Journal of Education, Teaching, and Learning
Volume 10 Number 2 Year 2025. Page 446-453
p-ISSN: 2477-5924 e-ISSN: 2477-8478

Analysis of Teacher and Student Readiness in Implementing Coding-Based Learning and Artificial Intelligence at Vocational High School 1 Mempawah Timur

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Article Information:
Received May 10th, 2026
Revised June 12nd, 2026
Accepted August 7th, 2026

Keywords: Keywords: coding-based learning; teacher readiness; student readiness; artificial intelligence; vocational education.

Abstract
This study aimed to analyze the readiness of teachers and students in implementing coding-based learning at SMK Negeri 1 Mempawah Timur. The research employed a quantitative descriptive approach with the research respondents were 10 teachers and 45 students. Data collection techniques including questionnaires, interviews, and documentation. The results indicate that both teacher and student readiness were categorized as moderately ready. Teachers showed positive attitudes toward coding-based learning; however, limitations remain in terms of technical skills and school facility support. Similarly, students demonstrate adequate motivation and positive attitudes toward technology, yet they still require guidance in the use of digital learning tools. Therefore, strategic efforts such as continuous teacher training, improvement of school facilities, and enhanced student learning support are necessary to ensure the effective and sustainable implementation of coding-based learning in vocational high schools.

How to cite: Danar, S., Lesmana, C., & Arpan, M. (2025). Analysis of Teacher and Student Readiness in Implementing Coding-Based Learning and Artificial Intelligence at Vocational High School 1 Mempawah Timur. *JETL (Journal of Education, Teaching and Learning), 10*(2), 446-453. doi: **http://dx.doi.org/10.26737/jetl.v10i2.9000**

INTRODUCTION

The development of digital technology in the era of the Industrial Revolution 4.0 and Society 5.0 has brought fundamental changes to the world of education. Education no longer focuses solely on the mastery of knowledge, but also on the development of 21st-century skills, such as critical thinking, creativity, collaboration, communication, and digital literacy. This is in line with the global education vision that emphasizes the importance of adaptive abilities and problem-solving in facing future challenges in the era of digital transformation (OECD, 2019). One learning approach considered relevant to these demands is coding-based learning, which plays an important role in developing computational thinking. Computational thinking is increasingly recognized as an essential competency for learners across educational levels, including vocational education, as it supports students in understanding complex problems and designing effective solutions (Shute et al., 2017; Tikva & Tambouris, 2021). Through coding-based learning, students not only acquire technological knowledge but also develop structured, critical, and creative thinking skills.

In the context of Vocational High Schools (SMK), coding-based learning holds significant urgency as it aligns with the institutional objective of producing industry-ready graduates capable of adapting to rapid technological shifts. The integration of coding-based learning and Artificial Intelligence (AI) has become a fundamental necessity in vocational education to bridge the gap between academic instruction and industrial demands. As highlighted by Crompton and Burke (2023), AI is no longer a peripheral technology but a core driver in higher and vocational education that reshapes how students interact with complex data. Furthermore, Ouyang and Jiao (2021) emphasize that moving toward an AI-driven educational paradigm allows for more personalized and adaptive learning experiences, which are essential for developing the logical and systematic thinking patterns required in coding. Mastering these technologies in SMK is crucial not only for technical proficiency but also for ensuring that graduates remain competitive in a labor market increasingly dominated by automated and intelligent systems.

However, the success of implementing such innovations is largely determined by the readiness of various educational components, especially teachers and students. Teachers have a central role as designers and implementers of learning. Teacher readiness includes mastery of knowledge about coding, technical skills, attitudes toward innovation, and pedagogical abilities in integrating technology into the learning process (Mulyasa, 2017). In addition to teachers, student readiness is also an important factor. Student readiness includes prior knowledge, learning motivation, and attitudes toward technology. Differences in background and access to technology often become challenges in implementing coding-based learning in schools. The government has encouraged the strengthening of technology- and coding-based learning as part of the national education transformation (Kemendikbud, 2022). Nevertheless, implementation at the school level still faces various obstacles, such as limited infrastructure and a lack of continuous assistance. Based on this description, it is necessary to conduct research to analyze teacher and student readiness at SMK Negeri 1 Mempawah Timur as a basis for formulating strategies to improve vocational education quality.

METHODS

This study used a descriptive quantitative approach aimed at describing the level of teacher and student readiness in the implementation of coding-based learning in Vocational High School (SMK). This approach was chosen because the research focuses on presenting objective conditions based on numerical data obtained from respondents without applying any specific treatment.

Type and Research Design

The type of research used is descriptive research with a survey design. This study is designed to identify and analyze the level of teacher and student readiness based on predetermined indicators, including aspects of knowledge, skills, attitudes, and facility support in the implementation of coding-based learning.

