Improving Student's SWOT Analysis Skills By Implementation Project-Based Digital Learning: A Case in Vocational High School in Merauke

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ABSTRACT

Vocational education plays a strategic role in preparing students not only for employment but also for entrepreneurship, particularly in remote regions like Merauke where access to business resources is limited. However, many vocational students struggle with essential entrepreneurial skills such as SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This study aimed to evaluate the effectiveness of Project-Based Digital Learning (PBDL) in improving students' SWOT analysis skills. A quasi-experimental approach with a non-equivalent control group design was employed, involving 98 vocational students and 4 teachers from four accredited vocational schools in Merauke. Data were collected through pretests, posttests, and observation sheets focused on the implementation of PBDL elements. The data were analyzed using paired and independent sample t-tests. The findings showed significant improvements in all four SWOT dimensions in the experimental group compared to the control group. The discussion revealed that PBDL supports critical thinking, collaboration, and digital competence, especially when implemented in a structured, contextual, and reflective learning environment. Despite its limitations in scope and duration, this study recommends broader adoption of PBDL in vocational entrepreneurship education. Practically, teachers should be trained to deliver digital project-based instruction, while theoretically, this study contributes to the development of blended learning models that integrate strategic thinking into vocational curricula.

Keywords: SWOT Analysis; Project-Based Digital Learning; Vocational Learning; Vocational Education

INTRODUCTION

Vocational education has a primary mandate to prepare students to have competencies that are in accordance with the demands of the world of work, and at the same time, be able to create jobs independently through entrepreneurship (Billett, 2011; Clark & Winch, 2007; Prosser, 1950). In the context of economic globalization and digital transformation, vocational education is expected to be the main driver of the growth of a productive workforce that is not only ready to be absorbed by industry but also able to become innovators in the local and national economic sectors (Lenkei et al., 2018; Wiramihardja et al., 2022). However, this strategic responsibility is faced with various complex problems, ranging from the low level of job absorption of graduates, the long waiting period to get a job, to the misalignment between the competencies possessed by graduates and the needs of the labor market (Kurniawan et al., 2021; Tran et al., 2020). One of the most significant problems is the low number of vocational education graduates who have the enthusiasm and ability to start their own businesses (Doan & Phan, 2020; Ephrem et al., 2019; Pranić, 2023). This phenomenon is exacerbated in remote areas such as Merauke, where access to capital, information, and business assistance is very limited, so that students are increasingly discouraged from taking the risk of entrepreneurship (Anggadwita et al., 2017; Martono et al., 2022). If this problem is not addressed immediately, there will be an accumulation of educated unemployment, which will become a burden on the social and economic regions, as well as hinder the goal of developing superior human resources that are adaptive and independent.

The lack of vocational education graduates who become entrepreneurs is not solely caused by external factors such as limited capital or market access, but also due to the weak spirit, mentality, and basic entrepreneurial skills of students, especially in terms of strategic thinking and business decision-making (Kisubi et al., 2021; Triyono et al., 2023). One of the fundamental skills in entrepreneurship is the ability to conduct a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis (Lee et al., 2000; Ngyah-Etchutambe et al., 2022). This skill allows students to identify internal and external potentials that influence the success of the business they will or are running (Tukundane et al., 2015). Unfortunately, many studies show that the SWOT analysis skills of vocational school students are still very low. A study by Rahmawati et al. (2022) stated that more than 65% of vocational school students were unable to correctly describe SWOT factors in the context of a simple business plan. This is in line with the findings of Hoang et al. (2021), which stated that weaknesses in strategic analytical thinking skills are one of the main causes of the failure of school entrepreneurship programs. This problem is more pronounced in remote areas such as Merauke, where business literacy and exposure to real entrepreneurial practices are still very minimal (Selfina Pare, 2021). If the problem of low SWOT analysis skills is allowed to continue, it will increase the risk of failure of vocational education entrepreneurship programs and distance the goal of making graduates strong and competitive job creators.

The low SWOT analysis skills of vocational education students are inseparable from the learning approach and climate that are still traditional and less contextual (Kholifah et al., 2022; Mutohhari et al., 2023). The dominant learning model is theoretical and teacher-centered, making interaction in the learning process passive and limited (Nurtanto et al., 2021; Techanamurthy et al., 2020). Interaction between students as part of collaborative learning is rarely facilitated optimally, thus inhibiting the process of exchanging ideas, critical discussions, and exploration of real cases that are essential in developing strategic analysis skills (Sutiman et al., 2022). This condition is exacerbated by the lack of learning innovation that allows integration between the realities of the business world and the learning process in the classroom (Fawaid et al., 2022). Students are rarely involved in learning that requires them to think critically, analyze contextual problems, or design solutions based on real environments (Kholifah et al., 2025). In areas such as Merauke, limited infrastructure and educational resources that are not yet accustomed to innovative learning approaches exacerbate this condition. Without a paradigm shift in the learning approach, strategic competencies such as SWOT analysis will be difficult for students to achieve meaningfully, efficiently, and effectively (Lamalewa et al., 2018). In fact, this skill is very crucial in encouraging their readiness to become entrepreneurs who are able to read situations, design strategies, and navigate market challenges adaptively (Akhter et al., 2022; Hassan et al., 2021).

