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Project-Based Learning and Vocational Self-Concept as Predictors of Employability Skills among Grade XII Vocational High School Students in Gorontalo

Sunardi[1*], Lanto Mohamad Kamil Amali[2], Buyung R. Machmoed[3], Jumiati Ilham[4], Hasmah[5]
[1,2,3,4,5]Universitas Negeri Gorontalo, Gorontalo, Indonesia

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ABSTRACT

Purpose: This study examined project-based learning and vocational self-concept as predictors of employability skills among Grade XII vocational high school students in Gorontalo, Indonesia. **Methods:** A quantitative correlational design was used with 215 students selected through proportional random sampling. Data were collected using questionnaires measuring project-based learning, vocational self-concept, and employability skills, and analysed using descriptive statistics, assumption tests, simple regression, and multiple regression. **Findings:** The descriptive results indicated that students' responses were predominantly distributed in the high category for project-based learning experience, vocational self-concept, and employability skills. Project-based learning significantly predicted employability skills, $R^2 = 0.471$, $F\ (1, 213) = 189.746$, $p < .001$. Vocational self-concept also significantly predicted employability skills, $R^2 = 0.519$, $F\ (1, 213) = 229.476$, $p < .001$. Together, both predictors explained 62.3% of the variance in employability skills, $R^2 = 0.623$, adjusted $R^2 = 0.620$, $F\ (2, 212) = 175.467$, $p < .001$. Vocational self-concept showed a slightly stronger standardized contribution than project-based learning in the simultaneous model. **Research implications:** Vocational high schools should integrate authentic project-based learning with career-oriented reflection, mentoring, and vocational identity development. **Originality:** This study integrates a pedagogical predictor and an identity-based predictor in a single employability model within a regional Indonesian vocational education context.

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INTRODUCTION

Technical and vocational education and training (TVET) plays a strategic role in preparing students for the transition from school to work. At the senior secondary level, vocational high schools are expected to equip students not only with occupation-specific technical competence but also with employability skills that enable them to communicate, collaborate, solve problems, adapt to technological change, and participate effectively in workplace communities. This expectation is particularly relevant for Grade XII vocational high school students because they are approaching graduation and are expected to enter employment, continue further education, or develop entrepreneurial pathways. Therefore, employability skills should be understood as an important indicator of students' readiness for post-school vocational trajectories.

Recent international and national discussions in TVET emphasize that vocational competence is multidimensional. The OECD's PISA-VET framework, for example, distinguishes professional competence from broader employability skills such as literacy, problem solving, collaboration, and task performance (Rausch et al., 2024). Similar concerns have been reported in Indonesia, where vocational high schools continue to face challenges in aligning school-based learning outcomes with labour-market expectations (Pambudi, 2023; Wahyudin et al., 2025). Although vocational high schools are designed to prepare middle-level skilled workers, many learning practices still tend to emphasize technical task completion rather than the integrated development of transversal skills, work habits, and career readiness (Mutohhari et al., 2021). This condition indicates the need for learning strategies that connect technical mastery with employability-oriented competence.

Employability skills in vocational high schools include a combination of cognitive, interpersonal, technical, and adaptive capabilities. Students need to perform technical tasks, but they also need to interpret information, manage time, communicate ideas, work in teams, solve practical problems, and respond to workplace demands. Previous studies have shown that work readiness and employability are influenced by interpersonal skills, knowledge construction, motivation, self-efficacy, and the relevance of learning to workplace contexts (Darni et al., 2025; Indrawati et al., 2023; Omar et al., 2023; Permana & Aulia, 2023). These findings suggest that employability skills cannot be developed through technical instruction alone. They require learning environments that allow students to experience authentic work-related tasks and reflect on their vocational identity.