Subjects and Research Location

This research was conducted at SMK Negeri 1 Mempawah Timur, West Kalimantan, Indonesia. The study population consisted of teachers and students who were directly involved or potentially involved in the implementation of coding-based learning and Artificial Intelligence (AI). The number of students was determined using Isaac and Michael's sample size table at a 5% significance level, which is commonly used to determine representative samples from limited populations (Isaac & Michael, 1981; Sugiyono, 2022). Based on the population size, 45 students were selected as study respondents. Meanwhile, 10 teachers were selected purposively because they were directly involved in learning activities and were considered to have relevant knowledge and experience regarding the implementation of coding-based learning in schools.

who are participating or being prepared to participate in coding-based learning. The selection of research subjects was carried out using purposive sampling techniques, based on considerations of the relevance of the subjects to the research objectives.

Data Collection Techniques

Research data were collected through several techniques, namely:

1. Questionnaire
   Two distinct questionnaire instruments were developed—one for teachers and one for students—as the readiness indicators differ based on their roles in the learning process. Both instruments utilized a 5-point Likert scale (ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree"). The teacher questionnaire focused on five dimensions: *Knowledge and Professional Competence*, *Pedagogical and Technical Skills*, *Attitude and Psychological Readiness*, *Facilities and School Support*, and *Barriers*. Correspondingly, the student questionnaire measured *Learning Attitude and Motivation*, *Cognitive and Affective Readiness*, *Initial Knowledge and Experience*, *Facilities and Learning Environment*, and *Learning Barriers*. Prior to distribution, both instruments underwent validity testing to ensure alignment with the AI-TPACK framework.
2. Interview
   To provide depth to the quantitative findings, semi-structured interviews were conducted. Rather than interviewing the entire population, a purposive sampling technique was applied, involving five teachers from various departments and three school administrators responsible for infrastructure and curriculum policies. These participants were selected for their leadership and instructional roles, allowing for a triangulation of questionnaire data and a deeper understanding of systemic constraints and institutional support requirements.
3. Documentation
   Documentation was utilized as a supplementary method to triangulate the findings. This involved collecting school profile data, curriculum documents, and institutional policy records regarding technology-based learning implementation. These documents served to provide context for the facilities and institutional environment reported by respondents in the questionnaires.

Research Instrument

The research instrument was in the form of teacher and student readiness questionnaires developed based on theoretical studies and indicators of readiness for coding-based learning. The instrument covered several aspects, namely readiness of knowledge and technical skills, readiness of attitudes and motivation, and readiness of facilities and the learning environment.

Before use, the instrument first went through a content validation process by experts to ensure the suitability of the indicators with the research objectives.

Data Analysis Techniques

The data obtained in this study were analyzed using descriptive statistics. This analysis aims to describe the level of teacher and student readiness in the implementation of coding-based learning based on the scores obtained from the questionnaire instruments. Each questionnaire item was prepared using a Likert scale, with scores assigned to each answer choice. The scores obtained from respondents were then summed for each readiness indicator. Furthermore, these scores were calculated in the form of averages and percentages to determine the overall level of readiness as well as readiness by aspect. The results of the score calculations were then classified into categories of readiness levels using certain criteria, namely very ready, ready, fairly ready, less ready, and not ready. This categorization was carried out to facilitate data interpretation and drawing conclusions regarding the condition of teacher and student readiness.

In addition to quantitative data, data from interviews and documentation were analyzed descriptively and qualitatively. These data were used as supporting data to strengthen the results of the questionnaire analysis, especially in explaining the factors influencing teacher and student readiness and the obstacles faced in implementing coding-based learning. The results of the data analysis are presented in the form of tables and narrative descriptions to make them easy to understand and to provide a comprehensive picture of teacher and student readiness in the implementation of coding-based learning at SMK Negeri 1 Mempawah Timur.

RESULT AND DISCUSSION

The results of this study were obtained from the analysis of questionnaire data given to teachers and students at SMK Negeri 1 Mempawah Timur. The analysis was conducted to determine the level of teacher and student readiness in the implementation of coding-based learning based on several readiness indicators. Teacher Readiness in the Implementation of Coding-Based Learning. The results of the analysis of teacher readiness data are presented in Table 1.

