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Developing Digital Literacy and Artificial Intelligence-Based Innovative Learning to Enhance the Quality of Senior High School Graduates in Gresik Regency

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Abstract. The development of digital technology and artificial intelligence (AI) has driven significant transformations in educational practices, particularly in enhancing the quality of learning and graduate competencies. Senior high schools are increasingly required to adapt by developing innovative learning practices that integrate digital literacy and AI. However, research on the implementation of digital literacy- and AI-based learning in public and private senior high schools in regional areas, particularly in Gresik Regency, remains relatively limited. This study aims to analyze the development of innovative learning based on digital literacy and AI to improve the quality of graduates from public and private senior high schools in Gresik Regency. This study employed a qualitative approach with a case study design. Data were collected through interviews, observations, and documentation involving school principals, teachers, students, and educational stakeholders. The data were analyzed interactively through data condensation, data display, and conclusion drawing. The findings indicate that the integration of digital literacy and AI facilitates the development of learning practices that are more innovative, interactive, flexible, and student-centered. The utilization of these technologies contributes to strengthening students' critical thinking, creativity, problem-solving skills, and technological adaptability. The findings further demonstrate that the effectiveness of AI utilization is not determined by technology alone but is influenced by teachers' capacity to integrate technology with pedagogical strategies and learning objectives. Sustaining educational innovation requires collaborative support among schools, government, educators, and the wider community. This study generates an empirical model demonstrating that digital literacy and AI serve as instruments of pedagogical transformation that, through interactive and student-centered learning, contribute to improving graduate quality. The study provides implications for the development of more contextualized and sustainable technology-based learning policies and practices in senior high schools in Gresik Regency.

Keywords: *Digital Literacy; Artificial Intelligence; Innovative Learning; Graduate Quality; Senior High Schools.*

Abbreviations: There are no abbreviations such as AI and others used in the abstract. This is because the term "artificial intelligence" is written in full and is not abbreviated as AI..

INTRODUCTION

The rapid advancement of digital technology has brought about fundamental changes across various aspects of life, including the field of education. [1] Digital transformation is no longer limited to the use of technological devices as supplementary tools for learning; rather, it has evolved into an integral component of the educational process, encompassing instructional planning, the provision of learning resources, learning implementation, assessment, and the development of students' competencies. The emergence of various digital platforms, online learning resources, communication technologies, and artificial intelligence (AI) has created new opportunities for educational institutions to develop learning processes that are more adaptive, interactive, personalized, and responsive to students' needs.. [2] This condition requires schools not merely to keep pace with technological developments but also to strategically integrate technology into the educational process in order to produce graduates with competencies aligned with the demands of a rapidly changing world. [3].

This transformation is particularly important at the senior high school level, as students at this stage are expected to develop the competencies necessary either to pursue further education or to participate effectively in social life and the workforce. [4] Graduate quality can no longer be determined solely by the mastery of academic knowledge but also by students' abilities in critical thinking, creativity, problem-solving, communication, collaboration, digital literacy, and adaptation to technological developments. [5] Therefore, learning at the senior high school level needs to shift from a content-delivery-oriented approach

toward a learning paradigm that encourages students to actively seek, process, evaluate, and generate knowledge by responsibly utilizing diverse sources and technologies.

One of the increasingly important competencies in the transformation of education is digital literacy. [6] Digital literacy is not merely understood as the ability to operate computers, smartphones, applications, or the internet; rather, it encompasses students' capacity to access, understand, evaluate, use, create, and communicate information through digital technologies effectively, critically, ethically, and responsibly. [7] Accordingly, the development of digital literacy in learning is closely associated with improvements in the quality of both educational processes and outcomes. Digitally literate students are not merely technology users; rather, they are expected to become independent learners who are critical in evaluating information, creative in generating ideas, and capable of leveraging technology to address a wide range of academic and real-world problems.

In addition to digital literacy, the advancement of artificial intelligence (AI) has introduced a new dimension to educational practices. [8] AI technologies can be utilized to support information retrieval, instructional material development, personalized learning, feedback provision, idea generation, simulation, problem-solving, and assist teachers in developing more adaptive learning strategies. [9] For students, the use of AI can broaden access to learning resources and enable learning processes to take place in a more flexible manner. [10] However, the use of AI in education also presents several challenges, particularly regarding students' ability to verify information, maintain academic integrity, understand the ethical use of technology, and avoid excessive dependence on technological tools. Therefore, the integration of AI into learning should be positioned as a pedagogical instrument that enhances students' thinking and learning processes rather than as a substitute for the role of teachers or for students' own cognitive processes.