Responding to these challenges, project-based learning (PjBL) has emerged as an effective approach to foster contextual and applicable SWOT analysis skills (Fan et al., 2021; Laptev & Shaytan, 2022). PjBL allows students to be actively involved in designing, implementing, and evaluating real projects related to the business world (Barbosa et al., 2024). Through this approach, students are trained to identify problems, explore potential, and formulate solutions in the form of SWOT analysis-based business plans (Tomaselli et al., 2022). Several studies have proven the effectiveness of this model. For example, research by Zen et al. (2022) and Fan et al. (2021)shows that the integration of PjBL can significantly improve students' critical thinking and strategic analysis skills. However, the effectiveness of PjBL can be further enhanced through the integration of digital technology into Project-Based Digital Learning (PBDL) (Barbosa et al., 2024; Zen et al., 2022). With the help of digital platforms, students have wider access to information sources, can interact with the business world through online media, and are able to document and reflect on the learning process more systematically (Fan et al., 2021). PBDL also allows for more flexible personalization of learning and virtual collaboration, making it a futuristic approach that is very relevant to vocational education in the digital era (Huang et al., 2022). In areas like Merauke, the use of this technology can bridge the limitations of access to physical resources, and open up new spaces for relevant, contextual, and empowering learning (Selfina Pare, 2021).

Based on the descriptions above, the outline is that the low entrepreneurial skills of vocational high school students, especially in remote areas such as Merauke, are rooted in weak SWOT analysis skills, which in turn are triggered by a less-than-optimal learning approach. The lack of innovation in creating an interactive, collaborative, and project-based learning environment is the primary obstacle to achieving these strategic competencies. Vocational Education has a great responsibility not only to prepare a ready-to-use workforce, but also to produce young entrepreneurs who can become the driving force of the local economy. A promising solution to answer this challenge is to integrate the Project-Based Digital Learning approach, which combines

the power of project-based learning with the ease and advantages of digital technology. This approach is believed to address the need for meaningful, flexible, efficient, and contextual understanding, while enhancing student engagement and motivation to learn. Therefore, this study aims to evaluate and measure the effectiveness of implementing Project-Based Digital Learning (PBDL) in improving students' SWOT analysis skills at one of the Vocational High Schools in Merauke. The results of this study are expected to be a strategic reference for the development of a digital-based entrepreneurship learning model that is relevant to regional needs and the challenges of the times.

METHOD

This study uses a quasi-experimental approach that aims to test the effectiveness of project-based digital learning (PBDL) in improving SWOT analysis skills in vocational Education students. This approach was chosen because of its relevance to provide accurate and reliable information about the effectiveness of an event that is controlled with certain considerations. In addition, the quasi-experiment shows its strength in explaining two different groups controlled by researchers, by ensuring that no research subjects feel disadvantaged. In this case, two different groups already existed previously, so to anticipate bias in the data produced, we used a non-equivalent group quasi-experimental design adopted from Campbell & Stanley (1963). We consider this design because of its rationality and the level of accuracy that can prevent bias in treatment and measurement results, because it is carried out without randomizing existing groups (Kohan et al., 2024). This research approach and design are translated into five main stages: identification and focus, pretest implementation, treatment administration, posttest implementation, interpretation, and conclusion. The research was conducted over approximately five months, starting from mid-January to early June 2025. The treatment process took place in twelve meetings in accordance with the time allocation for learning entrepreneurial practices for vocational Education students.

Four vocational high schools (VHS) in Merauke Regency were involved in this study, where all schools had two classes in the same current year with the same essence of vision and mission. The selection of VHS was also based on several other considerations to ensure the rationality and scientificity of the data without violating ethical procedures in the entire research process. First, the four schools are VHS, which has been accredited A, which is in line with what was proposed by Zilic (2018), that equality of ranking and standardization is one aspect that can increase the rationality of quasi-experimental research. Second, the two classes that are studying entrepreneurship in each school are taught by the same teacher. Third, the availability of digital infrastructure and its accessibility are considerations to ensure that PBDL can be implemented by students and teachers in the Entrepreneurship subject. Finally, the partnership between VHS and the world of work and business that has been running for more than five years is the main consideration to ensure the relevance of learning to actual work conditions (Rohm et al., 2021). A total of 98 students and four teachers were involved in a series of research processes, which were divided into two control classes and two experimental classes. Before deciding on the involvement of all participants, we ensure their legality through adequate licensing procedures.

