quality and relevant to labor market needs while simultaneously encouraging learners to engage in entrepreneurship (Law of the Republic of Indonesia No. 20 of 2003). This law on the National Education System affirms the functions and objectives of national education, including relevance to development needs and the cultivation of learners' potential to become productive individuals (Law of RI No. 20/2003). Presidential Regulation No. 68 of 2022 concerning the Revitalization of Vocational Education and Training targets increased access, quality, and relevance of vocational provision in alignment with labor market demands, as well as the provision of competencies for employment and/or entrepreneurship (Perpres RI No. 68/2022). The Merdeka Curriculum further reinforces the simplification of learning outcomes, opportunities for project-based learning, and character development— all contexts relevant to the design of integrated entrepreneurship activities (Kemdikbudristek, 2022). Most recently, Directorate General of Primary and Secondary Education Regulation No. 14 of 2025 regarding Technical Guidelines for Creative and Entrepreneurship Projects (PKK) in SMKs explicitly aims to cultivate entrepreneurial competencies and mindsets so that graduates are capable of creating jobs (Perdirjen Dikdasmen No. 14/2025). Thus, the ideal condition requires a school-based entrepreneurship ecosystem that is structured, measurable, and accountable (Perpres RI No. 68/2022).

Despite strengthened policy support, labor market data continue to highlight challenges. As of February 2025, the Open Unemployment Rate (TPT) for SMK graduates remains the highest among educational levels—8.00%, compared to 6.35% for senior high school, 6.23% for undergraduate and postgraduate levels (D4/S1–S3), 4.84% for diploma levels (D1–D3), and 4.35% for junior high school (BPS 2025a). Furthermore, unemployment shares by educational level show that SMK graduates continue to constitute a significant group in the labor market (BPS, 2025b). On a positive note, efforts to conduct tracer studies at SMKs have increased yearly, reaching near-universal participation in 2024. However, detailed findings on employment absorption and transition quality still vary across regions and fields of expertise (Kemdikbudristek, 2024). Figure 1 presents a bar chart of unemployment rates by educational attainment (February 2025), illustrating the employment challenges that SMK graduates face.

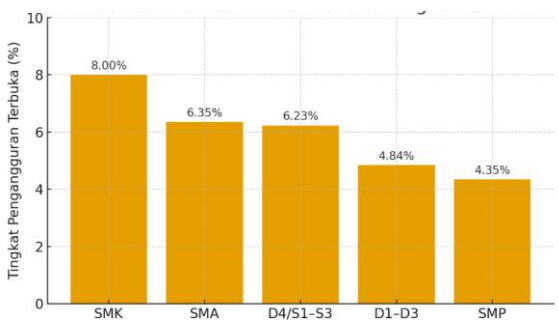

Figure 1. Open Unemployment Rate

The main gap lies in the absence of a standardized instrument that holistically captures the performance of the entrepreneurship system in SMKs—covering aspects of input (school policies, human resources, facilities), processes (entrepreneurship learning, work-based learning, teaching factory, incubation), outputs (entrepreneurship competencies and employability skills), outcomes (employment or entrepreneurial engagement), and enablers (industry partnerships and career support). Without a validated instrument, schools face difficulties in evaluating and refining interventions, while policymakers struggle to identify effective practices and channel data-driven support.

Studies in 2025 highlighted three major themes. First, contextual entrepreneurship education models in SMKs emphasize the importance of integrating project activities, partnerships and entrepreneurial culture. Second, work-based learning improves employability skills, with self-efficacy and vocational identity acting as mediators. Third, new instruments have been validated to measure entrepreneurial intentions, orientation, and employability, such as the Individual Entrepreneurial Orientation scale (Clark et al., 2025; Hartini, 2025), Intrapreneurial Intentions (Baena-Luna et al., 2025), Digital Entrepreneurial Platform Capability (Mady et al., 2025), and employability and problem-solving instruments (Zhan et al., 2025; Ventura-León et al., 2025). In Indonesia, the validation of entrepreneurial intention instruments for vocational students (Rafli & Indreswari, 2025) and models of vocational education systems involving industry (Ramadhan et al., 2025) confirm the need for localized measurement tools in the Indonesian context.

