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Responsive vocational education to the needs of the world of work: A literature review of critical factors

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Abstract: This article aims to identify and analyze critical factors that influence the responsiveness of vocational education to the needs of the world of work through a systematic literature review approach to 30 international scientific articles indexed by Scopus. The results of the study indicate that the responsiveness of vocational education is largely determined by four main elements, namely: (1) strategic partnerships between vocational education institutions and the industrial world in order to align the curriculum (link and match), (2) strengthening the integration between hard skills and soft skills in graduates to face the challenges of 21st century competencies, (3) the central role of vocational educators that needs to be improved through continuous professional training, and (4) the use of innovation and learning technology such as VR (Virtual Reality), AR (Augmented Reality), and AI (Artificial Intelligence) in the vocational education process. These findings emphasize that vocational education needs to continue to adapt to the dynamics of industry and technological developments *to* produce competent, adaptive, and highly competitive graduates in the global job market.

Keywords: vocational education; industrial need; link and match; soft skills; learning technology

1. Introduction

Vocational education programs play an important role in the development of human resources (HR) in a country, both developed and developing countries. Vocational education is designed to prepare graduates who have specific expertise and skills in their fields, so that they are required to have higher work readiness compared to graduates of other higher education (Suhartanta et al., 2024). The main objective of vocational education is to create individuals who are ready to compete in the world of work, identify types of jobs that suit their interests and talents, and provide strong work preparation provisions to support sustainable career development (Pritasari et al., 2024).

Vocational education is seen as one of the determining factors in improving the economic welfare of a country (Kokkinopoulou et al., 2025). Vocational education has an important role as a driver in realizing inclusive and sustainable economic growth, even in facing complex economic challenges such as in the 21st century (Yoto et al., 2024). If vocational education is managed well by the government through improving the quality of teaching, improving facilities and strong partnerships with the industrial world, then this program has the potential to make a significant contribution to national economic development (Hunushek & Ludger, 2020). Through higher education, especially vocational education, science and technology can be spread more evenly. This can later strengthen the synergistic relationship between vocational higher education and the industrial world. Therefore, it is important for developing countries to be able to improve the

quality of education, because the knowledge and work readiness of graduates have a very close correlation with national economic growth (Priyono et al., 2024).

Along with the rapid development of technology such as artificial intelligence (AI), robotics and the Internet of Things (IoT) have become drivers of industrial transformation (Ubihatun et al., 2024). The development of this technology makes companies prefer to adopt technology to increase industrial efficiency (Ayu et al., 2022). This results in the skills needed by companies changing significantly. In addition, the industry also needs graduates who can work independently, proactively, are motivated, work in teams, solve problems and communicate solutions to these problems (McGunagle & Zizka, 2020). However, vocational graduates who have competence in the engineering field are still required to be able to complete tasks related to their scientific disciplines.

These conditions indicate that, as stated by Chen & Zhang (2022) vocational education must adapt to the development of science and technology, as well as the dynamics of the labour market, so that it can create a modern economic system and achieve better quality employment. Therefore, an in-depth review is needed of the critical factors that influence the responsiveness of vocational education, such as the suitability of the curriculum to industry needs, the skills gap of graduates in the 21st century, and the use of innovation and technology that can be used in vocational learning. Through a review of these factors, it is hoped that vocational education will be able to produce graduates who are not only technically competent, but also adaptive to changes and the demands of the ever-growing industry.

2. Methods

This study uses a systematic literature review approach, as explained by Andriani (2022), that in this research method, findings will be obtained based on data that has been collected systematically and structured. In the data collection process, researchers conducted a review of 30 international research journals indexed by Scopus published in the period 2020 to 2025, as well as other articles relevant to the topic of discussion regarding vocational education, graduate work readiness (employability), industry needs, curriculum alignment and similar topics. The data obtained will be analysed, simplified and its validity through narrative descriptions. Furthermore, conclusions are drawn from the results of the discussion and verification to ensure its authenticity, so that the data obtained can be used as a basis for further development.

3. Results

3.1 The role of cooperation with industry (link and match)

Vocational education has the responsibility to create graduates who have superior Human Resources (HR). Therefore, cooperation is needed between vocational higher education and the industrial world of work, known as the link and match concept. This concept is an important strategy in overcoming the competency gap between vocational graduates and the needs of the world of work. This cooperation will not only be symbolic but will play a structural role in integrating the education system with the needs of the national economy.