In this context, innovative learning based on digital literacy and artificial intelligence has become a strategic necessity for schools seeking to improve the quality of education. [11] Learning innovation is not merely concerned with the adoption of new technologies but also involves transforming how teachers design learning experiences, how students acquire knowledge, and how schools develop learning ecosystems that support the effective use of technology. [12] Digital- and AI-based learning can foster more interactive, flexible, collaborative, and student-centered learning environments. Through the appropriate use of technology, students can be provided with greater opportunities to explore information, develop ideas, conduct analyses, solve problems, and produce meaningful work. [13] Thus, technology-based learning innovation has the potential to contribute to a more comprehensive enhancement of graduate competencies.

Nevertheless, the implementation of digital literacy- and AI-based learning cannot be separated from the specific conditions and characteristics of individual educational institutions. [14] Differences between public and private schools, the availability of digital infrastructure, teacher competence, school leadership, school culture, student readiness, parental support, as well as government and community engagement may influence the successful implementation of learning innovations. [15] Schools with relatively adequate technological facilities do not necessarily achieve high-quality digital learning if these facilities are not accompanied by adequate teacher competence and supportive school policies. Conversely, limited technological resources do not always constitute an absolute barrier when schools are able to foster creativity and collaboration and develop effective strategies for optimizing available resourcesl. [16] Therefore, research on digital literacy- and AI-based learning needs to examine its implementation comprehensively, not only in terms of technology utilization but also from pedagogical, managerial, human resource, school culture, and educational ecosystem support perspectives.

Gresik Regency provides an important context for examining this issue. As a region characterized by dynamic social, economic, industrial, and educational development, Gresik faces increasing demands to prepare human resources capable of adapting to technological change. The presence of public and private senior high schools with diverse characteristics, resources, and educational environments provides an interesting context for understanding how learning innovations based on digital literacy and AI are developed and implemented. In this context, improving graduate quality is not solely the responsibility of teachers and schools but requires support from various stakeholders, including local governments, parents, communities, the business and industrial sectors, and other parties committed to advancing education.

The issue that subsequently arises is not simply whether schools have adopted digital technology or AI in learning, but rather how these technologies are integrated into the learning process so that they can genuinely contribute to improving graduate quality. This question is particularly important because the use of digital devices does not automatically indicate a transformation in learning practices. Technology may be used merely as a tool for delivering instructional content, while patterns of interaction, teaching strategies, and the overall orientation of learning remain conventional. [17] Similarly, the use of AI without adequate digital literacy may create new challenges, including technological dependence, the use of

unverified information, and a decline in students' capacity for independent thinking. Therefore, an approach is needed that positions digital literacy and AI as integral components of pedagogical innovation, systematically designed to develop students' competencies.

On the other hand, research on educational technology has predominantly focused on higher education institutions, schools in urban areas, or educational settings with relatively adequate technological support. [18] Meanwhile, research specifically examining how digital literacy and artificial intelligence are integrated into learning innovations in public and private senior high schools in regional settings such as Gresik Regency remains relatively limited. This research gap highlights the need for studies that go beyond describing technology use to critically examining the processes underlying the development of learning innovations, the strategies adopted by schools and teachers to integrate technology, students' responses, enabling and constraining factors, and the contribution of such innovations to improving graduate quality.

This study is increasingly important because graduate quality in the era of digital transformation needs to be understood from a broader perspective. High-quality graduates are not merely those who achieve high academic scores but also those who are able to think critically and creatively, solve problems, adapt to technological change, use information responsibly, and engage in lifelong learning. From this perspective, learning innovations based on digital literacy and AI can serve as a strategic approach to bridging educational needs with the competency demands of the twenty-first century. However, the success of such an approach depends largely on schools' capacity to develop a learning ecosystem that integrates technology, pedagogy, teacher competence, school leadership, and the engagement of diverse stakeholders.