Project-based learning is one pedagogical approach that is highly relevant to vocational high school contexts. Through project-based learning, students engage in planning, designing, implementing, evaluating, and presenting products or solutions. These activities resemble workplace processes because they require problem identification, task division, resource management, collaboration, communication, and iterative improvement. In vocational high schools, project-based learning can bridge classroom instruction, workshop practice, and industry-oriented performance. Previous studies have reported that project-based learning can improve practical skills, 21st-century competencies, engagement, motivation, and employability-related outcomes when projects are authentic and connected to industrial needs (Dzulkurnain et al., 2024; Fadillah, 2025; Ghafara et al., 2025). Technology-supported learning, including digital modules, augmented reality, and computational thinking activities, may further strengthen vocational learning when integrated with authentic projects rather than used as isolated instructional tools (Amri et al., 2022; Amsari et al., 2025; Dewi et al., 2025; Lapisa et al., 2025).

However, employability skills are not shaped only by instructional strategies. Students' vocational self-concept also plays an important role. Vocational self-concept refers to students' perception of themselves in relation to their chosen vocational field, including confidence in their vocational ability, identification with occupational roles, and belief that their learning is relevant to future work. Students with stronger vocational self-concept may be more likely to interpret school projects as meaningful preparation for employment, persist in challenging tasks, and develop clearer career aspirations. Found that vocational self-concept significantly predicted employability among vocational students (Ahmid et al., 2023), argued that students' self-evaluation of employability skills influences their school-to-work aspirations (Romanova, 2022). These findings indicate that vocational high schools need to cultivate not only practical learning experiences but also students' occupational identity and confidence.

Despite the growing literature on employability skills, project-based learning, and vocational self-concept, several limitations remain. Many previous studies have examined pedagogical variables, work readiness, self-efficacy, or vocational identity separately. As a result, there is still limited evidence on how an applied pedagogical variable and an identity-based psychological variable jointly explain employability skills among senior vocational high school students. This gap is important because employability development in vocational high schools is likely to involve both external learning experiences and internal vocational orientation. Project-based learning provides authentic opportunities to practise work-related skills, whereas vocational self-concept may influence how students value, internalize, and transfer those skills into future occupational contexts.

The present study addresses this gap by examining project-based learning and vocational self-concept as predictors of employability skills among Grade XII vocational high school students in Gorontalo, Indonesia. Gorontalo represents a meaningful regional context because vocational high schools in developing regions are expected to support local workforce development while responding to national vocational education reforms and broader labour-market demands. By focusing on Grade XII students, this study examines employability skills at a critical stage of school-to-work transition. The study does not aim to claim causal effects, but to test predictive associations that can inform vocational high school learning design, career guidance, and employability development.

Based on this background, the study was guided by the following research questions: (1) What are the descriptive levels of project-based learning, vocational self-concept, and employability skills among Grade XII vocational high school students in Gorontalo, Indonesia?; (2) To what extent does project-based learning predict employability skills among Grade XII vocational high school students?; (3) To what extent does vocational self-concept predict employability skills among Grade XII vocational high school students?; (4) To what extent do project-based learning and vocational self-concept simultaneously predict employability skills among Grade XII vocational high school students?.

METHOD

Research Design and Context

This study employed a quantitative correlational design to examine the predictive contribution of project-based learning and vocational self-concept to employability skills among Grade XII vocational high school students. A

correlational design was considered appropriate because the study aimed to test the direction and strength of statistical associations among variables without manipulating classroom learning conditions. The study was cross-sectional; therefore, the findings are interpreted as predictive associations rather than causal effects.

The research was conducted in vocational high schools in Gorontalo, Indonesia. The focus on Grade XII students was based on their position at the final stage of senior secondary vocational education. At this level, students have generally completed several semesters of vocational subjects, practical learning, school-based projects, and preparation for workplace participation. Consequently, employability skills are a relevant outcome for examining students' readiness for the school-to-work transition.

Population and Sample

The population of this study consisted of 465 Grade XII students from 11 vocational high schools in Gorontalo, Indonesia. The students were enrolled in four vocational competencies: Machining Engineering, Welding Engineering, Light Vehicle Automotive Engineering, and Motorcycle Engineering and Business. These competencies were selected because they represent technical and automotive-related vocational fields in which employability skills, project-based learning, and vocational self-concept are highly relevant to students' school-to-work transition.

A total of 215 students were selected as the research sample using proportional random sampling. This sampling technique was applied to ensure that each vocational high school was represented proportionally according to the size of its Grade XII student population. The sample allocation was determined by comparing the number of Grade XII students in each school with the total population and then assigning the sample proportionally to each school.