Table 1. Level of Teacher Readiness in the Implementation of Coding-Based Learning

No	Aspect of Teacher Readiness	Percentage (%)	Category
1	Knowledge and Professional Competence	58.93	Fairly Ready
2	Pedagogical and Technical Skills	56.78	Fairly Ready
3	Attitude and Psychological Readiness	81.10	Ready
4	Facilities and School Support	73.90	Ready
5	Barriers and Challenges	20.00	Not Ready
	Average	58.10	Fairly Ready

Based on Table 1, the overall teacher readiness is categorized as "Fairly Ready" with an average score of 58.10%. This categorization is interpreted through the e-readiness framework by Aydin and Tasci (2005), which emphasizes that successful innovation requires an alignment between psychological preparedness, institutional support, and professional competence. The high score in Attitude and Psychological Readiness (81.10%) aligns with Bandura's (1997) self-efficacy theory, suggesting that teachers possess strong intrinsic motivation to adopt new technologies. However, the Knowledge and Professional Competence (58.93%) and Pedagogical and Technical Skills (56.78%) aspects remain in the "Fairly Ready" category. When analyzed using the TPACK framework (Mishra & Koehler, 2006) and the contemporary AI-TPACK model (Luh et al., 2026), these findings indicate a "readiness gap" where teachers require more intensive, practice-based training to synthesize coding and AI tools with their pedagogical practices. Furthermore, the "Not Ready" status for Barriers and Challenges (20.00%) underscores the presence of significant systemic obstacles, which, according to Ertmer's (1999) classification, must be proactively managed to prevent these barriers from hindering the implementation of coding and AI-based learning in the classroom.

Student Readiness in the Implementation of Coding-Based Learning The results of the analysis of student readiness are presented in Table 2.

Table 2. Level of Student Readiness in the Implementation of Coding-Based Learning

No	Aspect of Student Readiness	Percentage (%)	Category
1	Learning Attitude and Motivation	75.00	Ready
2	Initial Knowledge and Experience	66.74	Fairly Ready
3	Facilities and Learning Environment	71.49	Ready
4	Cognitive and Affective Readiness	74.30	Ready
5	Learning Barriers	20.00	Not Ready
	Average	61.51	Fairly Ready

Based on Table 2, student readiness in the implementation of coding and AI-based learning is categorized as "Fairly Ready," with an overall average score of 61.51%. The data reveals that students possess strong psychological and environmental support, with *Learning Attitude and Motivation* (75.00%), *Cognitive and Affective Readiness* (74.30%), and *Facilities and Learning Environment* (71.49%) all categorized as "Ready". This reflects a high level of self-efficacy and positive orientation, which, according to Bandura's (1997) social cognitive theory, are essential precursors for successful innovation adoption. However, the *Initial Knowledge and Experience* indicator remains "Fairly Ready" (66.74%), suggesting that while students are psychologically prepared, they require further foundational scaffolding in coding and AI concepts as framed by the TPACK model (Mishra & Koehler, 2006) and the AI-TPACK model (Luh et al., 2026). Furthermore, the "Not Ready" status of *Learning Barriers* (20.00%) underscores the presence of significant obstacles. Consistent with Ertmer's (1999) classification, these barriers—coupled with the findings of the e-readiness framework (Aydin & Tasci, 2005)—indicate that systemic and practical challenges must be systematically addressed to translate students' high motivation into tangible learning outcomes.

Discussion

The results of this study indicate that teacher readiness for implementing coding and AI-based learning at SMK Negeri 1 Mempawah Timur is categorized as "Fairly Ready," with an average percentage of 58.10%. Based on the indicator analysis, the highest score was found in the *Attitude and Psychological Readiness* aspect (81.10%), followed by *Facilities and School Support* (73.90%), both categorized as "Ready". These findings align with Bandura's (1997) self-efficacy theory, suggesting that teachers possess high intrinsic motivation and positive perceptions toward innovation. However, the *Knowledge and Professional Competence* (58.93%) and *Pedagogical and Technical Skills* (56.78%) aspects remain "Fairly Ready". When analyzed through the TPACK framework (Mishra & Koehler, 2006) and the contemporary AI-TPACK model (Luh et al., 2026), these results indicate a "readiness gap" where teachers require more intensive, practice-based scaffolding to effectively integrate coding and AI tools into their pedagogical strategies. Furthermore, the "Not Ready" status of the *Barriers and Challenges* indicator (20.00%) reflects the second-order barriers identified by Ertmer (1999), necessitating systemic management to ensure these obstacles do not impede implementation.

Regarding student readiness, the overall average reached 61.51%, also categorized as "Fairly Ready". Students demonstrated strong psychological readiness, with *Learning Attitude and Motivation* (75.00%), *Cognitive and Affective Readiness* (74.30%), and *Facilities and Learning Environment* (71.49%) all categorized as "Ready". This positive orientation is consistent with Aydin and Tasci's (2005) e-readiness model, which posits that psychological readiness is a critical precursor to digital learning success. Nevertheless, the *Initial Knowledge and Experience* indicator only reached 66.74% ("Fairly Ready"), suggesting that despite high motivation, students require foundational support in coding and AI concepts as emphasized by the AI-TPACK framework (Luh et al., 2026).

