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Technology-Based Curriculum Development Towards Sustainable Education

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A B S T R A C T

The development of the times goes hand in hand with the development of technology and science, which automatically influences the world of education. Technology and education have a close relationship. In Indonesia, technology has been integrated into the curriculum system. The Indonesian government still implements an independent curriculum with the use of technology. A technology-appropriate and oriented curriculum system not only improves the quality of education but also serves as a catalyst for sustainable social and economic transformation. This is an interesting area to research, particularly in understanding the value of technology use in the educational curriculum. The research employs a descriptive qualitative method. This literature review was compiled descriptively using secondary data from previous research conducted by other researchers. The compilation of this literature review began with identifying the problem, collecting library data, reading, taking notes, analyzing, and processing the collected data.The study, based on literature review, utilizes secondary data from existing studies. The research findings indicate that a curriculum system based on Information and Communication Technology (ICT) can create supportive learning environments. This is manifested in several ways, including engaging or interactive learning, more realistic learning experiences, more effective and efficient learning management, encouragement of independent learning, improved learning quality, flexible learning processes, and fostering positive responses in learning. Therefore, strategic support from various parties, including the government and educational institutions, is essential to optimize the benefits of ICT in supporting the quality of sustainable education in the digital era.

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INTRODUCTION

Education is essential for the progress of a nation and state. Modern education is developed through technology-based learning, from the entire teaching and learning process to the assessment stage. Education in the 21st century is characterized by a focus on student skills (Okpatrioka & Abdullah, 2024). The development of the times goes hand in hand with the development of technology and science (Huda, 2020). These developments automatically influence the world of education (Sundari et al., 2024). The reason is that the world of education will adapt to developments in technology and science. Every time a new technology emerges, the education sector not only becomes familiar with it but also strives to study and adapt it. In fact, the education sector is also capable of creating new technologies by studying and developing previous technologies.

Technology and education have a close relationship. Currently, students can search for information and access learning materials through the use of technology such as the internet, digital applications, mobile phones, and laptops. The presence of technology in the world of education has become a form of study and application of technology as a teaching and learning facility (Listyaningsih et al., 2024). According to Matachi A. (2006) in Nur'ariyani & Jumyati (2022), education consists of four pillars, including learning to know, learning to do, learning

to live together, and learning to be. These four pillars are optimized to address the challenges of the modern world. Therefore, educational institutions need to orient their curriculum development to be relevant to new demands and focus on technological developments. According to Ramdhan (2019) in Fathurrahman et al. (2024), the curriculum is a complex element that encompasses various dimensions.

In Indonesia, technology has been integrated into the curriculum system. According to Sabri (2009) in Suweta (2023), the main factors in the integration of technology and curriculum are manifested in the provision of technological infrastructure, the ability to adapt to technology, and the characteristics of the teaching and learning environment. The entire curriculum system in Indonesia utilizes technology for both students and educators. This is outlined in the Amendment to the Minister of Education, Culture, Research, and Technology Regulation Number 12 of 2024 concerning the Curriculum for Early Childhood Education, Primary Education, and Secondary Education.

The Indonesian government continues to implement the independent curriculum with the use of technology. However, the implementation of the independent curriculum still faces obstacles such as unequal access to technology in various regions. This poses a challenge in implementing the independent curriculum with the equitable use of technology (Farid et al., 2024). The use of technology is not merely a formality but is truly understood and applied by educators and accepted and adapted by teaching staff (Prihantini et al., 2024). Learning related to digital technology requires innovation and responsiveness to local needs and educational structures (Sundari et al., 2024) to achieve the goal of quality education. Quality and effective education can create a sustainable education model (Koelsoem & Kusmiyati, 2024). The reason is that the use of technology in learning can support and prepare students to enter society and handle challenges in the outside world and the digital world (Mekalungi et al., 2024) (Subagyo et al., 2024).

A technology-based and oriented curriculum system not only improves the quality of education but also serves as a catalyst for sustainable social and economic transformation (Athallah et al., 2025). According to Ansyar (2015) in Jaya et al. (2023), the concept of sustainable education is oriented toward continuous learning and adapting to developments across all sectors. Especially in the era of technological and digital development, sustainable education is realized through easy access to information, opportunities for online and offline learning, and a paradigm shift in understanding an effective curriculum system to give sustainable education a new momentum.

Based on the above explanation, it is interesting to conduct in-depth research, particularly in literature studies related to technology-based curricula and sustainable education. The aim is to understand how technology-based curricula are connected to sustainable education.