Based on the foregoing discussion, it can be understood that the advancement of digital technology and artificial intelligence presents both opportunities and challenges for improving the quality of education at the senior high school level. Schools are therefore required to develop learning innovations that not only keep pace with technological developments but also utilize technology meaningfully to enhance students' competencies and graduate quality. In the context of public and private senior high schools in Gresik Regency, empirical investigation is needed to examine how learning innovations based on digital literacy and AI are developed, implemented, and contribute to improving graduate quality. This study is expected to provide a more comprehensive understanding of technology-based learning innovation practices while identifying empirical patterns or models that can serve as references for schools in developing learning practices that are responsive and adaptive to technological developments..

Thus, research on the development of learning innovations based on digital literacy and artificial intelligence to improve the quality of graduates from public and private senior high schools in Gresik Regency holds both academic and practical relevance. Academically, this study is expected to enrich the body of knowledge on learning innovation, digital literacy, and the use of artificial intelligence in the context of secondary education. Practically, the findings are expected to provide recommendations for school principals, teachers, local governments, and educational stakeholders in developing an effective, ethical, and sustainable technology-based learning ecosystem. Furthermore, this study is expected to generate an empirical model for developing learning innovations that strengthens collaboration among schools, government, educators, communities, and other stakeholders, thereby ensuring that the use of digital technology and AI is genuinely oriented toward improving the quality of learning processes and graduate outcomes in Gresik Regency.

METHODS

This study employed a qualitative approach with a case study design to examine the development and implementation of innovative learning based on digital literacy and Artificial Intelligence (AI) in improving the quality of senior high school graduates in Gresik Regency, East Java, Indonesia. The research was conducted in selected public and private senior high schools that had implemented digital technology and/or AI in the learning process. [19]

Participants were selected through purposive sampling and consisted of school principals, teachers, students, and relevant educational stakeholders. [20] Data were collected through in-depth interviews, observations. Interviews explored school policies, teacher practices, student experiences, technology integration, learning innovation, challenges, and the contribution of digital literacy and AI to graduate competencies. Observations were conducted to examine the implementation of technology-based learning, while documentation was used to support and verify the findings [21].

Data were analyzed interactively through data condensation, data display, and conclusion drawing and verification. The analysis focused on four main themes: digital literacy, AI integration, learning innovation, and graduate quality, particularly students' critical thinking, creativity, problem-solving, and technological adaptability [22].

The credibility of the findings was ensured through source and method triangulation, member checking, and continuous comparison of interview, observation, and documentary data. Ethical principles were maintained by obtaining participants' consent, protecting their identities, and ensuring that the data were used solely for research purposes. [23]

RESULTS AND DISCUSSION

Result-1: Development of Learning Innovations Based on Digital Literacy and Artificial Intelligence (AI)The first finding indicates that public and private senior high schools in Gresik Regency have begun to develop learning innovations by integrating digital technology and AI into the learning process. This integration is implemented through the utilization of digital platforms, internet-based learning resources, interactive learning media, and various applications that support students' learning activities.

The use of technology is not limited to delivering instructional content but also serves to assist students in searching for information, exploring learning materials, developing ideas, completing assignments, and identifying alternative solutions to problems. These findings indicate a shift from a predominantly teacher-centered learning approach toward a learning process that provides students with greater opportunities to independently access, explore, and process information.

Result-2 Integration of AI to Support the Learning Process

The second finding indicates that AI has begun to be used as a supplementary resource in the learning process. The use of AI facilitates students' access to information, enables them to seek additional explanations, develop ideas, and explore alternative solutions to various problems.

For teachers, the availability of AI also provides an alternative means of developing learning resources and activities. However, the use of AI still requires teacher guidance, as AI-generated information needs to be verified, cross-checked, and aligned with the learning context. This finding indicates that AI in learning primarily functions as a supportive tool that facilitates the learning process rather than as a substitute for the role of teachers..

Result-3 Enhancing Critical Thinking, Creativity, and Problem-Solving Skills

The third finding demonstrates the contribution of digital literacy- and AI-based learning to the development of students' cognitive competencies. Students are provided with greater opportunities to seek information from multiple sources, compare information, develop ideas, and explore alternative solutions to problems. These processes contribute to the development of three key competencies: Critical thinking, through activities involving the retrieval, comparison, evaluation, and verification of information. Creativity, through the exploration of diverse ideas and the development of alternative solutions; and problem-solving, through the utilization of various information sources and technologies to identify solutions to learning-related problems.

These findings indicate that the use of technology provides students with greater opportunities to engage in learning activities that require higher-order thinking processes.