Throughout the study, we used several data collection techniques to ensure a high level of accuracy and meet the adequacy of data to answer the stated research objectives. At the pretest stage, we used a questionnaire on collaboration and communication skills to measure the initial abilities of both. The questionnaire used was a Likert scale questionnaire with four answer options: Strongly Agree (4); Agree (3); Less Agree (2); and Disagree (1). This questionnaire became the basis for obtaining an initial picture and analyzing the equilibrium between groups (control and experiment) as a requirement for the non-equivalent group quasi-experimental design to be carried out. We also used the questionnaire to measure the value of SWOT analysis skills at the posttest stage. During the implementation of PBDL, we used observation techniques to observe and ensure the implementation of the stages and elements of PBDL in entrepreneurship learning. Therefore, the data collection instruments we used included a SWOT analysis skills questionnaire and a PBDL implementation observation sheet. Table 1 explains in detail the blueprint for both instruments in this study.

Table 1 Blueprint Of Questionaire Instrument

Instrument	**Indicator**	**Operational**
Strength	Producing ideas	Ability to analyze new ideas that have high market value.

(Tukundane et al., 2015)	Experiences	Ability in self-development & adaptation.
	Technology integration	Ability to integrate digital technology into business.
	Fexibility & networking	Flexibility in entrepreneurship & building networks.
Weakness (Puyt et al., 2023)	Capital limitations	Ability to know the capital limitations in starting a business.
	Technology accessibility	Ability to analyze the lack of technology accessibility.
	Community behavior	Less or non-consumptive community behavior.
Opportunity (Puyt et al., 2023)	Market analysis	Ability to analyze the current and the future market
	Potential	Ability to analyze potential
Threat (Puyt et al., 2023)	Market competition	Ability to analyze market competition
	Market trends	Ability to analyze changes in market trends
	Business disruptions	Ability to recognize business disruptions
PBDL implementation observation sheet (Haryanto et al., 2021; Sudira et al., 2022)	Problem orientation	Asking questions about contextual issues or problems using digital technology
	Project planning & design	Designing projects, defining learning objectives & roles, and developing work plans and project schedules collaboratively.
	Investigation & exploration	Conduct in-depth exploration and data/information collection through digital sources, observations, or online interviews.
	Project development	Develop solutions/prototypes/project works assisted by digital tools.
	Collaboration & communication	Share progress and work results among team members, including teachers and experts.
	Reflection & feedback	Evaluate the learning process, obstacles faced, and self and team evaluation, both individually and collectively.

Data Analysis The collected data were analyzed using a t-test with two different specific methods. First, to test the effectiveness of PBDL in improving collaboration and communication skills, it is necessary to look at the trend of differences in the average pretest-posttest scores in each class, both in the experimental class and the control class. In this case, the paired sample t-test is the most appropriate method in terms of accuracy and suitability of the results. In addition, the normality that is met in the data provides an opportunity for this testing method to be used more rationally (Reid, 2014). After seeing the trend of the differences, the independent sample t-test was then used to test the difference in the average posttest scores of collaboration and communication skills between the experimental class and the control class. The provision is, if the significance value (p) is below or equal to a significance level of 5% ($p \leq 0.050$), which indicates that the experimental class has a higher average value, then the hypothesis is accepted, or in other words there is a difference in the average posttest score between the two classes. The homogeneity standard that is met provides an opportunity for this testing method to be carried out (Johnson & Wichern, 2007). There are two hypotheses proposed in this study, which include: (1) There is a significant average difference between the experimental pretest class and the experimental posttest class; and (2) There is a significant average difference between the experimental posttest class and the control posttest class.

RESULT

Analysis Prerequisite Test

Prerequisite analysis test was conducted to determine whether the data were normally distributed and had homogeneous variance as a requirement to perform paired sample t-test and independent sample t-test. The analysis prerequisite test contains tests for data normality and homogeneity of variance. The analysis prerequisite test was carried out using SPSS V 21 software. The results of the data normality test are shown in table 2 below.

Table 2 Normality Test Result

Variable	**Pre-test p Value**		**Decision**	**Post-test p Value**	**Decision**	
	Experiment	**Control**		**Experiment**	**Control**	
Strength analysis skill	0,065	0,117	Normal	0,110	0,202	Normal
Weakness analysis skill	0,402	0,118	Normal	0,167	0,089	Normal
Opportunity analysis skill	0,168	0,123	Normal	0,190	0,062	Normal
Threat analysis skill	0,277	0,091	Normal	0,200	0,217	Normal

Based on the results of the data normality test using the Kolmogorov Smirnov formula, the significance value in each class was greater than 0.050 at a significance level of 5%, so it can be concluded that the data is normally distributed. After the data is known to be normally distributed, then the homogeneity of variance test is then carried out. Based on the results of the homogeneity of variance test, it is known that the significance value for all variables is greater than 0.050 at a significance level of 5%, so it can be concluded that the variance of the experimental class posttest data and control class posttest data on the strength, weakness, opportunity and threat analysis skill variables is the same or homogeneous. The results of the homogeneity test are shown in table 3 below.