All respondents were male students. This demographic characteristic reflects the gender composition of the sampled technical and automotive vocational competencies. Therefore, the findings should be interpreted in relation to male Grade XII students in technical vocational high school programs and should not be generalized without caution to female students or to non-technical vocational programs.

Table 1. Population and sample distribution

Number	Vocational High School	Population	Sample
1	SMKN 3 Gorontalo	132	61
2	SMKN 1 Suwawa	48	22
3	SMKN 1 Marisa	78	36
4	SMKN 2 Gorontalo Utara	45	21
5	SMKN 1 Paguyaman	13	6
6	SMKN 2 Paguyaman	43	20
7	SMKN 1 Batudaa	40	18
8	SMK Almamater Telaga	15	7
9	SMKN 1 Mootilango	17	8
10	SMKN 1 Dungaliyo	19	9
11	SMKN Tirtayasa	15	7
Total		**465**	**215**

Variables and Instruments

This study involved two independent variables and one dependent variable. The first independent variable was project-based learning (X1), which referred to students' perceptions of learning experiences organized around authentic projects, planning activities, problem solving, collaboration, production processes, presentation, and reflection. The second independent variable was vocational self-concept (X2), which referred to students' self-perception, confidence, occupational orientation, and identification with their vocational field. The dependent variable was employability skills (Y), which referred to students' perceived readiness to perform cognitive, interpersonal, technical, adaptive, and work-related competencies required for future workplace participation.

Data were collected using questionnaire instruments. The project-based learning questionnaire consisted of 21 items covering seven dimensions. The vocational self-concept questionnaire consisted of 12 items covering four dimensions. The employability skills questionnaire consisted of 30 items covering ten dimensions. Responses were measured using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Higher scores indicated stronger perceived project-based learning experience, vocational self-concept, or employability skills.

The descriptive scores of each variable were classified into five categories: very high, high, moderate, low, and very low. These categories were used to describe the distribution of students' responses before conducting inferential statistical analysis.

Validity and Reliability of the Instruments

The initial validation of the instruments was conducted through expert judgment to assess content validity. The instruments were reviewed by experts to evaluate the relevance, clarity, and appropriateness of the items for measuring project-based learning, vocational self-concept, and employability skills among vocational high school students. Feedback and suggestions from the experts were used to revise and refine the instruments before the try-out stage.

After the instruments were revised based on expert input, an instrument try-out was conducted. Item validity was examined using item-total correlation. The results showed that all items met the validity criterion. The project-based learning instrument had item correlation coefficients ranging from 0.314 to 0.781, the vocational self-concept instrument had coefficients ranging from 0.334 to 0.708, and the employability skills instrument had coefficients ranging from 0.326 to 0.751. Since all coefficients were higher than the required r-table value of 0.301, all items were considered valid.

Table 2. Summary of instrument validity test

Variable	Instrument Items	r-count Range	Criterion
Project-based learning	1-21	0.314 - 0.781	≥ 0.301
Vocational self-concept	1-12	0.334 - 0.708	≥ 0.301
Employability skills	1-30	0.326 - 0.751	≥ 0.301

Reliability was examined using Cronbach's alpha coefficient. The reliability coefficient for the project-based learning instrument was 0.872, the vocational self-concept instrument was 0.801, and the employability skills instrument was 0.870. These values exceeded the minimum reliability criterion of 0.60, indicating that the instruments had acceptable internal consistency and were reliable for data collection.

Table 3. Summary of instrument reliability test

Variable	Cronbach's Alpha	Criterion	Conclusion
Project-based learning	0.872	> 0.60	Reliable
Vocational self-concept	0.801	> 0.60	Reliable
Employability skills	0.870	> 0.60	Reliable

Data Collection Procedure

Data collection was conducted after obtaining permission from the relevant schools and research authorities. The researchers coordinated with school administrators and teachers to identify eligible Grade XII students and to arrange the questionnaire administration schedule. Before completing the questionnaire, students were informed about the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses. The questionnaires were administered offline in printed form. Students completed the questionnaires individually under the supervision of the researchers or appointed school personnel. The researchers ensured that students understood the instructions and that their responses would be used only for academic research purposes. Completed questionnaires were checked for completeness before being processed for statistical analysis.