Result-4 Fostering More Interactive, Flexible, and Student-Centered Learning

The fourth finding indicates that the integration of digital platforms and AI has transformed the characteristics of the learning process, making it more interactive, flexible, and student-centered.

Learning becomes more interactive as students are able to engage with various digital learning resources, instructional media, teachers, and peers. Learning also becomes more flexible because students have greater opportunities to access learning resources according to their needs and learning circumstances.

Meanwhile, the student-centered nature of learning is reflected in the increased opportunities for students to seek information, explore learning materials, develop ideas, and complete learning activities more independently. This finding also indicates a shift in the teacher's role, from being predominantly an information provider to functioning more extensively as a facilitator, mentor, and guide throughout the learning process.

Result-5 Enhancing Technological Adaptability as a Key Component of Graduate Quality

The fifth finding indicates that digital literacy- and AI-based learning contributes to students' ability to adapt to technological developments. Students become increasingly familiar with using various digital resources and platforms throughout the learning process.

Technological adaptability is reflected in students' ability to respond to changes in learning media and resources, utilize technology to complete learning activities, and adjust to technological developments within the educational environment.

Thus, graduate quality in the context of digital transformation is demonstrated not only through the mastery of academic knowledge but also through the ability to think critically and creatively, solve problems, and adapt to technological developments.

Result- 6 Collaboration as a Driver of Sustainable Learning Innovation

The sixth finding indicates that the development of digital- and AI-based learning requires the support and collaboration of multiple stakeholders. Schools, government, teachers, and communities all play important roles in creating an environment conducive to the effective use of technology in education.

Such collaboration is essential for strengthening educational policies, enhancing educators' competencies, providing and optimizing technological resources, and fostering learning environments that support innovation. Thus, the sustainability of digital- and AI-based learning innovation depends not only on schools' capacity to utilize technology but also on the support of the broader educational ecosystem.

Discussion

Pengembangan Inovasi Pembelajaran Berbasis Literasi Digital dan AI

The findings of this study indicate that public and private senior high schools in Gresik Regency have begun to develop learning innovations Learning is increasingly being developed through the integration of digital literacy and Artificial Intelligence (AI). This integration is reflected in the utilization of digital platforms, online learning resources, interactive instructional media, and AI to support information retrieval, exploration of learning materials, idea development, and the completion of learning tasks. These findings indicate a shift in the function of technology, from merely serving as a supplementary learning tool to becoming an integral component of students' learning environments.

This transformation is significant because learning innovation in the digital era cannot be assessed solely based on the availability of technological devices or applications used by schools. A more substantive indicator lies in the pedagogical changes that occur following the integration of technology. When technology enables students to access broader sources of information, explore learning materials independently, and obtain alternative solutions to problems, it begins to transform the learning experience itself.

These findings can be explained through the framework of Technological Pedagogical Content Knowledge (TPACK). TPACK emphasizes that the successful integration of technology depends on teachers' ability to combine technological knowledge, pedagogical knowledge, and content knowledge in the design and implementation of learning. [24] Thus, the use of AI cannot be separated from teachers' competence in designing meaningful learning experiences. AI provides educational value when its use is intentionally aligned with learning objectives rather than merely driven by the pursuit of technological advancement.

These findings can also be understood through the Technology Integration Matrix (TIM) and the SAMR model. [25] At the lowest level of technology integration, technology merely substitutes conventional tools, whereas at higher levels, it can modify and even transform the learning experience. The use of digital platforms and AI for information exploration, idea development, and problem-solving demonstrates that schools have opportunities to move beyond administrative digitalization toward pedagogical transformation.

Thus, the findings of this study indicate that digital- and AI-based learning innovation in senior high schools in Gresik Regency is not merely a matter of technology adoption but rather a process of transforming how students learn and how teachers manage learning. Technology serves as an instrument, whereas pedagogical transformation constitutes the substantive dimension of the innovation.

Integrating AI to Support the Learning Process

Temuan kedua menunjukkan bahwa AI mulai dimanfaatkan untuk membantu peserta didik memperoleh informasi, mendapatkan AI provides students with additional explanations, facilitates idea development, and enables them to identify alternative solutions to problems. For teachers, AI also offers alternative means of developing learning resources and learning activities.