In the context of developing countries, research Ali et al. (2020) suggests that there are several factors that determine the success of cooperation between vocational education and industry. Among them are the practical involvement of industry in developing learning programs and providing work practice facilities that meet business standards. In line with this research, (Zhao, 2024) emphasizes the importance of integration between the fields of expertise offered by

universities and the workforce needs required by industry. The mismatch between study programs and industry needs will directly contribute to mismatches in job placement, low productivity and increasing unemployment rates for vocational education graduates.

Astuti et al., (2021) in their research, stated that through cooperation between the world of education and the world of industry, it not only influences the improvement of students' academic abilities, but also has a positive impact on the attitudes and social skills of graduates. Meanwhile, Kemper & Renold, (2024) explained that cooperation programs involving direct work practices in the industry, instructor training by experts in the industry, and the holding of competency-based tests will provide a learning experience that is in accordance with the needs of the world of work. Through this cooperation, the quality of human resources can be improved and become superior graduates.

However, there is still a gap between the expectations of the industrial world and the competencies of vocational education graduates. As stated by Edeigba, (2022) that through link and match, it should be able to bridge industry expectations regarding the skills of graduates produced (such as communication and problem-solving skills). However, if there is no direct involvement from industry in the curriculum planning process, the gap will continue to recur. van Dijk et al., (2022) Through collaboration between vocational education and industry, it can provide access to the creation of meaningful and sustainable jobs, while increasing the capacity of individuals to contribute productively to community life.

In the context of a sustainable economy, Olofsson & Lundmark (2025) highlighted the collaboration between vocational education and industry in providing jobs, that this collaboration can answer the challenge of inequality in access to work. Furthermore, Kholifah et al., (2025) showed that through industry involvement it also has a positive impact on students' career decisions. One of them is through increasing graduates' self-confidence in their career choices. This collaboration will help students feel confident that vocational education is the right choice, as well as forming a positive view of career opportunities in the vocational field.

Through good cooperative relationships, it will build students' self-confidence. Abdel Hadi et al., (2023) stated that vocational education students who are involved in collaboration with industry will have high self-confidence and good adaptability to changes in the work environment. In fact, through this collaboration, it will influence policies in education. The higher the public's awareness of the importance of this connection, the more it will encourage the government to formulate vocational education policies that are more in line with the needs of the labour market (Liu et al., 2024).

In line with several articles referenced in this study, several gaps were still identified. Research conducted by Ali et al., (2020) focused more on technical aspects such as learning programs and practical facilities. Meanwhile, research by Astuti et al., (2021) highlighted the importance of the policy dimension in the learning process. This indicates the need for research that can integrate these two aspects more comprehensively. On the other hand, Edeigba (2022) emphasized that competency gaps can also arise from students' lack of mastery of non-technical skills, such as communication and problem-solving. Therefore, the integration of academic achievement with soft skills remains problematic. Meanwhile, Zhao (2024) in his research emphasized the importance of curriculum relevance to current workplace needs, indicating the need for in-depth study of this issue.

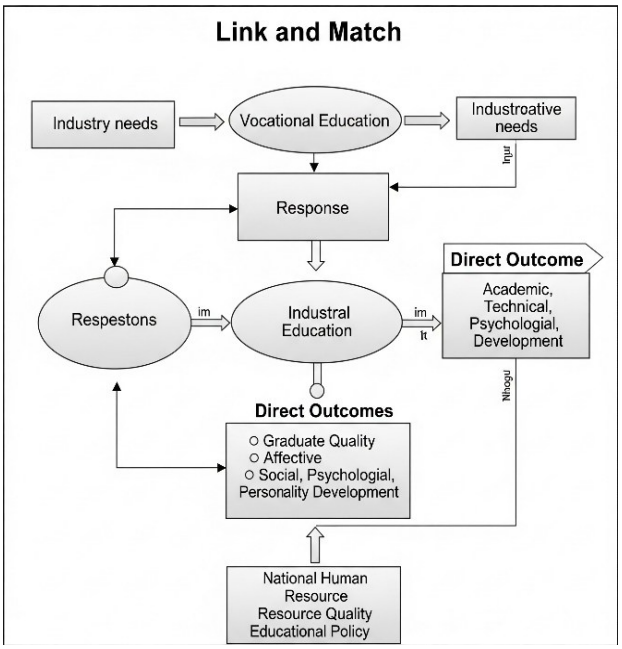

Figure 1. Link and match

The Figure 1 explains the close relationship between Vocational Education, Industry and Graduates, which can be described as follows:

1. There is a need for human resources in industry
2. Link and Match is one strategy to overcome the competency gap; this concept is designed to close the gap between what is taught in schools and the current needs of the job market.
3. The existence of a main collaboration mechanism, through several means for example:
   a. Through industrial work practices/internships
   b. Instructor training by industry experts
   c. Competency based certification test

So, it can be concluded that link and match is a systematic process starting from the need for human resources in industry, so there needs to be collaboration between education and industry, which can later produce graduates with superior quality and ultimately have a positive impact on Human Resource Development (HRD) and lead to education policy.

3.2 Soft skills and hard skills competencies of graduates

In the context of vocational education, the competency of graduates produced is not only determined by their mastery of them to hard skills that are technical and specific to the field of work but also emphasize the importance of mastering soft skills that are non-technical such as communication skills, teamwork, leadership and emotional intelligence. The combination of soft skills and hard skills is a major factor in determining the success of vocational education graduates in entering the workforce, especially now that we have entered the industrial era 5.0 which demands synergy between humans and technology. Hard skills refer to technical skills and specific expertise that are in accordance with the field being studied. These skills are still the focus in the current vocational education curriculum. As stated by Dai & Martins (2024), the increase in vocational graduates in various cities in China has contributed directly to increased income and job opportunities, this shows that mastery of hard skills has an impact on economic value.

As technology advances towards the industry 5.0 era, attention to graduates' soft skills mastery is increasing. Polednov & Moln (2023) stated that currently soft skills such as communication skills and teamwork are now determining factors in work success, especially in digital and collaborative work. Strengthening soft skills learning in vocational education is also emphasized by Bisschoff & Massyn (2025) who stated that it is important for graduates to have interpersonal skills, empathy and work ethics as part of work readiness before they enter the industrial world.

In developing countries such as Indonesia, Kholifah et al. (2025) emphasized that career choices in vocational education are not only influenced by the hard skills they have, but also by an individual's ability to act which has a close relationship with soft skills. This shows that psychological aspects and self-confidence also play an important role in the formation of graduate work competencies. In addition, in developing countries such as Europe, Marcato (2023) explains that the modern job market tends to require workers who not only have mastery of hard skills but also have soft skills which include skills in mastering data literacy, complex communication and good time management as part of the minimum qualifications in the company.

Meanwhile, Fareri et al. (2023) explained that there is a gap in industrial digital skills which shows that the hard skills possessed by graduates must be combined with digital skills and technological literacy, as a transition towards energy efficiency and digitalization. In line with this, in his research Miller (2020) stated that currently vocational education emphasizes the need for synergy between technical skills, cognitive skills and positive work attitudes as a response to the challenges of increasingly complex global economic development. In addition, through the integration of technology in education, it also requires a combination of hard skills and soft skills. In his study Gupta & Datta (2023), he stated that personal and contextual factors such as attitudes towards technology and institutional support determine the success of technology in learning.

An individual's ability to recognize their potential also contributes to deciding on a career and students' readiness to enter the workforce. In line with this, Waichun & Seeshing (2022) explained that cognitive and effective self-awareness has an influence on students' decisions in choosing a career, this shows that graduate competence is not only determined by the hard skills they have, but also by social sensitivity and the ability to adapt in the work environment. Mcgrath & Yamada (2023) explained that the importance of life skills and real work experience, such as work ethics and social skills, are very relevant for vocational graduates, especially in the context of developing countries.

Several existing studies indicate that there are still gaps in the competency development of vocational education graduates, particularly in terms of the balanced and comprehensive integration of hard and soft skills. Most current vocational education curricula still focus on mastering technical hard skills. Dai & Martins (2024) highlights that communication skills, teamwork, and work ethic have received particular attention in the industry 5.0 era. Furthermore, studies conducted by Fareri et al. (2023) and Gupta & Datta (2023) indicate gaps in digital skills and technological readiness, which have yet to be integrated into vocational education. Meanwhile, psychological aspects and individual awareness also play a crucial role in preparing for work readiness and choosing a future career. This finding aligns with research by Kholifah et al. (2025) and Waichun & Seeshing (2022), which suggest that there are still gaps in students' understanding of psychological aspects, which ultimately influence their career choices.