The consistently high unemployment rate among SMK graduates signals the necessity for a systemic approach at the school level: not merely "teaching entrepreneurship," but rather building a measurable and managed entrepreneurship system (BPS, 2025a). A validated instrument enables baseline mapping, quality audits of processes, benchmarking across schools, and targeted decision-making in funding and program development (Perpres RI No. 68/2022; Perdirjen Dikdas 14/2025). This study aimed to develop an entrepreneurship system instrument to enhance the employability skills of SMK students. The proposed instrument covers the domains of policy and governance, authentic learning experiences (entrepreneurship courses, teaching factories, internships, projects), industry partnerships and incubation, career services, and graduate outcomes (employability and entrepreneurial activities), accompanied by validity and reliability procedures in accordance with best practices in 2025.

2. METHOD

This study employed a research and development (R&D) method to produce an entrepreneurship system instrument for vocational high schools (SMK). Research and development in education refers to a process or set of steps designed to generate new products or improve existing ones while testing their validity and reliability (Borg & Gall, 1983). In the educational context, development research is used to design evaluation instruments, learning media, and instructional models tailored to the needs of students and educational institutions (Gall et al., 2003).

The instrument development procedure in this study followed the framework of Mardapi (2012), which outlines the following steps: (1) formulating the conceptual and operational definitions of the constructs to be measured; (2) preparing indicators and instrument blueprints; (3) writing instrument items in accordance with the blueprint; (4) conducting content validation through expert judgment; (5) analyzing the items (validity and reliability); and (6) revising the instrument based on trial results. The adopted methodology aimed to assure the validity, reliability, and practicality of the developed instrument as a true measure of the entrepreneurship system at vocational high schools (Mardapi, 2012).

Content validity was measured using Aiken's V index, which evaluates V agreement among experts regarding the relevance of instrument items to the construct indicator (Aiken, 1985). The instrument's reliability was tested to diagnose the instrument's self-consistency. Because the instrument was a Likert-scale questionnaire, it was assessed using Cronbach's alpha. An alpha coefficient ≥ 0.70 was classified as reliable (Nunnally & Bernstein, 1994). In addition, composite reliability testing was performed to reinforce the instrument's reliability (Hair et al., 2019). Construct validity was assessed through Confirmatory Factor Analysis (CFA) using a Structural Equation Modeling (SEM) approach. The aim of the CFA is to test

whether the empirical indicators of a certain set of variables fit the theoretical model (Byrne, 2016). The model fit indices used were Chi-Square/df, CFI, TLI, RMSEA, and SRMR. A model is considered fit when it meets the following criteria: CFI ≥ 0.90, TLI ≥ 0.90, and RMSEA and SRMR ≤ 0.08 (Hu & Bentler, 1999).

3. RESULT AND DISCUSSION

3.1 Instrument

The details of the instruments are shown in Tables 1 and 2.

Table 1. Instrument

Aspect	Indicator
Content Quality	Accuracy of content
	Clarity of content
	Logical sequence of content
	Relevance of content
	Ease of understanding the content
	Ability to attract user attention
	Provision of examples
	Availability of contact information for further inquiries
Visual Communication	Appropriateness of font selection
	Appropriateness of color selection
	Appropriateness of sound/music selection
	Clarity of images/animations/visuals
	Accuracy of navigation
	Quality of design/appearance
Software Engineering	Quality of media presentation
	Effectiveness of use
	Reliability of the media when used
	Clarity and completeness of user guidelines
	Usability (ease of use)
	Accessibility

Table 2. Research Questionnaire

Aspect	Indicator
Content Quality	Accuracy of the content presented according to students' needs to start a business
	Clarity of the content presented, easily understood
	Logical order of content on the website according to business sequence
	Relevance of content such as format and videos to students' needs in starting a business
	Ease of understanding the content
	Content displayed attracts students' attention
	Provision of examples in video form that can serve as motivation to start a business
	Availability of contact information for further inquiries
Visual Communication	Appropriateness of font selection used on the website
	Appropriateness of color selection displayed on the website
	Appropriateness of sound/music included on the website
	Clarity of images/animations/visuals on the website
	Accuracy of website navigation
	Quality of design/appearance of the website
Software Engineering	Quality of website presentation
	Website can be used as a reference to understand material for starting a business
	The start-up website can be relied upon