Data Analysis

Data analysis was conducted in several stages. First, descriptive statistics were used to describe the distribution of project-based learning, vocational self-concept, and employability skills. The descriptive analysis included frequency, percentage, and category classification for each variable.

Second, prerequisite tests were conducted to determine whether the data met the assumptions for regression analysis. Normality testing was used to examine whether the variable scores were normally distributed. Linearity testing was used to assess whether the relationship between each independent variable and employability skills followed a linear pattern. Multicollinearity testing was used to determine whether the two independent variables could be included simultaneously in the multiple regression model without excessive overlap.

Third, simple linear regression was used to examine the individual predictive contribution of project-based learning to employability skills and the individual predictive contribution of vocational self-concept to employability skills. Fourth, multiple linear regression was used to examine the simultaneous predictive contribution of project-based learning and vocational self-concept to employability skills. The regression models were interpreted using unstandardized coefficients, standardized beta coefficients, standard errors, confidence intervals, t-values, F-values, significance values, R^2, and adjusted R^2. Statistical significance was determined at $p < .05$.

Ethical Considerations

This study followed ethical principles for research involving student participants. Before data collection, permission was obtained from the participating vocational high schools. The students were informed about the purpose of the

study, the voluntary nature of their participation, and the confidentiality of their responses. They were also informed that the data would be used only for academic research purposes and would be reported in aggregate form. No personal identities of students or schools were disclosed in the analysis of individual responses.

RESULTS

The results are presented in three parts: the descriptive profile of the variables, prerequisite tests for regression analysis, and regression models predicting employability skills. This structure separates descriptive findings from inferential statistical findings so that students' response patterns and the predictive models can be interpreted clearly.

Descriptive Profile of the Variables

Table 4 presents the descriptive distribution of project-based learning, vocational self-concept, and employability skills among Grade XII vocational high school students. For project-based learning, 8.84% of students were in the very high category and 45.12% were in the high category. This indicates that 53.96% of students perceived their project-based learning experiences positively. For vocational self-concept, 9.77% of students were categorized as very high and 48.37% as high, showing that 58.14% of students had a high or very high vocational self-concept. Employability skills showed the strongest positive distribution, with 11.63% of students in the very high category and 52.09% in the high category.

Table 4. Descriptive distribution of project-based learning, vocational self-concept, and employability skills

Category	Project-Based Learning (%)	Vocational Self-Concept (%)	Employability Skills (%)
Very high	8.84	9.77	11.63
High	45.12	48.37	52.09
Moderate	22.79	20.00	18.60
Low	18.60	18.14	15.35
Very low	4.65	3.72	2.33

These results indicate that most Grade XII vocational high school students reported positive levels of project-based learning, vocational self-concept, and employability skills. The highest proportion of high and very high responses was found in employability skills, followed by vocational self-concept and project-based learning. This pattern suggests that students generally perceived themselves as having relatively strong readiness for workplace participation, although a smaller proportion of students remained in the moderate, low, and very low categories.

Prerequisite Tests for Regression Analysis

Before conducting regression analysis, prerequisite tests were performed to examine normality, linearity, and multicollinearity. The normality test showed significance values of 0.197 for project-based learning, 0.200 for vocational self-concept, and 0.200 for employability skills. Since all values were greater than 0.05, the data were considered normally distributed.

The linearity test showed that the deviation-from-linearity significance value for the relationship between project-based learning and employability skills was 0.286, while the value for the relationship between vocational self-concept and employability skills was 0.304. Both values exceeded 0.05, indicating that the relationships between each predictor and employability skills were linear.

The multicollinearity test produced a tolerance value of 0.618 and a VIF value of 1.662 for both independent variables. These values indicate that project-based learning and vocational self-concept did not have a multicollinearity problem and could be included simultaneously in the multiple regression model.