Table 3 Homogenity Test Result

Variabel	Df1	Df2	Sig	Dec.
Strength analysis skill	1	96	0,200	Homogeneous
Weakness analysis skill	1	96	0,167	Homogeneous
Opportunity analysis skill	1	96	0,132	Homogeneous
Threat analysis skill	1	96	0,267	Homogeneous

The Effectiveness of Project-Based Digital Learning in Improving SWOT Analysis Skill

Before assessing the effectiveness of the Project-Based Digital Learning (PBDL) model in improving students' SWOT analysis skills through inferential statistical analysis using t-tests, it was essential to first conduct an initial equivalence test on both skill variables between the experimental and control groups. This preliminary step aimed to ensure that both groups had comparable levels of initial ability prior to the implementation of the intervention, thereby allowing any subsequent differences in outcomes to be more confidently attributed to the PBDL treatment rather than to pre-existing disparities. The equivalence test was carried out using an independent sample t-test, which is a commonly used method to compare the means of two separate groups. The results of this analysis indicated that the significance values for the whole skills were greater than 0.05, suggesting that there were no statistically significant differences in the pretest scores between the experimental and control

classes. These findings confirm that the two groups were balanced in terms of their initial skill levels, which validates the appropriateness of proceeding with the effectiveness testing phase. The confirmation of this baseline equivalence is critical in quasi-experimental designs, especially those employing non-randomized groups, as it helps to ensure the internal validity of the study. The detailed results of the equivalence test, including the degrees of freedom, mean scores, t-values, and significance levels, are presented in Table 4 of the findings section.

Table 4 Intial Ability Test Result

Variabel	Esperiment		Control		t Value	Sig	Decision
	Df	Mean	Df	Mean			
Strength analysis skill	47	21,84	47	20,64	1,012	0,288	Balanced
Weakness analysis skill	47	20,08	47	20,64	1,012	0,288	Balanced
Opportunity analysis skill	47	18,62	47	19,12	1,121	0,237	Balanced
Threat analysis skill	47	9,08	47	9,86	0,120	0,231	Balanced

Following the completion of the initial ability testing, the next crucial step in the research process was the implementation of the Project-Based Digital Learning (PBDL) model as an instructional treatment for the experimental class. In contrast, the control class continued to use the conventional instructional model that had been previously in place. This treatment phase was carried out over a series of twelve structured sessions, each aligned with the practical learning schedule allocated for the subject of plantation and herbal commodities processing. PBDL in Entrepreneurship subjects in Vocational High Schools (VHS) is designed to improve students' SWOT analysis skills through contextual, active, and technology-based learning. This learning process is carried out in twelve structured meetings based on six main stages. The first stage is problem orientation, where students are invited to ask critical questions about entrepreneurship issues that are contextual and relevant to their environment, with the help of digital technology such as online forums, inspirational videos, or digital case studies. Furthermore, in the project planning & design stage, students design entrepreneurship projects collaboratively by determining business ideas, formulating learning objectives, defining the roles of each team member, and compiling work plans and project schedules using an online project management platform. This phase is important for fostering individual and collective responsibility, as well as ensuring a systematic and measurable direction of teamwork.

Entering the third stage, namely investigation & exploration, students explore data and collect information needed to compile a SWOT analysis of the business idea that has been designed. This process is carried out by utilising various digital sources such as business articles, online surveys, virtual interviews with business actors, and local market observations through e-commerce platforms or social media. The results of this exploration are then processed in the fourth stage, namely project development, where students develop entrepreneurial solutions and products in the form of business prototypes, digital business proposals, or digital promotional media such as advertising videos, online posters, or simple online stores. The fifth stage is collaboration & communication, which encourages students to actively interact, discuss, and share the results of their work and the challenges they face with team members, supervising teachers, and, if possible, with business practitioners through virtual meetings. This collaboration strengthens communication skills, joint decision-making, and collective problem-solving. Finally, in the reflection & feedback stage, students evaluate the learning process and project implementation reflectively, both individually and in groups. They reflect on the obstacles faced, successful strategies, and the quality of the products produced, while receiving feedback from teachers and peers for future improvements. Overall, the implementation of PBDL produces digital entrepreneurial products that demonstrate students' deep understanding of SWOT analysis, while developing critical, creative, collaborative, and communicative thinking competencies that are very important in today's world of work and entrepreneurship.

Table 5 Paired Sample t-Test Result

Variabel	Pre. – Post. Experiment			Pre. – Post Control		
	Mean Diff.	t Value	Sig	Mean Diff.	t Value	Sig
Strength analysis skill	-12,972	-8,629	0,000	-4,025	-3,141	0,000
Weakness analysis skill	-7,139	-5.078	0,000	-3,352	-2,037	0,024
Opportunity analysis skill	-12,618	-8,402	0,000	-4,020	-3,122	0,001
Threat analysis skill	-8,014	-6,586	0,000	-3,388	-2,184	0,012

Based on the results of the paired sample t-test, the significance values for the pretest-posttest pairs in the experimental class for both collaboration and communication skills were 0.000 ($p \leq 0.05$), indicating a statistically significant improvement in students' abilities after receiving the Project-Based Digital Learning (PBDL) treatment. This outcome confirms that the implementation of PBDL had a meaningful and positive effect on enhancing these SWOT analysis skills, thereby supporting the first research hypothesis. Following the confirmation of significant within-group improvement, an independent sample t-test was conducted to compare the posttest mean scores between the experimental class and the control class. This analysis aimed to determine whether the observed improvements in the experimental group were significantly greater than those in the control group, with detailed results presented in Table 6 below.