	Clarity and completeness of website user guidelines
	Ease of use of the website
	Accessibility of the website

3.2 Validity Test

Content validity was measured using Aiken's V Index. The test involved five experts, each of whom provided assessments using a five-point Likert scale (see Table 3).

Tabel 3. Validity Test

No	Rater					S_1	S_2	S_3	S_4	S_5	Σs	n(c-1)	V	Ket	Kategori
	1	2	3	4	5										
1	5	4	5	5	5	4	3	4	4	4	19	20	0.950	Valid	High
2	5	5	5	4	4	4	4	4	3	3	18	20	0.900	Valid	High
3	5	5	4	4	5	4	4	3	3	4	18	20	0.900	Valid	High
4	4	5	4	5	4	3	4	3	4	3	17	20	0.850	Valid	High
5	4	5	5	4	5	3	4	4	3	4	18	20	0.900	Valid	High
6	4	5	5	4	5	3	4	4	3	4	18	20	0.900	Valid	High
7	4	5	5	5	5	3	4	4	4	4	19	20	0.950	Valid	High
8	5	4	5	5	4	4	3	4	4	3	18	20	0.900	Valid	High
9	5	5	5	5	5	4	4	4	4	4	20	20	1.000	Valid	High
10	5	4	5	5	5	4	3	4	4	4	19	20	0.950	Valid	High
11	5	5	5	4	4	4	4	4	3	3	18	20	0.900	Valid	High
12	5	5	4	4	5	4	4	3	3	4	18	20	0.900	Valid	High
13	4	5	4	5	4	3	4	3	4	3	17	20	0.850	Valid	High
14	4	5	5	4	5	3	4	4	3	4	18	20	0.900	Valid	High
15	4	5	5	4	5	3	4	4	3	4	18	20	0.900	Valid	High
16	4	5	5	5	5	3	4	4	4	4	19	20	0.950	Valid	High
17	5	4	5	5	4	4	3	4	4	3	18	20	0.900	Valid	High
18	5	5	5	5	5	4	4	4	4	4	20	20	1.000	Valid	High
19	4	5	5	5	5	3	4	4	4	4	19	20	0.950	Valid	High
20	5	5	5	4	5	4	4	4	3	4	19	20	0.950	Valid	High

Based on the results of the content validity test above, it can be concluded that all items are valid in the high category. The coefficient values of Aiken's V ranged between 0 and 1 (Lewis-Beck et al., 2004). Thus, the results of the content validity analysis fell within the range of 0–1. According to the calculation of Aiken's V index, an item or instrument can be categorized based on its index value (De Toni et al., 1995). If the index is less than or equal to 0.4, the validity is considered low; if it ranges from 0.4–0.8, the validity is considered moderate; and if it is greater than 0.8, the validity is considered very high (Guzmán et al., 2019). Therefore, it can be concluded that the statements from the content validity analysis above are valid.

3.3 Reliability Test

Reliability refers to the degree of trustworthiness; therefore, the reliability test aims to determine the level of consistency of the questionnaire used in the research. Thus, the questionnaire employed is expected to possess dependability in measuring the components of the study.

Table 4. Case Processing Summary

Case Processing Summary			
		N	%
Cases	Valid	233	100.0
	Excluded[a]	0	.0
	Total	233	100.0
a. Listwise deletion based on all variables in the procedure.			

Table 4 provides information on the number of respondents (N = 233). Since there were no missing data (all questions were answered by the respondents), the number of valid cases is 100%.

Table 5. Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
.900	20

Table 5 shows that the number of items (N of items) in the questionnaire is 20, with a Cronbach's alpha value of 0.900. Since the Cronbach's alpha value of 0.900 is greater than 0.60, based on the decision criteria of the reliability test, it can be concluded that all 20 questionnaire items are reliable and consistent.