Table 5. Summary of prerequisite tests for regression analysis

Test	Variable/relationship	Statistic	Decision
Normality	Project-Based Learning (X1)	Sig. = 0.197	Normal
Normality	Vocational Self-Concept (X2)	Sig. = 0.200	Normal
Normality	Employability Skills (Y)	Sig. = 0.200	Normal
Linearity	X1 → Y	Deviation from linearity Sig. = 0.286	Linear
Linearity	X2 → Y	Deviation from linearity Sig. = 0.304	Linear
Multicollinearity	X1 and X2	Tolerance = 0.618; VIF = 1.662	No multicollinearity

Regression Models Predicting Employability Skills

Table 6. Summary of regression models predicting employability skills

Model	Regression Equation	R	R^2	Adjusted R^2	F	p
X1 → Y	Y = 44.644 + 0.639X1	0.686	0.471	0.469	189.746	< .001
X2 → Y	Y = 37.337 + 0.817X2	0.720	0.519	0.516	229.476	< .001
X1, X2 → Y	Y = 27.819 + 0.373X1 + 0.548X2	0.790	0.623	0.620	175.467	< .001

Table 6 presents the summary of the regression models predicting employability skills. The first simple regression model showed that project-based learning significantly predicted employability skills. The regression equation was Y = 44.644 + 0.639X1, with R = 0.686. The coefficient of determination indicated that project-based learning explained 47.1% of the variance in employability skills, $R^2 = 0.471$, adjusted $R^2 = 0.469$. The model was statistically significant, F (1, 213) = 189.746, p < .001. This finding indicates that students who reported stronger project-based learning experiences tended to report higher employability skills.

The second simple regression model showed that vocational self-concept also significantly predicted employability skills. The regression equation was Y = 37.337 + 0.817X2, with R = 0.720. Vocational self-concept explained 51.9% of the variance in employability skills, $R^2 = 0.519$, adjusted $R^2 = 0.516$. The model was statistically significant, F (1, 213) = 229.476, p < .001. This result suggests that students with stronger vocational self-concept tended to have higher perceived employability skills.

The multiple regression model showed that project-based learning and vocational self-concept simultaneously predicted employability skills. The regression equation was Y = 27.819 + 0.373X1 + 0.548X2, with R = 0.790. Together, the two predictors explained 62.3% of the variance in employability skills, $R^2 = 0.623$, adjusted $R^2 = 0.620$. The simultaneous model was statistically significant, F (2, 212) = 175.467, p < .001. This finding indicates that employability skills among Grade XII vocational high school students are better explained when both applied learning experiences and vocational self-concept are considered together.

Table 7. Coefficients of the Multiple Regression Model Predicting Employability Skills

Predictor	B	Std. Error	β	t	p	95% CI for B
Constant	27.819	3.421	-	8.131	< .001	[21.075, 34.564]
Project-Based Learning	0.373	0.049	0.401	7.680	< .001	[0.277, 0.469]
Vocational Self-Concept	0.548	0.059	0.483	9.258	< .001	[0.432, 0.665]

Table 7 presents the coefficient estimates of the multiple regression model. The results show that project-based learning significantly predicted employability skills, B = 0.373, SE = 0.049, β = 0.401, t = 7.680, p < .001, 95% CI [0.277, 0.469]. This indicates that, after controlling for vocational self-concept, higher project-based learning scores were associated with higher employability skills scores. Vocational self-concept also significantly predicted employability skills, B = 0.548, SE = 0.059, β = 0.483, t = 9.258, p < .001, 95% CI [0.432, 0.665]. This finding indicates that, after controlling for project-based learning, students with stronger vocational self-concept tended to report higher employability skills. Since the confidence intervals for both predictors were entirely above zero, both variables made significant positive contributions to employability skills.

Based on the standardized beta coefficients, vocational self-concept showed a slightly stronger unique contribution to employability skills than project-based learning in the simultaneous model. This suggests that students' internal vocational orientation, confidence, and occupational self-perception are important factors in explaining employability skills, alongside their project-based learning experiences.