Table 6 Independent Sample t-Test Result

Variable	**Mean difference**	**t Value**	**Sig.**
Strength analysis skill	8,947	6,928	0,000
Weakness analysis skill	3,787	2,400	0,008
Opportunity analysis skill	8,598	6,710	0,000
Threat analysis skill	4,626	4,008	0,000

Based on the results of the independent sample t-test, the significance values for SWOT analysis skills were found to be 0.000 ($p \leq 0.05$), indicating a statistically significant difference in the mean scores between the experimental class, which received the Project-Based Digital Learning (PBDL) treatment, and the control class, which did not. These results confirm that students in the experimental group outperformed those in the control group in both skill areas following the intervention. The significantly higher average scores in the experimental class demonstrate the effectiveness of the PBDL model in fostering students' SWOT analysis, thus providing empirical support for the second hypothesis of the study.

DISCUSSION

These results show a statistically significant difference between the experimental and control groups across the four SWOT dimensions: strength, weakness, opportunity, and threat. This improvement was supported by a well-structured project-based digital learning design, which follows six sequential stages, from problem orientation to reflection, that encourage students to think critically, collaboratively, and constructively. These findings align with constructivist theories, which argue that knowledge is built through direct experiences and social interaction. Additionally, they support the concept of "active learning" in vocational Education, as Billett (2011) emphasized that authentic participation in contextual activities effectively enhances competence development. The integration of digital technology into the learning process also enriched students' learning experiences. It expanded their access to strategic business information, which is particularly valuable in remote

areas like Merauke, where access to physical resources is limited.

Nevertheless, the effectiveness of PBDL in entrepreneurship education remains a topic of scholarly debate. Several studies, such as those by Giacomin et al. (2023); Helms & Nixon (2010), highlight that the success of project-based learning approaches depends greatly on teacher readiness, the availability of digital infrastructure, and students' digital literacy levels. Conversely, research by Nicholls-Nixon et al. (2024) and Brecht et al. (2023) supports the view that the integration of digital tools into project-based learning can overcome access barriers in underserved areas and stimulate students' creativity in data-based problem solving. Therefore, the success of PBDL is not universal but highly contextual. It depends on the synergy between instructional design, institutional support, technological readiness, and a collaborative classroom culture. The findings of this study offer strong empirical evidence that PBDL can be successfully adapted in geographically disadvantaged contexts like Merauke, provided that the instructional model is tailored to local conditions and needs.

In terms of the specific skills developed, the study found that the most significant improvements occurred in the *strength* and *opportunity* dimensions, compared to *weakness* and *threat*. This can be explained using Bandura's social cognitive learning theory, which suggests that individuals are more inclined to identify strengths and opportunities when encouraged to reflect and relate the project to their personal experiences (Marnewick, 2023; Maros et al., 2023). In contrast, identifying weaknesses and threats requires a higher level of cognitive maturity and metacognitive awareness to assess risk and limitations objectively. This poses a challenge in vocational education, where students may not yet have the experience or confidence to critically evaluate their own shortcomings (Jääskä et al., 2022; Tomaselli et al., 2022). Therefore, teacher guidance becomes crucial during the reflection phase to ensure that students not only complete SWOT analyses technically but also understand how to use them conceptually and strategically for business decision-making. These findings also highlight the teacher's role not merely as an information provider but as an active facilitator who supports students' strategic thinking through dialogue, simulation, and real-world case exploration.

The implications of this study are both practical and theoretical. Practically, PBDL is a promising and strategic instructional model that can be adopted by vocational schools to strengthen entrepreneurship competence through strategic analysis. This learning model is highly suitable for entrepreneurship-related subjects such as business management and digital marketing, especially in areas with limited physical access but growing digital capabilities. Theoretically, the study reinforces the emerging framework of blended entrepreneurship learning, which combines project-based learning with digitalization as a core pedagogical innovation in the era of Industry 4.0 and Society 5.0. Future research is recommended to explore the integration of artificial intelligence and augmented reality into PBDL to create even more immersive business simulations. Meanwhile, vocational education policymakers should consider adopting PBDL at a national level as part of a broader strategy to produce SMK graduates who are adaptive, innovative, and capable of navigating complex market dynamics. Stronger collaboration with industry through digital platforms should also be encouraged to create an authentic, collaborative, and future-oriented learning ecosystem.

CONCLUSION

This study concludes that the implementation of Project-Based Digital Learning (PBDL) significantly enhances vocational students' SWOT analysis skills across all four dimensions: strength, weakness, opportunity, and threat. The structured learning process, which integrates digital platforms into contextual entrepreneurial projects, allows students to actively engage in problem identification, exploration, solution development, and reflective evaluation. These findings confirm that PBDL is effective in fostering critical, collaborative, and strategic thinking, especially in geographically disadvantaged areas such as Merauke. However, this study has several limitations, including its focus on a specific region, a relatively short intervention duration (twelve sessions), and reliance on quasi-experimental design without randomization. Future research should consider larger, more diverse samples and longitudinal studies to assess the long-term impact of PBDL. Practically, this study recommends vocational schools adopt PBDL to increase students' entrepreneurial competence in a digital context. Teachers should receive professional development to facilitate project-based and technology-integrated instruction effectively. Theoretically, the study contributes to the expansion of digital pedagogical frameworks in vocational education by demonstrating how blended approaches can address strategic skill gaps. Strengthening industry-school collaboration through digital platforms is also essential to build authentic learning ecosystems

that reflect the realities of modern entrepreneurship.