Table 6. Item-Total Statistics

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
item1	49.42	143.875	.025	.909
item2	49.50	129.682	.657	.892
item3	49.35	127.124	.696	.890
item4	49.24	127.252	.737	.889
item5	49.45	131.283	.587	.894
item6	49.84	126.370	.711	.890
item7	48.97	137.572	.305	.901
item8	48.95	129.101	.701	.891
item9	49.40	132.156	.488	.896
item10	49.09	132.686	.564	.894
item11	49.15	135.142	.468	.897
item12	49.53	131.931	.653	.892
item13	49.66	123.787	.718	.889
item14	49.09	131.815	.578	.894
item15	49.58	144.211	.013	.910
item16	49.24	132.824	.594	.894
item17	49.48	138.009	.233	.904
item18	48.82	129.427	.718	.890
item19	49.74	131.545	.658	.892
item20	49.12	128.827	.670	.891

Based on the output in Table 6, it can be concluded that the Cronbach's alpha if item deleted values in the table for all 20 questionnaire items are greater than 0.60. Therefore, it can be concluded that all 20 questionnaire items are reliable. This means that they demonstrate an adequate level of consistency and stability (Mulyadi & Mulianti, 2018).

3.4 Construct Validity

Construct validity was examined using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

Table 7. EFA Test Result

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.948
Bartlett's Test of Sphericity	Approx. Chi-Square	1881.135
	df	190
	Sig.	.000

The analysis results in Table 7 show that the KMO value is 0.948, which is greater than 0.05. This indicates that the instrument analyzed has an adequate model and can therefore be continued with the CFA. The subsequent analysis aimed to identify the number of factors contained in the instrument, which can be observed from the scree plot. Figure 2 shows the results of the scree plot analysis.

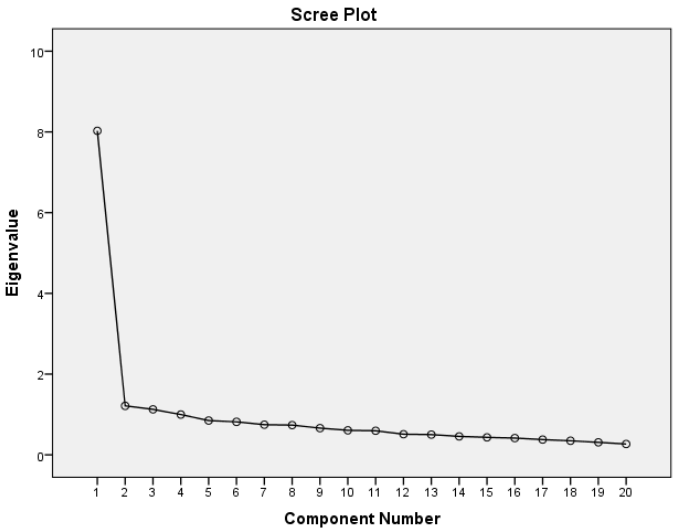

Figure 2. Scree Plot

The results of the scree plot in Figure 2 indicate that the eigenvalues began to decline at factor 2. This suggests that there is a dominant factor in measuring students' entrepreneurial ability. These results demonstrate that the instrument meets the unidimensionality assumption, or in other words, measures only one dominant factor.