DISCUSSION

This study examined project-based learning and vocational self-concept as predictors of employability skills among Grade XII vocational high school students in Gorontalo. The findings show that both predictors were significantly associated with employability skills, either individually or simultaneously. These results indicate that employability skills in vocational education are related not only to students' exposure to applied learning experiences but also to their internal perception of themselves as capable future workers. This interpretation is consistent with the broader view that employability skills include technical, interpersonal, cognitive, adaptive, and career-related capabilities that must be developed through both learning processes and identity formation (Rausch et al., 2024; Widarto et al., 2023).

The first finding showed that project-based learning significantly predicted employability skills. Project-based learning explained 47.1% of the variance in employability skills, indicating that students who reported stronger project-based learning experiences tended to report higher employability skills. This finding is theoretically relevant because project-based learning requires students to engage in planning, problem solving, collaboration, task management, production, presentation, and reflection. These activities are closely aligned with workplace demands and are particularly important in vocational high schools, where students are expected to transform technical knowledge into practical and productive performance.

This result is consistent with previous studies showing that project-based learning can strengthen practical skills, 21st-century competencies, engagement, motivation, and employability-related outcomes in vocational education. Project-based learning helped optimize students' practical skills in vocational high schools (Dzulkurnain et al., 2024), integrated STEM project-based learning improved students' theoretical knowledge, practical competence, engagement, and employability (Fadillah, 2025). Project-based learning supported cognitive, affective, psychomotor, and soft skill development in vocational informatics learning (Ghafara et al., 2025). These findings are also supported, who showed that teaching factory-based learning can strengthen employability skills through practical and industry-oriented learning models (Prianto et al., 2025).

The relevance of project-based learning can also be understood in relation to the wider need for experiential, contextual, and technology-supported vocational pedagogy. Emphasized that problem-based flipped learning with a STEM orientation can promote collaboration and critical thinking among vocational high school students (Mustaqim et al., 2025). Found that digital technology innovation in TVET can improve learning outcomes and 4C skills (Lapisa et al., 2025), while technological literacy in vocational education is closely associated with hands-on activities, tool use, teamwork, and peer learning (Larsson et al., 2024). These studies support the idea that vocational learning becomes more employability-oriented when students are actively engaged in authentic tasks rather than only receiving theoretical instruction.

However, the result should be interpreted carefully. Because this study used a cross-sectional correlational design, the finding does not prove that project-based learning directly causes employability skills to increase. Rather, it indicates that students who perceived their learning as more project-based also tended to report stronger employability skills. This distinction is important because employability skills may also be influenced by other factors, such as teacher competence, school facilities, internship quality, industry involvement, students' motivation, and family or socioeconomic background. Previous studies have shown that work readiness and employability are also related to competency alignment, soft skills, employer expectations, technical communication, and industry-based experiences (Daryono et al., 2023; Fernando & Wickramasinghe, 2024; Ramamuruthy et al., 2021; Rizwan et al., 2021; Wahyudin et al., 2025).

The second finding showed that vocational self-concept also significantly predicted employability skills. Vocational self-concept explained 51.9% of the variance in employability skills, which was slightly higher than the contribution of project-based learning in the simple regression model. This suggests that students' confidence, occupational identification, and perception of their vocational ability are important factors in employability development. Students with stronger vocational self-concept may be more likely to see school tasks as meaningful preparation for work, persist in challenging activities, accept feedback constructively, and connect their learning experiences with future occupational roles.

This finding is aligned with previous studies emphasizing the role of vocational identity, self-efficacy, and career-related confidence in employability development. Found that vocational self-concept significantly influenced employability among vocational students (Ahmid et al., 2023). Students' self-evaluation of employability skills shapes their aspirations and confidence in the school-to-work transition (Romanova, 2022). Employability skills and career development self-efficacy are important indicators of workforce success (Omar et al., 2023), self-efficacy was positively related to vocational students' work readiness (Permana & Aulia, 2023). More recent evidence also indicates that self-efficacy and vocational identity can shape the relationship between work-based learning and employability skills (Suyitno et al., 2025), and that career decision-making self-efficacy contributes to vocational students' career adaptability (Zhang et al., 2025).