METHOD

Research methods are operational steps in research aimed at solving formulated problems to obtain accurate, objective, and scientific results. These research methods are expected to serve as a foundation for discovering, developing, and examining scientific truths. According to Sugiyono (2017), research methods are essentially scientific ways of obtaining data for specific purposes and uses. Based on this, there are four key words that need to be considered, namely scientific methods, data, objectives, and purposes. Scientific methods are research based on scientific characteristics, namely rational, empirical, and systematic. Rational means that research activities are carried out in a reasonable manner, so that they are accessible to human reasoning. Empirical means that the methods used can be observed by human senses, allowing others to observe and understand the methods employed. Systematic means that the process used in the research follows specific logical steps. Based on the above explanation, it can be concluded that a research method is a scientific approach to obtaining data with specific objectives and purposes.

Type of Research

This literature review was compiled descriptively using secondary data from previous research conducted by other researchers. The compilation of this literature review began with identifying the problem, collecting library data, reading, taking notes, analyzing, and processing the collected data. The data was then compiled into a systematic review. The stages of the literature review compilation method are shown in the figure below.

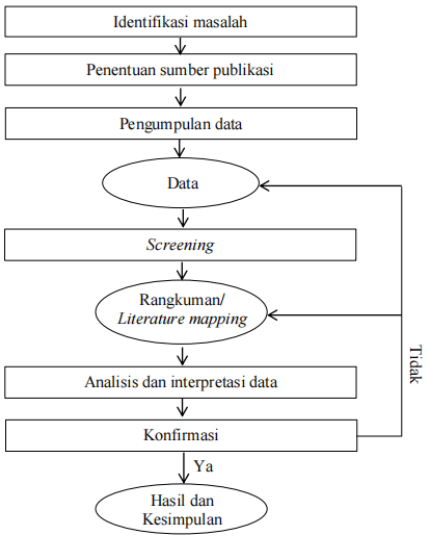

Figure 1. Literature Review Method

Source: Fink (2013)

The method of compiling a literature review is generally divided into two stages. The first stage involves data collection, which consists of identifying the problem, determining the sources of literature based on eligibility criteria and inclusion or exclusion criteria, collecting data, and sorting (screening) based on the suitability of the literature to the topic being discussed. The second stage involves processing the sorted data, which includes analyzing and interpreting the data as well as confirming the data. Confirmed data will be used as references in the discussion, while unconfirmed data will be resorted.

Determination of References

Data sources are the origin from which the data is obtained or acquired. The existence of data is to be able to present sources of information as the subject of study or analysis tools used by researchers. According to (Arikunto, 2010), the data sources referred to in research are the subjects from which data can be obtained. The literature data used must be at least 20 in number and sourced from journals and scientific articles accessed from scientific journal databases such as Sinta, ScienceDirect, and Springer, with a reference year limit of 5 years as a reference for theory, reliable, credible, and valid research results, as well as academic books related to the topic of this literature review.

The criteria for the suitability of the journal or book used are as follows: (1) scientific sources that have undergone peer review, (2) journals with a reputation based on impact factor (SCImago Journal Country Rank) and accredited under Sinta 6, 5, 4, 3, 2, or 1, (3) websites under renowned organizations or institutions, (4) academic books containing information and data relevant to the discussion, (5) academic books published by universities and/or professional associations that provide extensive bibliographies to enhance credibility, and (6) research data that has not been published (unpublished results) explicitly in the bibliography.

The collected literature data will be sorted based on criteria that must be met as requirements for inclusion in the review (inclusion criteria) and specific criteria that render the literature ineligible for inclusion in the review (exclusion criteria) (Fink, 2013). These criteria are listed in the table below:

Table 1. Inclusion and Exclusion Criteria for References

Type	Inclusion Criteria
Publication language	Indonesian or English

Type of source	Journals, articles, theses or dissertations, and books that meet the eligibility criteria
Author	Academics related to the topic to be studied
Research design	Experimental and/or other studies and literature review
Year of publication	Main libraries identified in the last 5 years (2021-2025)
Topic	In accordance with the topic details
Journal ranking	Accessible via SCImago Journal and Country Rank and SINTA Score

Library Data Collection and Sorting

Library data that meets the eligibility and inclusion criteria will be used for library data collection based on various keywords relevant to the topic of discussion. According to Fink (2013), there are two sorting stages that must be carried out, namely as follows:

Practical Screening

This sorting stage is carried out to determine which references meet the criteria for use in the discussion.

Methodological Screening

This sorting stage is carried out to determine the quality of the references selected based on the criteria in Table 1 and is used to identify the best references based on the suitability of the methods used by researchers to collect results.