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REFERENCES

1. Akhter, A., Anwarul Islam, K. M., Karim, M. M., & Bin Latif, W. (2022). Examining determinants of digital entrepreneurial intention: A case of graduate students. Problems and Perspectives in Management, 20(3), 1–14. https://doi.org/10.21511/ppm.20(3).2022.13
2. Anggadwita, G., Luturlean, B. S., Ramadani, V., & Ratten, V. (2017). Socio-cultural environments and emerging economy entrepreneurship women entrepreneurs in Indonesia. Journal of Entrepreneurship in Emerging Economies, 9(1), 85–96. https://doi.org/10.1108/JEEE-03-2016-0011
3. Barbosa, B., Saura, J. R., & Bennett, D. (2024). How do entrepreneurs perform digital marketing across the customer journey? A review and discussion of the main uses. Journal of Technology Transfer, 49(1), 69–103. https://doi.org/10.1007/s10961-022-09978-2
4. Billett, S. (2011). Vocational Education: Purposes, Traditions and Prospects. Springer. https://doi.org/10.1007/978-94-007-1954-5
5. Brecht, S., Le Loarne-Lemaire, S., Kraus, S., & Maalaoui, A. (2023). The role of time management of female tech entrepreneurs in practice: Diary and interview results from an innovative cluster. Journal of Business Research, 163(1), 1–15. https://doi.org/10.1016/j.jbusres.2023.113914
6. Campbell, D. T., & Stanley, J. C. (1963). Experimental and Quasi-Experimental Designs for Research. Houghton Mifflin Company.
7. Clark, L., & Winch, C. (2007). Vocational Education : International Approaches, Developments and Systems. Routledge.
8. Doan, X. T., & Phan, T. T. H. (2020). The impact of entrepreneurial education on entrepreneurial intention: The case of Vietnamese. Management Science Letters, 10(8), 1–15. https://doi.org/10.5267/j.msl.2019.12.040
9. Ephrem, A. N., Namatovu, R., & Basalirwa, E. M. (2019). Perceived social norms, psychological capital and entrepreneurial intention among undergraduate students in Bukavu. Education and Training, 61(7–8), 963–983. https://doi.org/10.1108/ET-10-2018-0212
10. Fan, T., Schwab, A., & Geng, X. (2021). Habitual entrepreneurship in digital platform ecosystems: A time-contingent model of learning from prior software project experiences. Journal of Business Venturing, 36(5), 1–14. https://doi.org/10.1016/j.jbusvent.2021.106140
11. Fawaid, M., Triyono, M. B., Sofyan, H., Nurtanto, M., Mutohhari, F., Jatmoko, D., Majid, N. W. A., & Rabiman, R. (2022). Entrepreneurial intentions of vocational education students in indonesia: PLS-SEM approach. Journal of Technical Education and Training, 14(2), 91–105. https://doi.org/10.30880/jtet.2022.14.02.009
12. Giacomin, O., Janssen, F., Guyot, J. L., & Lohest, O. (2023). Opportunity and/or Necessity Entrepreneurship? The Impact of the Socio-Economic Characteristics of Entrepreneurs. Sustainability (Switzerland), 15(14), 1–16. https://doi.org/10.3390/su151410786
13. Haryanto, H., Kusuma, W. M., Mutohhari, F., Nurtanto, M., & Suyitno, S. (2021). Innovation media learning: online project-based learning (O-PBL) on drawing competence in automotive engineering using video on youtube. ICE-ELINVO 2021, 1–10. https://doi.org/10.1088/1742-6596/2111/1/012020
14. Hassan, A., Anwar, I., Saleem, I., Islam, K. M. B., & Hussain, S. A. (2021). Individual entrepreneurial orientation, entrepreneurship education and entrepreneurial intention: The mediating role of entrepreneurial motivations. Industry and Higher Education, 35(4), 403–418. https://doi.org/10.1177/09504222211007051
15. Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis – where are we now?: A review of academic research from the last decade. Journal of Strategy and Management, 3(3), 215–251. https://doi.org/10.1108/17554251011064837
16. Hoang, G., Le, T. T. T., Tran, A. K. T., & Du, T. (2021). Entrepreneurship education and entrepreneurial intentions of university students in Vietnam: the mediating roles of self-efficacy and learning orientation.