The simultaneous regression model provides a more complete explanation. Project-based learning and vocational self-concept together explained 62.3% of the variance in employability skills. This finding indicates that the two predictors are complementary. Project-based learning represents the external learning environment through which students practise workplace-related skills, while vocational self-concept represents the internal orientation that helps students value, internalize, and transfer those experiences into future occupational readiness. In other words, authentic project experiences may provide opportunities for skill development, but vocational self-concept may influence how strongly students interpret those experiences as relevant to their future work identity.

An important issue in the regression results is the decrease in coefficients from the simple regression models to the multiple regression model. In the simple regression model, project-based learning had B = 0.639, while vocational self-concept had B = 0.817. In the multiple regression model, the coefficients decreased to B = 0.373 for project-based learning and B = 0.548 for vocational self-concept. This pattern is expected because simple regression coefficients represent the total association between each predictor and employability skills, including variance that may be shared with the other predictor. In contrast, multiple regression coefficients represent the unique contribution of each predictor after controlling for the other. Therefore, the decrease in coefficients does not weaken the findings; rather, it shows that project-based learning and vocational self-concept partly overlap in explaining employability skills.

The standardized beta coefficients in the multiple regression model further showed that vocational self-concept had a slightly stronger unique contribution than project-based learning. Vocational self-concept produced $\beta = 0.483$, while project-based learning produced $\beta = 0.401$. This suggests that, when both predictors were considered simultaneously, students' occupational self-perception, vocational confidence, and identification with their field contributed slightly more strongly to employability skills than project-based learning experience. This does not reduce the importance of project-based learning. Instead, it suggests that project-based learning may become more meaningful when accompanied by structured reflection, career guidance, and activities that help students develop a clearer vocational identity.

These findings have practical implications for vocational high schools. Schools should continue to strengthen authentic project-based learning by designing tasks that reflect real work processes, local industry needs, and occupational standards. Project activities should not only focus on the final product but also assess planning, teamwork, communication, problem solving, documentation, adaptability, and reflection. This is consistent with the broader view of vocational competence as a multidimensional construct that includes both professional competence and broader employability skills such as collaboration, task performance, literacy, and problem solving (Rausch et al., 2024). Competency-based training can support technical skills mastery when learning outcomes are aligned with industry needs (Masran et al., 2025).

At the same time, vocational schools need to integrate vocational self-concept development into classroom learning, workshop practice, and career guidance. Teachers can help students reflect on what occupational skills they use in projects, how their performance relates to workplace expectations, and how school-based learning contributes to their career readiness. Industry involvement can further strengthen this process by providing authentic problems, feedback, mentoring, and evaluation of student products. Real-world contexts and industry involvement are important in developing graduate employability skills (Majid et al., 2024), while modern equipment and collaboration with local industries can improve students' confidence and employability skills (Musyimi, 2021).

The findings also suggest that employability development should be treated as an integrated school process rather than as an isolated learning outcome. Project-based learning, career guidance, reflective assessment, teacher feedback, and industry collaboration need to be connected. If project-based learning is implemented without career-oriented reflection, students may complete school projects without fully understanding their relevance to future work. Conversely, if vocational self-concept is developed without authentic learning experiences, students may have career confidence without sufficient opportunities to practise workplace-related skills. Therefore, vocational schools should combine authentic project experiences with structured identity formation and career reflection. This requires teacher readiness, appropriate instructional resources, and professional development support, as shown in studies on 4C integration and teacher capacity in vocational and applied learning contexts (Abdullah et al., 2022; Haryani et al., 2021; Jaedun et al., 2022; Pharamela & Singh-Pillay, 2025).

Several limitations should be acknowledged. First, this study used a cross-sectional correlational design, so the results cannot be interpreted as causal effects. Second, the data were collected through self-report questionnaires, which may be influenced by subjective perception and common method bias. Third, the sample was limited to Grade XII students from technical and automotive-related vocational competencies in Gorontalo, and all respondents were male. Therefore, the findings should be generalized cautiously to other regions, grade levels, vocational fields, or female students. Future research should use longitudinal, experimental, or mixed-methods designs and include teacher assessments, employer feedback, performance-based tasks, or portfolio evidence to obtain a more comprehensive understanding of employability skills development.