The sources obtained can be sorted through several steps, namely: (1) reading the title of the reference to estimate its contents, (2) reading the abstract or introduction to gain an overview and determine its relevance to the topic being discussed, (3) comparing one reference with another to avoid duplication, and (4) reading and systematically noting the important parts of the reference data, then organizing them into a summary and literature mapping based on the year of publication.

The number of books that have been identified and have passed the feasibility test and sorting can be calculated based on the image below:

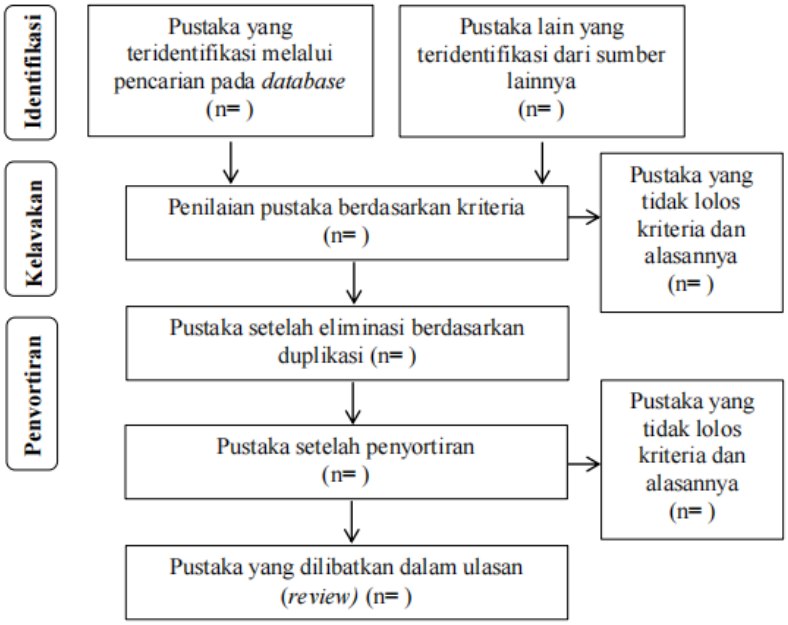

Figure 2 System for Determining the Number of References in a Review

Description: n = number of libraries

Sumber: Modifikasi Fink (2013)

Data Analysis, Interpretation, and Confirmation

Analysis and interpretation of data from the sorted library can be done in the following stages: (1) Technology-based education curriculum. (2) Continuing education curriculum. (3) Analyzing the relationship between technology-based education curriculum and continuing education.

Confirmation is carried out by comparing one piece of literature data with other similar literature data or other supporting literature. Unconfirmed data will be reinterpreted or compared with other data or sorted again to determine its relevance to the topic, while confirmed data will be used in descriptive discussions (reviews). This descriptive review is based on the results of interpreting the similarities and differences in the objectives, methods, and results of research from various literature sources found (Fink, 2013). The final conclusion regarding the relationship between religion and science in the use of new media in information disclosure by the government, which is in line with the principles of communication from an Islamic perspective, can be obtained in accordance with the results of this review.

FINDINGS AND DISCUSSION

The research is based on the results of a literature review. The number of references was determined to be 30. These 30 references were selected from the results of a discussion of research on technology-based education curricula related to sustainable education.

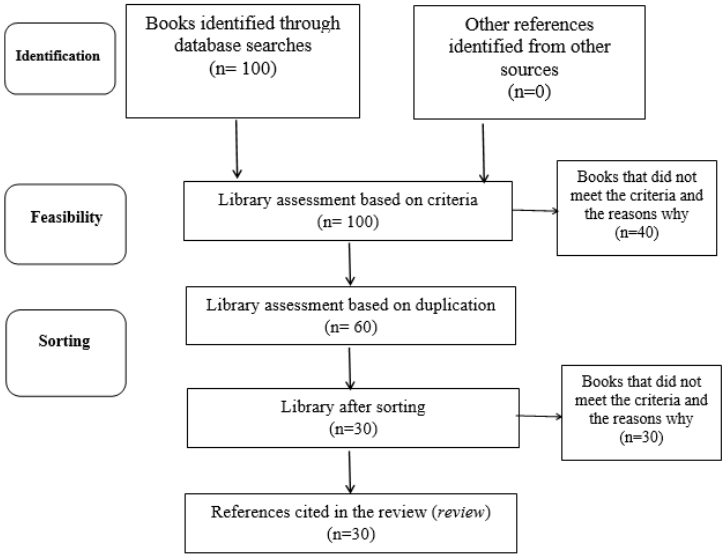

Figure 3. Results of Determining the Number of References in the Review

Description: n = number of libraries

Curriculum by Creating Information and Communication Technology (ICT)-Based Learning Supports Learning.