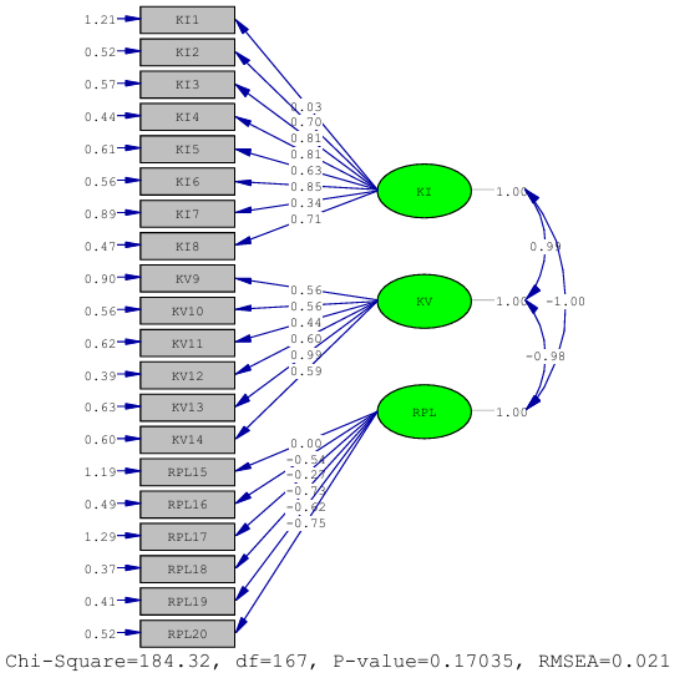

Figure 3. CFA

The instrument in Figure 3 was developed to examine the quality of the tool to be used in data collection. This development follows established research principles and methodologies. The instrument was reviewed both theoretically and contextually using various testing procedures (Schröder & Lundqvist, 2022; Tam, 2001). The quality of the instrument resulting from these tests can be applied to problem-solving (Abdurrahman & Mahmudah, 2023; Akareem & Hossain 2016). Harlanu et al. (2023), as well as de Souza et al. (2020), are specialists who analyse and assess effectiveness. To assess its validity, content validity and construct validity must be considered (Shirali et al., 2018; Nofrida et al., 2022). Validity and reliability are both critical considerations in formulating assessment instruments for credible research findings (Sullivan, 2010; Bodzin et al., 2020). In addition, assessment instruments should not have items influenced by biased differential functioning (Mardapi, 2008; Cárdenas-Gutiérrez et al., 2021a). For measurement purposes, it is important to use instruments that have been thoroughly validated (Doward et al., 2004; Cahyono et al., 2021; Cárdenas-Gutiérrez et al., 2021b). Based on the outcomes of the research, the developed instrument on the entrepreneurship system has content validity, good reliability, and construct validity that aligns with the theoretical model, thus confirming its appropriateness as a measurement instrument in vocational high schools (SMK). These outcomes support the theory of instrument development that an instrument for research is valid as long as the data collected satisfy the criteria set for reliability (Sullivan, 2011). The instrument's content validity is high, as determined by Aiken's V index, and the statements associated with the levels of the entrepreneurship system are relevant within its framework. This is in line with Aiken (1985), who pointed out that the judgement of a panel of professionals is an important instrument of content validity. These have also been complemented by Shirali et al. 's (2018) work on the content validity of instruments for measuring the culture or systems of schools and other educational organizations.

Moreover, the CFA of the instrument showed the construct validity of the scale when it was realized that the factor structure of the scale was consistent with the theory of the system of entrepreneurship. This outcome is consistent with the recommendations provided by Byrne (2016) and Hu and Bentler (1999), who highlighted that CFA is a mandatory step for the establishment of convergence between empirical indicators and theoretical constructs. Given that the CFI, TLI, RMSEA, and SRMR statistics all fell within the fit cut-offs, the instrument met contemporary psychometric standards. The Cronbach's alpha value from the reliability test was 0.900, suggesting that the internal

consistency was very high. As a cutoff point, a reliability above 0.70 is normally considered good enough for social research (Nunnally & Bernstein, 1994).

The resulting instrument is specific to contemporary measurement requirements within vocational entrepreneurship education. Abdurrahman and Mahmudah (2023) stated that project-based digital entrepreneurship tools can accommodate students' growing competence. Similarly, Zhan et al. (2025) stressed the need for reliable measures to instrument employability in an engineering and vocational educational setting, which may also apply to the SMK context. The instrument, therefore, not only complies with methodological requirements but also ensures that the practical requirement of monitoring the quality of entrepreneurship systems is met. It enhances the evaluation mechanisms of school-running in vocational colleges, especially the promotion of vocational education-related schools involved in rejuvenation at work. With a valid and reliable tool, schools can conduct data-driven evaluations, and governments can implement better mapping and interventions. Researchers can also use the tool to compare the effectiveness of entrepreneurship programs across schools, regions and fields of expertise. This supports the recommendation of Cárdenas-Gutiérrez et al. (2021a), who highlighted that validated entrepreneurial competency tools are essential for improving entrepreneurship education policy.