CONCLUSION

This study examined project-based learning and vocational self-concept as predictors of employability skills among Grade XII vocational high school students in Gorontalo, Indonesia. The findings showed that both project-based learning and vocational self-concept significantly predicted employability skills. Project-based learning explained 47.1% of the variance in employability skills, while vocational self-concept explained 51.9%. When both predictors

were included in the simultaneous regression model, they jointly explained 62.3% of the variance in employability skills. These findings indicate that employability skills among vocational high school students are better understood when both applied learning experiences and vocational self-concept are considered together.

The theoretical contribution of this study lies in its integration of a pedagogical predictor and an identity-based predictor in a single employability model. Project-based learning represents students' external learning experiences through authentic, collaborative, and work-oriented activities, while vocational self-concept represents students' internal perception of themselves as capable future workers. The finding that vocational self-concept showed a slightly stronger unique contribution than project-based learning in the simultaneous model suggests that employability development is not only a matter of providing practical learning experiences but also of strengthening students' vocational confidence, occupational identification, and career-oriented self-perception.

Practically, the findings suggest that vocational high schools should strengthen project-based learning while also integrating career-oriented reflection and vocational identity development into learning activities. Schools should design authentic projects that require students to plan, collaborate, solve problems, produce work-related outputs, document their work, and present their results. At the same time, teachers should help students reflect on how these project experiences relate to occupational standards, workplace expectations, and future career roles. Therefore, employability development should be treated as an integrated process involving project-based learning, career guidance, reflective assessment, teacher feedback, and industry involvement.

This study has several limitations. The cross-sectional correlational design means that the findings should be interpreted as predictive associations rather than causal effects. The use of self-report questionnaires may also introduce subjective perception and common method bias. In addition, the sample was limited to male Grade XII students from technical and automotive-related vocational competencies in Gorontalo, so the findings should be generalized cautiously to other student groups, vocational fields, and regional contexts. Future studies should use longitudinal, experimental, or mixed-methods designs and include performance-based assessments, teacher evaluations, employer feedback, or student portfolios to provide a more comprehensive understanding of employability skills development.

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AUTHOR CONTRIBUTION STATEMENT

Author 1 served as the main contributor to this study and was responsible for the overall conception of the research, formulation of the research problem, development of the study design, coordination of the research process, data interpretation, and manuscript preparation. Author 2 contributed to data collection, data organization, and statistical analysis. Author 3 supported the literature review, theoretical framing, and interpretation of the findings. Author 4 contributed to manuscript revision, language refinement, and academic validation of the article. Author 5 provided supervision, critical review, and final approval of the manuscript. All authors have read and agreed to the final version of the manuscript.

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The authors used OpenAI ChatGPT during the preparation of this work for language refinement, manuscript structuring, formatting assistance, and document preparation. After using the tool, the authors thoroughly reviewed and edited the content as needed and take full responsibility for the content of the publication.

***Sunardi (Corresponding Author)**
Fakultas Teknik, Universitas Negeri Gorontalo,
Jl. Prof. BJ. Habibie, Kab. Bone Bolango, Gorontalo, 96554, Indonesia
Email: sunardi@ung.ac.id

Lanto Mohamad Kamil Amali
Program Pascasarjana, Universitas Negeri Gorontalo,
Jl. Jenderal Sudirman No. 6, Gorontalo, 96128, Indonesia
Email: kamilamali@ung.ac.id

Buyung R. Machmoed
Fakultas Teknik, Universitas Negeri Gorontalo,
Jl. Prof. BJ. Habibie, Kab. Bone Bolango, Gorontalo, 96554, Indonesia
Email: buyungmachmoed@ung.ac.id

Jumiati Ilham
Fakultas Teknik, Universitas Negeri Gorontalo,
Jl. Prof. BJ. Habibie, Kab. Bone Bolango, Gorontalo, 96554, Indonesia
Email: jumiatiilham@ung.ac.id

Hasmah
Fakultas Teknik, Universitas Negeri Gorontalo,
Jl. Prof. BJ. Habibie, Kab. Bone Bolango, Gorontalo, 96554, Indonesia
Email: hasmahaiman@ung.ac.id