Education and Training, 63(1), 115–133. https://doi.org/10.1108/ET-05-2020-0142
17. Huang, S., Pickernell, D., Battisti, M., & Nguyen, T. (2022). Signalling entrepreneurs' credibility and project quality for crowdfunding success: cases from the Kickstarter and Indiegogo environments. Small Business Economics, 58(4), 1801–1821. https://doi.org/10.1007/s11187-021-00477-6
18. Jääskä, E., Lehtinen, J., Kujala, J., & Kauppila, O. (2022). Game-based learning and students' motivation in project management education. Project Leadership and Society, 3(1), 1–16. https://doi.org/10.1016/j.plas.2022.100055
19. Johnson, R. A., & Wichern, D. W. (2007). Applied Multivariate Statistical Analysis (6th ed.). Pearson Education, Inc.
20. Kholifah, N., Kusumawaty, I., Nurtanto, M., Mutohhari, F., Isnantyo, F. D., & Subakti, H. (2022). Designing the structural model of students' entrepreneurial personality in vocational education: An empirical study in Indonesia. Journal of Technical Education and Training, 14(3), 1–17. https://doi.org/10.30880/jtet.2022.14.03.001
21. Kholifah, N., Nurtanto, M., Mutohhari, F., Hamid, M. A., Mutiara, I., Setiawan, D., & Saputro, I. N. (2025). Factors influencing student career choice in vocational education in Indonesia: A mediating effect of self-efficacy. Social Sciences & Humanities Open, 11(1), 1–10. https://doi.org/10.1016/j.ssaho.2025.101369
22. Kisubi, M. K., Bonuke, R., & Korir, M. (2021). Entrepreneurship education and self-employment intentions: A conditional effect of entrepreneurial self-efficacy evidence from a developing country. Cogent Business and Management, 8(1), 1–14. https://doi.org/10.1080/23311975.2021.1938348
23. Kohan, N., Navabi, N., Motlagh, M. K., & Ahmadinia, F. (2024). Designing and evaluating ECG interpretation software for undergraduate nursing students in Iran: a non-equivalent control group pretest-posttest design. BMC Nursing, 23(1), 1–9. https://doi.org/10.1186/s12912-024-02472-0
24. Kurniawan, R., Jaedun, A., Mutohhari, F., & Kusuma, W. M. (2021). The absorption of vocational education graduates in the automotive sector in the industrial world. Journal of Education Technology, 5(3), 482–490. https://doi.org/10.23887/jet.v5i3.35365
25. Lamalewa, F., Kore, E. L. R., & Kalalo, C. N. (2018). The influence of practices of human resources management, compensation, work satisfaction and motivation on performance of bank employees in Merauke City. International Journal of Mechanical Engineering and Technology, 9(10), 64–71.
26. Laptev, G., & Shaytan, D. (2022). Co-design-based learning for entrepreneurs in the digital age. Measuring Business Excellence, 26(1), 93–105. https://doi.org/10.1108/MBE-11-2020-0158
27. Lee, S. F., Lo, K. K., Leung, R. F., & Sai on ko, A. (2000). Strategy formulation framework for vocational education: integrating SWOT analysis, balanced scorecard, QFD methodology and MBNQA education criteria. Managerial Auditing Journal, 15(8), 407–423. https://doi.org/10.1108/02686900010353999
28. Lenkei, B., Mustafa, G., & Vecchi, M. (2018). Growth in emerging economies: Is there a role for education? Economic Modelling, 73(1), 240–253. https://doi.org/10.1016/j.econmod.2018.03.020
29. Marnewick, C. (2023). Student experiences of project-based learning in agile project management education. Project Leadership and Society, 4(1), 1–15. https://doi.org/10.1016/j.plas.2023.100096
30. Maros, M., Korenkova, M., Fila, M., Levicky, M., & Schoberova, M. (2023). Project-based learning and its effectiveness: evidence from Slovakia. Interactive Learning Environments, 31(7), 4147–4155. https://doi.org/10.1080/10494820.2021.1954036
31. Martono, M., Dewantara, J. A., Efriani, E., & Prasetiyo, W. H. (2022). The national identity on the border: Indonesian language awareness and attitudes through multi-ethnic community involvement. Journal of Community Psychology, 50(1), 1–15. https://doi.org/10.1002/jcop.22505
32. Mutohhari, F., Triyono, M. B., Sudira, P., Nurtanto, M., & Kholifah, N. (2023). The role of entrepreneurial personality mediation and technological competencies moderation in determining entrepreneurial intentions in vocational education. Journal of Technical Education and Training, 15(1), 128–141. https://doi.org/10.30880/jtet.2023.15.01.012
33. Ngyah-Etchutambe, I. B., Aki, E. M., Mbi, S. E., & Farinkia, N. G. (2022). Informal vocational training and sustainable livelihood skills among unemployed youth in low-income countries: Insights from a SWOT analysis of tailoring apprenticeships in Cameroon. Frontiers in Education, 7(1), 1–15. https://doi.org/10.3389/feduc.2022.1027632
34. Nicholls-Nixon, C. L., Singh, R. M., Hassannezhad Chavoushi, Z., & Valliere, D. (2024). How university business incubation supports entrepreneurs in technology-based and creative industries: A comparative

study. Journal of Small Business Management, 62(2), 591–627. https://doi.org/10.1080/00472778.2022.2073360