The instrument developed in this study differs fundamentally from similar instruments, such as employability skills (Zhan et al., 2025) or entrepreneurial intention (Rafli & Indreswari, 2025). First, while employability instruments focus solely on individual work abilities and entrepreneurial intention instruments emphasize personal attitudes or intentions to become entrepreneurs, this instrument specifically measures the entrepreneurship system at the school level. Thus, it holistically assesses aspects of policy, governance, learning processes, ecosystems, industry partnerships, career services, and graduate outcomes (Ramadhan et al., 2025). Furthermore, its development context, based on the reality of Vocational High Schools (SMK) in Indonesia, makes this instrument relevant and contextualized. National regulations, such as Presidential Regulation No. 68/2022 concerning the Revitalization of Vocational Education and Directorate General of Elementary and Secondary Education Regulation No. 14/2025 concerning Creative Projects and Entrepreneurship, require a measurable and accountable school entrepreneurship ecosystem. Therefore, this instrument is present not only as a general evaluation tool but also as a measuring tool that is appropriate to the needs of vocational school revitalization in Indonesia, which can be a reference for improving data-based programs and policies at the school and government levels.

4. CONCLUSION

This study developed an instrument to measure the quality of the entrepreneurship ecosystem in vocational high schools (SMK). The tool examines policy and governance, entrepreneurship learning and teaching factories, partnerships with businesses, support for career services and incubation, and graduate outcomes. The analysis showed that the instrument had high content validity based on Aiken's V index, excellent reliability with a Cronbach's alpha value of 0.900, and strong construct validity through Confirmatory Factor Analysis (CFA). Therefore, the instrument is valid and reliable for use as an evaluation tool and can significantly support efforts to improve the employability skills of SMK graduates in the future.

Based on the research findings, several recommendations should be considered. For schools, this instrument can serve as an internal evaluation tool to be conducted regularly to identify the strengths and weaknesses of entrepreneurship programs. It can also guide the planning and development of learning programs for teachers. For local and national governments, the instrument can act as a reference for monitoring and evaluating entrepreneurship programs in SMKs. This can lead to more focused vocational education policy revitalization. For teachers and SMK administrators, the evaluation results obtained from this instrument can be used as a reference to strengthen entrepreneurship learning strategies, career services, and project-based activities that are more relevant to labor market needs. Meanwhile, for researchers, this instrument provides opportunities for further studies, both in the context of regional and program-based comparisons, enriching both academic literature and vocational education practices.

This study also leaves room for further development. The instrument needs to be tested on a broader scope across various fields of expertise and in different regions to ensure the generalizability of the results. Moreover, it can be developed into a digital application to make real-time school evaluations more practical and efficient in the future. Longitudinal studies are also essential to test the consistency of measurement results and to observe their impact on improving students' employability in the long term. Furthermore, the results of this instrument can be integrated with tracer study data to provide a more comprehensive picture of the effectiveness of entrepreneurship systems in SMKs. The findings of this instrument can serve as a foundation for designing more contextual entrepreneurship intervention programs, thereby addressing the specific needs of schools while simultaneously supporting the sustainable improvement of SMK graduates' quality.

Ethical Approval
Not Applicable

Informed Consent Statement
Not Applicable

Authors' Contributions
ARB contributed to the conceptualization of the study, theoretical framework, and supervision of the research process. She also coordinated the manuscript preparation and served as the corresponding author. FN contributed to the methodology design, data analysis, and validation procedures, including reliability and construct validity testing. P was responsible for data collection, literature review, and assisting in drafting and revising the manuscript.

Disclosure Statement
The Authors declare that they have no conflict of interest

Data Availability Statement
The data presented in this study are available upon request from the corresponding author for privacy.

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