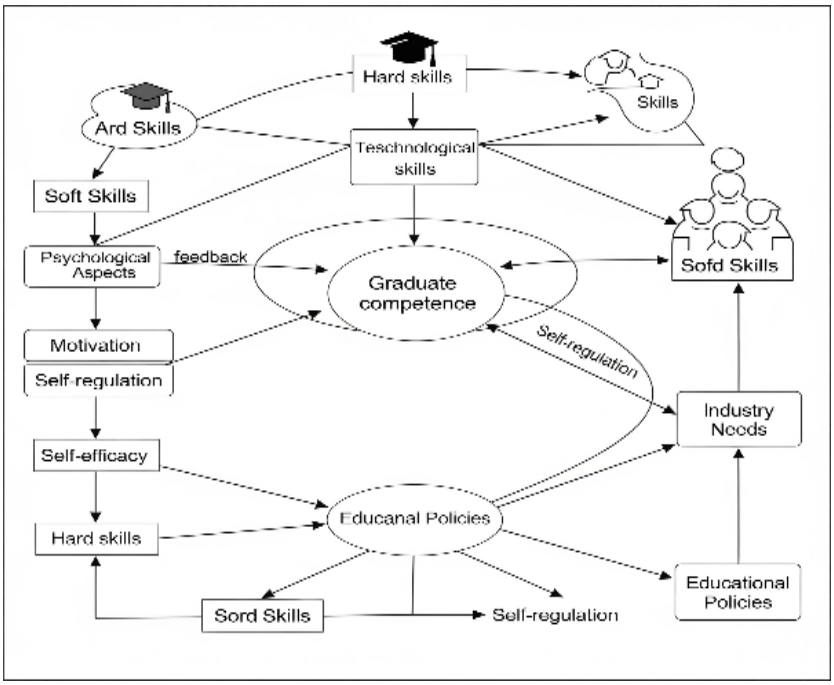

Figure 2. Hard skills and soft skills

It can be explained that the needs of the industry drive educational policies and vocational programs in the development of hard skills, soft skills and technological skills. To produce high-quality vocational education graduates. Competent graduates will later meet the needs of the industry and in the formation of future education policies. In creating a sustainable feedback environment, it will ensure that vocational education will continue to adapt and produce a workforce that is relevant to the dynamics of the current world of work.

3.3 The role of educators and training

Educators in vocational education have an important role in delivering materials and ensuring the achievement of competency-based learning objectives. In addition, they also play a role in academic guidance, facilitating practical skills, integration between educational institutions and the world of work, and participating in the formation of students' professional identities. Along with the complexity of the role of teachers and lecturers, the need for systematic and ongoing training is increasingly urgent.

In their research Zhou et al. (2022) emphasized that vocational education lecturers need to take part in professional learning that is continuous and in line with the dynamics of industry needs. Vocational education lecturers need a structured training strategy, including formal training, professional collaboration and in-depth practical reflection, in order to improve the quality of learning and self-development. This is reinforced in research Tacconi & Perini (2020) which shows that in case studies of teachers in Italy and Lithuania who took part in pedagogical training in the context of competency-based curriculum reform had an influence on a more flexible, participatory, and relevant learning approach to the context of the world of work. This shows that the training attended by educators is not only a means of increasing knowledge, but also as a mechanism for adapting to changes in policy and curriculum.

The development of professional identity of teachers and lecturers, Antera & Ter (2024) explains that in the process of forming the identity of vocational education lecturers, it is greatly influenced

by training security and participation in the community of practice. This explains that research not only improves technical skills but also strengthens the self-confidence and professional position of lecturers in the scope of education. Jin et al. (2022) studied that through training programs, it can increase effectiveness in teaching and critical reflection on teaching practices. Not only that, the role of lecturers in vocational education also includes functions in academic guidance, (N. Wang et al., 2024) stated that students need lecturer guidance in helping to determine career direction and develop their students' problem-solving skills.