35. Nurtanto, M., Kholifah, N., Masek, A., Sudira, P., & Samsudin, A. (2021). Crucial problems in arranged the lesson plan of vocational teacher. International Journal of Evaluation and Research in Education (IJERE), 10(1), 345–354. https://doi.org/10.11591/ijere.v10i1.20604
36. Pranić, L. (2023). What happens to the entrepreneurial intentions of gen z in a crony capitalist economy amidst the covid-19 pandemic? Sustainability (Switzerland), 15(7), 1–16. https://doi.org/10.3390/su15075750
37. Prosser, A. C. (1950). Vocational Education in a Democracy. American Technical Society.
38. Puyt, R. W., Lie, F. B., & Wilderom, C. P. M. (2023). The origins of SWOT analysis. Long Range Planning, 56(3), 1–15. https://doi.org/10.1016/j.lrp.2023.102304
39. Rahmawati, S., Abdullah, A. G., Widiaty, I., & Islami, A. R. (2022). The distributions of vocational high school teachers' advanced digital competence (ADC). Journal of Technical Education and Training, 14(2 SPECIAL ISSUE), 190–201. https://doi.org/10.30880/jtet.2022.14.02.017
40. Reid, H. M. (2014). Introduction to Statistics: Fundamental Concepts and Procedures of Data Analysis. SAGE Publications, Inc.
41. Rohm, A. J., Stefl, M., & Ward, N. (2021). Future proof and real-world ready: The role of live project-based learning in students' skill development. Journal of Marketing Education, 43(2), 204–215. https://doi.org/10.1177/02734753211001409
42. Selfina Pare. (2021). The implementation of e-commerce entrepreneurs craftsmen crocodile skin: Case study Daniel Skin. International Journal of Science, Technology & Management, 2(3), 875–879. https://doi.org/10.46729/ijstm.v2i3.219
43. Sudira, P., Nurtanto, M., Masrifah, N., Nurdianah, E., & Mutohhari, F. (2022). Online project-based learning (O-PjBL): effectiveness in teachers training and coaching in vocational education. Journal of Education Technology, 6(2), 326–337. https://doi.org/10.23887/jet.v6i2.41195
44. Sutiman, S., Sofyan, H., Arifin, Z., Nurtanto, M., & Mutohhari, F. (2022). Industry and education practitioners' perceptions regarding the implementation of work-based learning through industrial internship (WBL-II). International Journal of Information and Education Technology, 12(10), 1090–1097. https://doi.org/10.18178/ijiet.2022.12.10.1725
45. Techanamurthy, U., Alias, N., & Dewitt, D. (2020). A problem-solving flipped classroom module: Developing problem-solving skills among culinary arts students. Journal of Technical Education and Training, 12(4), 39–47. https://doi.org/10.30880/jtet.2020.12.04.004
46. Tomaselli, A., Ebbers, J. J., & Torluccio, G. (2022). Investments in Nascent Project-Based Enterprises: The interplay between role-congruent reputations and institutional endorsement. Organization Studies, 43(4), 595–622. https://doi.org/10.1177/0170840621994521
47. Tran, L., Huynh, V. S., Giang, T. V., Nguyen-Thi, M. L., & Nguyen-Thi, D. M. (2020). Vocational orientation and the need for establishing career counselling office in vietnamese schools. Journal of Technical Education and Training, 12(2), 46–54. https://doi.org/10.30880/jtet.2020.12.02.005
48. Triyono, M. B., Mutohhari, F., Kholifah, N., Nurtanto, M., Subakti, H., & Prasetya, K. H. (2023). Examining the mediating-moderating Role of entrepreneurial orientation and digital competence on entrepreneurial intention in vocational education. Journal of Technical Education and Training, 15(1), 116–127. https://doi.org/10.30880/jtet.2023.15.01.011
49. Tukundane, C., Minnaert, A., Zeelen, J., & Kanyandago, P. (2015). Building vocational skills for marginalised youth in Uganda: A SWOT analysis of four training programmes. International Journal of Educational Development, 40(1), 1–17. https://doi.org/10.1016/j.ijedudev.2014.10.007
50. Wiramihardja, K., N'dary, V., Al Mamun, A., Munikrishnan, U. T., Yang, Q., Salamah, A. A., & Hayat, N. (2022). Sustainable economic development through entrepreneurship: A study on attitude, opportunity recognition, and entrepreneurial intention among university students in Malaysia. Frontiers in Psychology, 13(1), 1–14. https://doi.org/10.3389/fpsyg.2022.866753
51. Zen, Z., Reflianto, Syamsuar, & Ariani, F. (2022). Academic achievement: the effect of project-based online learning method and student engagement. Heliyon, 8(11), 1–14. https://doi.org/10.1016/j.heliyon.2022.e11509
52. Zilic, I. (2018). General versus vocational education: Lessons from a quasi-experiment in Croatia. Economics of Education Review, 62(1), 1–11. https://doi.org/10.1016/j.econedurev.2017.10.009