The 20.00% "Not Ready" status for *Learning Barriers* among both groups may be attributed to the "Digital Readiness Paradox," where high psychological enthusiasm is frequently stifled by external constraints such as limited access to high-performance computing devices required for complex AI-based coding tasks. To bridge this readiness gap, it is recommended that the school shift from generic ICT training toward micro-credentialing and peer-coaching models. Teachers should be encouraged to co-design AI-based lesson plans with students, thereby turning the classroom into a collaborative "sandbox" where students' high motivation is channeled into practical coding projects. Finally, while this study provides a comprehensive overview of readiness at SMK Negeri 1 Mempawah Timur, the findings are limited by their cross-sectional nature. Future research should employ longitudinal tracking to measure how professional development interventions directly influence the evolution of AI-TPACK competencies over time. Collectively, these findings imply that while the psychological environment for coding and AI implementation is favorable, there is a clear demand for targeted technical training to bridge the competence gap for both teachers and students.

The finding that both teachers and students at SMK Negeri 1 Mempawah Timur are 'moderately ready' for coding and AI implementation reflects a growing global trend in digital education. This level of readiness aligns with the research by Zhai et al. (2021), which suggests that while there is high motivation, the transition to AI-integrated classrooms requires continuous support to move beyond basic familiarity toward deep pedagogical integration. Moreover, the importance of fostering student engagement during this transition cannot be overlooked; as Chiu (2021) argues, digital support in blended or technology-based learning must be grounded in self-determination to sustain student motivation. Therefore, the 'moderate' readiness observed in this study indicates a solid foundation, yet it underscores the need for strategic interventions to elevate technical confidence and ensure that digital engagement leads to meaningful learning outcomes.

Interestingly, both teachers and students obtained a score of 20% in the barriers and challenges indicator, categorized as not ready. This indicates that significant obstacles remain, including limited technological devices, internet access, and practical coding experience. Although the overall readiness level is categorized as fairly ready, these barriers imply that the implementation of coding-based learning and AI still requires comprehensive strengthening strategies. Such strategies should include improving teacher competencies, enhancing technological infrastructure, and providing structured assistance for students to ensure effective and sustainable implementation in vocational education settings.

CONCLUSIONS

Based on the research findings and discussion, it can be concluded that both teacher and student readiness for implementing coding and AI-based learning at SMK Negeri 1 Mempawah Timur is currently in the "Fairly Ready" category. While the school environment is supported by high psychological readiness—evidenced by teachers' positive attitudes and students' strong learning motivation—the practical implementation is hindered by a "readiness gap" in technical and pedagogical competencies.

Teachers demonstrate excellent psychological and institutional orientation, yet they require targeted support to enhance their pedagogical and technical skills in the AI-TPACK context. Simultaneously, although students exhibit high readiness in cognitive and affective aspects, there is a clear need for foundational scaffolding in initial coding knowledge and device usage to overcome the current "Fairly Ready" status. Consequently, the 20% "Not Ready" threshold in learning barriers underscores the critical need for systemic interventions, such as shifting from generic ICT training to micro-credentialing and peer-coaching models. To ensure the effective and sustainable implementation of coding and AI-based curriculum, it is imperative to align continuous professional development for teachers with structured, practice-based support for students. These strategic efforts will transform existing psychological motivation into tangible technical mastery, ultimately fostering a more adaptive and future-ready vocational education environment.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude and appreciation to the Institute for Research and Community Service (LPPM) of Universitas PGRI Pontianak for the financial support and facilities provided for this study. This research was conducted under the funding framework of the official research contract number 085/L.135/PNK/09/2025. The assistance from this institution has been instrumental in the successful completion of this academic project.

CONFLICTS OF INTEREST STATEMENT

The authors formally declare that this research was conducted in the absence of any personal, professional, or financial relationships that could be construed as a potential conflict of interest. Regarding the publication of this manuscript, there are no competing interests to disclose. This study received financial support from the Institute for Research and Community Service (LPPM) of Universitas PGRI Pontianak under the research contract number 085/L.135/PNK/09/2025, and the authors maintain full responsibility for the objectivity and integrity of the findings presented herein.

AUTHOR CONTRIBUTIONS

Danar.Santoso was responsible for the conceptualization, research methodology design, primary data collection, formal data analysis, and the preparation of the original manuscript draft. Chandra Lesmana. provided intensive supervision, validated the research framework, and offered methodological guidance throughout the study. Muhamad Arpan contributed to data validation, language editing to meet international academic standards, and conducted a comprehensive review of the manuscript. All authors participated in the final review and gave their full approval for the version to be published.

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