Along with the development of technology, Educators are required to better understand the development of technology and awareness of renewable energy, if there is no appropriate training, teachers cannot transfer technological competencies to students effectively Patel & Oghazi (2024). In addition, through the implementation of a dual education system (Vocational Education and Training/VET) in Spain, it shows that through training for educators it is very influential in managing integrated learning between industry and industry (Laura, 2025). Thus, the various results of these studies explain that the role of Educators in vocational education is very strategic and requires strengthening of competencies through continuous training. Proper training not only improves understanding and teaching skills but also has a direct impact on the quality of graduates produced, especially in producing competent vocational graduates who are adaptive to changes in the work needs of the industrial world.

Based on previous research, several gaps remain. Studies by Zhou et al. (2022) and Tacconi & Perini (2020) emphasize the importance of formal research strategies, but these studies have limitations in specific countries, making the results less relevant for broader application, including to vocational education systems in developing countries. Furthermore, research conducted by N. Wang et al. (2024) highlights that aspects of academic and career guidance are still under-studied empirically regarding their impact on graduates' work readiness. Furthermore, research conducted by Laura (2025) on the dual education system VET focuses more on short-term implementation, resulting in a lack of explanation regarding the long-term impact of educational training on school-work integration. Therefore, further research is needed that can address these limitations through cross-contextual studies, longitudinal analysis, and in-depth evaluation of the effectiveness of ongoing training for vocational educators.

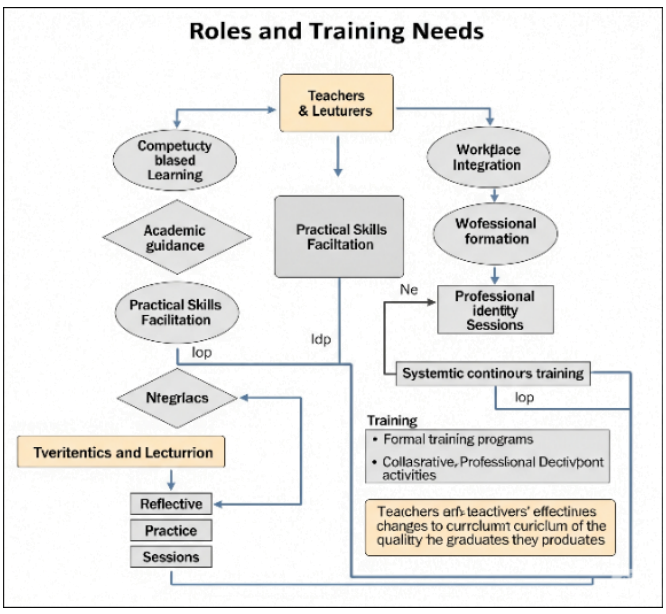

Figure 3. Roles and training needs

3.4 Innovation and technology in vocational learning

In the 21st century like today, innovation and utilization of technology in vocational learning have become strategies in responding to the challenges of globalization and the development of modern industry. Technologies such as virtual reality (VR) and augmented reality (AR) have been proven to create innovative and interactive work environments. In line with the results of the study, Thomann et al. (2024) showed that the use of VR in vocational education can significantly increase students' understanding of concepts and motivation to learn independently. This is reinforced by the study Bermejo et al. (2023) which concluded that through the use of VR/AR-based learning media will have a positive impact on the cognitive, effective and behavioural aspects of students in vocational education.

Artificial intelligence (AR) has played a crucial role in the transformation of vocational education. Through AR technology, personalization of learning, analysis of individual learning needs and efficiency in the evaluation and feedback process are possible. Prasetya et al. (2025) stated that through AI, it not only accelerates the learning process but also makes a real contribution to achieving sustainable development goals (SDGs) in the education sector. In addition, X. Wang & Cao (2025) explained that the use of cloud computing learning media also supports vocational education by providing digital infrastructure that allows for flexible, collaborative and data-based learning access. This media has been proven to be able to significantly improve learning outcomes.

In addition, the use of mixed reality (MR) learning media which is a combination of real and virtual worlds has been identified as an approach to practice-based learning. Bödding et al. (2025) stated that MR has a major influence on improving vocational learning outcomes, both in terms of cognitive and technical skills. In addition, the gamification innovation approach and game-based learning have been applied and have shown positive results in increasing student motivation, involvement and enthusiasm in vocational learning. Zuo et al. (2025) highlighted that this approach can support the creation of lifelong learning and strengthen students' readiness to face the world of work Shamzzuzoha et al. (2022) stated that in the context of sustainable development, vocational learning has also begun to integrate technology and innovation that support the application of *green skills,* such as in energy efficiency and environmentally friendly technology. This is in line with the integration and sustainable development agenda in 2030.