These findings illustrate the role of AI as a learning support system. AI expands students' access to learning resources and creates opportunities for learning processes that are more responsive to individual needs. Students do not always have to wait for explanations from teachers when they require additional information, as technology enables them to explore learning resources more flexibly.

Theoretically, this condition can be explained through Vygotsky's theory of social constructivism, particularly the concept of scaffolding. Within this perspective, AI can function as a supplementary source of support that assists students in performing tasks, exploring information, and developing understanding that may initially be difficult to accomplish independently. However, such support should remain guided by

teachers to ensure that AI-mediated learning contributes to meaningful knowledge construction rather than fostering dependence on technology. [26] In learning, scaffolding refers to the support provided to help students complete tasks that they are not yet able to perform independently. In the context of AI-based learning, technology can function as an additional form of support by providing explanations, examples, questions, and alternative sources of information.

However, the findings also indicate that the use of AI requires continued teacher guidance. This is important because AI does not always generate information that is accurate, complete, or appropriate to the learning context. Therefore, the use of AI should be positioned within a framework of human–AI collaboration rather than human replacement.

This perspective is consistent with the concept of AI literacy, which emphasizes the ability to understand, evaluate, and use AI critically as an essential component of students' competencies. Students need not only to know how to use AI but also to understand its limitations and critically assess the quality and reliability of the information it generates.

Thus, the findings demonstrate that the effectiveness of AI does not lie merely in its ability to generate answers rapidly but in its capacity to expand students' learning opportunities without displacing human thinking and cognitive processes.

Developing Critical Thinking, Creativity, and Problem-Solving Skills

The third finding represents one of the key findings of this study, indicating that digital literacy- and AI-based learning contributes to the development of students' critical thinking, creativity, and problem-solving skills.

The finding concerning critical thinking can be explained through Bloom's Taxonomy. [27] Within this framework, higher-order thinking skills encompass analyzing, evaluating, and creating. Digital learning environments provide access to diverse sources of information, giving students greater opportunities to compare information and evaluate alternative possible answers.

However, the availability of abundant information does not automatically result in the development of critical thinking. Critical thinking develops when students are engaged in tasks that require them to question information, verify its accuracy, compare sources, provide reasoned arguments, and draw conclusions.

In the context of AI, this process becomes more complex. AI can generate answers rapidly, but these responses still need to be verified. When students accept AI-generated answers without further examination, the technology may reduce their cognitive engagement. Conversely, when students are encouraged to critically examine AI-generated responses, compare them with other sources, identify limitations or inaccuracies, and formulate their own arguments, AI can instead serve as a stimulus for critical thinking [28].

Meanwhile, the enhancement of problem-solving skills can be explained through the principles of Problem-Based Learning (PBL). Within this approach, students learn through problems that require processes of problem identification, information seeking, analysis, the development of alternatives, and the determination of appropriate solutions. Digital technology and AI expand the range of resources that can be utilized throughout these processes.

Thus, these three competencies are interconnected through a continuous process involving digital literacy, information exploration, information evaluation, idea development, and problem-solving.

These findings indicate that the primary benefit of technology lies not merely in accelerating access to information but also in expanding students' cognitive space to think, create, and solve problems.

Transforming Learning into a More Interactive, Flexible, and Student-Centered Process

The fourth finding indicates that the use of digital platforms and AI has contributed to making the learning process more interactive, flexible, and student-centered. Learning becomes more interactive as students have greater opportunities to engage with digital learning resources, instructional materials, teachers, and their broader learning environment. Learning also becomes more flexible because information resources can be accessed through various platforms and are no longer entirely constrained by the physical classroom or conventional time boundaries.

These findings reinforce the principles of Student-Centered Learning, which position students as active agents in the learning process. [29] Technology provides students with greater opportunities to explore, engage with learning resources, and construct knowledge independently.

This perspective can also be further supported by Self-Determination Theory, particularly its dimensions of autonomy and competence. [30] When students are given opportunities to seek information and determine how to explore learning materials, they gain greater autonomy in the learning process.

However, student-centered learning does not imply that teachers become less important. Rather, it entails a transformation in the teacher's role. Teachers move from being predominantly information providers to becoming learning experience designers, facilitators, mentors, and evaluators.