Based on the studies contained in the referenced research, there are still several gaps that require attention. Research conducted by Thomann et al. (2024) and Bermejo et al. (2023) which discuss the effectiveness of VR/AR in improving understanding of concepts and learning motivation, however, these studies still focus on short-term results and do not explain the work readiness of vocational graduates in a real industrial context. Meanwhile, research by Prasetya et al. (2025) and Bödding et al., (2025) which discusses the use of AI, Cloud Computing, MR, still does not provide a picture of the relationship between cross-technology in building sustainable vocational learning. Furthermore, most studies still emphasize the use of educational technology in students, but do not discuss the readiness of educators in implementing learning. On the other hand, studies on the integration of green skills in vocational education, as proposed by Shamzzuzoha et al. (2022) is still conceptual and lacks empirical evidence, and in general, previous research has not explored the real impact of utilizing this technology on increasing the employability of vocational graduates and the acceptance of their skills in the world of work.

4. Discussion

Findings of this study highlight that the responsiveness of vocational education to the demands of the labor market cannot be separated from four interrelated factors: collaboration with industry, integration of hard and soft skills, the central role of educators, and the application of learning technology. These factors are not isolated; rather, they form a systemic framework that determines the relevance and competitiveness of vocational education. The strong collaboration between vocational institutions and industry illustrates the strategic importance of curriculum alignment with market needs. This partnership not only reduces the skills gap but also enhances graduates' confidence in entering the workforce. In practice, such collaboration shifts vocational education from being supply-driven to demand-driven, thereby increasing its social and economic value.

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Finally, the adoption of innovative technologies such as VR, AR, and AI marks a transformative phase in vocational learning. These tools are not merely supplementary media but serve as enablers that enhance experiential learning, improve efficiency, and prepare students for technologically advanced workplaces. However, their integration requires careful consideration of pedagogical design and educator readiness. Overall, the discussion reinforces that vocational education must be understood as a dynamic system that continuously adapts to industrial, technological, and societal transformations. The significance of the findings lies in providing a comprehensive framework that policymakers, educators, and industry stakeholders can use to strengthen vocational education as a driver of human resource development and sustainable economic growth.

5. Conclusion

The conclusion that can be drawn from the research using the *systematic literature review method* shows that vocational education has a strategic role in producing competent human resources who are ready to work amidst the dynamics of the industry that continues to grow. A review of 30 international articles indexed by *Scopus* identified four main findings that are critical factors in increasing the sensitivity of vocational education to the needs of the world of work, namely:

1. Effective collaborative relationships between vocational education and industry in aligning the curriculum with current market needs.
2. Strengthening between *hard skills* and *soft skills* by graduates in responding to competent challenges in the 21st century
3. The role of teachers and lecturers, which needs to be implemented with ongoing professional training in order to align learning with the dynamics of industry needs.
4. Integration of innovation and learning technology such as the use of VR, AR and IA which can be used to improve the learning outcomes of vocational students.

Understanding these factors is very important because it will be used as a basis for designing

relevant, adaptive and highly competitive vocational education policies. Without a comprehensive approach to these aspects, vocational education will find it difficult to produce graduates who are ready to enter the workforce and contribute to national economic development.

Author's declaration

Author contribution

Febriani Lukitasari: Conceptualization, methodology design, drafting of manuscript, data analysis, and correspondence. **Tri Wrahatnolo**: Critical revision of the manuscript, theoretical framework development, and validation. **Ratna Suhartini**: Data curation, literature review, and editing. **Anistian Nur Azizah**: Data collection, literature review, and proofreading.

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Conflict of interest

The authors declare that there is no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

Ethical clearance

This research does not involve humans as subjects.

AI statement

Grammar checking was conducted using Grammarly, and sentence coherence was improved using ChatGPT. The authors have carefully rechecked all sentences to ensure alignment with the research topic and accuracy of the data. The language quality of this article has also been validated and verified by an English language expert from Universitas Negeri Surabaya

Publisher's and Journal's note

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