This transformation is important because, although technology can provide information, it cannot fully replace the pedagogical functions of teachers in understanding students' characteristics, providing contextual guidance, fostering motivation, and directing the process of knowledge construction. Thus, digital transformation in learning fundamentally involves a transformation in the roles of both teachers and students

Technological Adaptability as a New Dimension of Graduate Quality

The fifth finding indicates that digital literacy- and AI-based learning contributes to students' ability to adapt to technological developments. Students become increasingly familiar with interacting with various platforms, digital resources, and technologies used in the learning process.

This finding is significant because technological developments are occurring at an unprecedented pace. Technologies that are widely used today may change or even be replaced in the future. Therefore, education should not merely teach students how to use specific applications but should also foster their capacity to learn and adapt to emerging technologies.

This perspective is consistent with the concepts of 21st-century skills and learning agility, which position adaptability as an essential competency for navigating continuous change.. [31] Thus, technological adaptability does not merely indicate students' ability to operate digital devices but also reflects their capacity to respond productively to changes in the technological environment.

In the context of graduate quality, this finding broadens the conceptualization of what constitutes a high-quality graduate. Quality graduates are not merely those who possess strong academic knowledge but also those who are able to: think critically, generate creative ideas, solve problems and adapt to technological developments.

In other words, graduate quality is becoming increasingly multidimensional, encompassing not only academic achievement but also cognitive, creative, problem-solving, and technological adaptability competencies.

Stakeholder Collaboration in Optimizing Learning Innovation

The sixth finding indicates that the development of digital- and AI-based learning requires collaboration among schools, government, educators, and communities.

This finding can be explained through Collaborative Governance Theory, which emphasizes that complex problems cannot be effectively addressed by a single actor alone. [32] Technology-based educational transformation is a multifaceted process involving policy, resources, human competencies, technology, ethics, and the broader social environment.

Schools occupy a central position as institutions responsible for translating technology-related policies into learning practices. Teachers serve as key actors in implementing technology pedagogically within the learning process. Governments play a strategic role in regulation, institutional support, and the provision of a supportive policy ecosystem. Meanwhile, communities constitute an important part of the social environment that contributes to the sustainability of educational transformation.

From the perspective of Diffusion of Innovations Theory, the sustainability of an innovation also depends on the extent to which it is accepted and adopted by individuals and organizations. [33] Innovations are more likely to develop and gain wider acceptance when their benefits are clearly perceived, aligned with existing needs, and supported by the surrounding environment.

Therefore, AI-based learning innovation cannot be developed solely through internal school policies. A collaborative ecosystem is required to enable schools to access technological support, strengthen teachers' capacities, implement relevant policies, and secure community support.

CONCLUSION

Based on the findings and discussion, it can be concluded that the development of innovative learning based on digital literacy and artificial intelligence (AI) in public and private senior high schools in Gresik Regency represents a form of pedagogical transformation that goes beyond the mere use of technology and focuses on improving the quality of learning processes and graduate competencies. The integration of

digital platforms and AI has provided students with greater opportunities to access information, explore knowledge, develop ideas, and address learning-related problems.

The implementation of digital literacy and AI contributes positively to the development of students' critical thinking, creativity, problem-solving, and technological adaptability. However, these contributions do not occur automatically through the use of technology alone but depend on pedagogically designed learning processes in which teachers function as learning designers, facilitators, mentors, and evaluators. Thus, the quality of technology utilization is largely determined by teachers' ability to integrate technology, pedagogy, and subject matter.

The integration of digital technology and AI also promotes learning processes that are more interactive, flexible, and student-centered. Students are provided with greater opportunities to engage actively in learning, explore diverse sources of information, develop ideas, and construct knowledge according to their learning needs. At the same time, the use of AI needs to be accompanied by digital literacy and teacher guidance to prevent technological dependence and instead strengthen students' thinking skills and learning autonomy.

This study further demonstrates that improving graduate quality through digital- and AI-based learning requires the support of a collaborative educational ecosystem. Schools, government, educators, and communities need to establish collaborative efforts to strengthen educational policies, teacher competencies, technology utilization, and the sustainability of learning innovation.

Thus, technology should not be regarded as the ultimate goal of educational transformation but rather as an instrument for creating more meaningful learning experiences and developing graduates who are capable of thinking critically and creatively, solving problems, and adapting to technological developments. These findings further underscore the importance of developing contextualized digital- and AI-based learning models that address the needs of public and private senior high schools in Gresik Regency and are supported by collaboration among all educational stakeholders.

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