The existence of a curriculum system based on Information and Communication Technology (ICT) can create learning support. This is manifested in several ways, including engaging or interactive learning, more realistic learning, more effective and efficient learning management, encouragement of independent learning, improved learning quality, flexible learning processes, and the creation of positive responses in learning (Sumakula et al., 2024).

This is also evidenced in various studies, including:

Information and Communication Technology (ICT)-based learning can create a more engaging and interactive learning system.

Information and Communication Technology (ICT)-based learning can create a more engaging and interactive learning system both in and out of the classroom. The use of supporting media in the teaching and learning process, such as photos and videos, has a significant impact on students' interest and attention. However, if educators only rely on written and verbal explanations, students may become bored and find it difficult to grasp the intended meaning of the lesson content.

Educators can teach, assign tasks, and facilitate group work in a varied and stimulating manner using photos and videos of the objects discussed in the lesson. Learning with the use of technology has proven that students who participate in interactive technology-based learning show greater motivation in the teaching and learning process, find the material easier to understand, and are more receptive to new concepts. Additionally, the use of technology can also support collaboration between students and educators in communication and

interaction. In essence, the innovation of learning media through the use of interactive technology has great potential in improving the quality of education and the active role of students in school (Hirzi & Ibrahim, 2025).

Adapting to changes in the times can make students interested and not bored in the teaching and learning process. The use of digital technology plays a role in increasing students' interest and enthusiasm in learning, and students are even more interactive when learning uses technology. In addition, educators are also more motivated to innovate in learning using technology and creative media (Aisyah et al., 2025).

Technology plays a supportive role in learning by facilitating collaborative interaction and creating meaningful context that is easy to understand. Students and educators will build a collaborative communication network through technology-based learning. Educators act as mentors and facilitators, with students at the center. This means that educators are the ones who determine learning needs and learning media. Meanwhile, students will be more active in applying and presenting material (Salsabila & Agustian, 2024).

Information and Communication Technology (ICT)-Based Learning Becomes More Concrete and Real

Learning becomes more concrete and realistic. The use of learning media in schools is relevant to concrete operational characteristics. Technological media in learning makes it easier for students to understand something directly by seeing, hearing, feeling, and touching.

Technology-based learning media serves as a facility for teachers in conveying messages, information, and knowledge to students. Such as explaining learning materials and transferring knowledge to students. The ability to package abstract material into a more concrete form is enhanced. Technological support makes the learning process more enjoyable for students. The use of technology-based learning media can assist educators in presenting material to students, especially abstract material, using image and video techniques that demonstrate real concepts (Jamun et al., 2023).

Technology in learning helps students and educators carry out the teaching and learning process. The learning process requires components such as media or tools with technology that can balance the field being studied. The learning process is positive when students learn from having no understanding to understanding the subject matter (Maritsa et al., 2021).

The development of students' skills oriented toward the use of technology, such as digital platforms for classroom management, creating interactive learning media, and technology-based evaluation that is more efficient and objective. Technology-based learning innovations can enhance students' direct involvement in the teaching and learning process, as reflected in increased participation (Mesterjon et al., 2025).

Information and Communication Technology (ICT)-Based Learning Becomes More Effective and Efficient

Educators find it easier to explain material without having to write and draw illustrations on the blackboard frequently. With the availability of technological media, educators can display material and illustrations accurately and quickly. Learning with technological media does not require a lot of materials; a computer and projector are sufficient. Furthermore, material does not need to be written repeatedly; it can simply be displayed through slides. There is also no need to draw on the blackboard; instead, clearer and more detailed photos and videos can be displayed.

The implementation of digital learning concepts enhances effectiveness. Technology-based learning can be more effective and efficient, and the overall quality of learning improves. This is particularly true when using e-learning media or other digital learning technologies. The effectiveness of digital learning can be measured by aspects such as improved skills, deeper understanding, learning motivation, and student participation, as well as improved performance in line with learning outcomes. Meanwhile, the efficiency of digital learning is related to the efficient use of technology and digital platforms in learning, with measurement tools including time, cost, and resource efficiency (Riyani et al., 2023).

Technology-based learning has a significant influence and impact on improving student learning outcomes compared to conventional learning systems. The effectiveness and efficiency of technology-based learning, such as time and energy efficiency in acquiring knowledge and information quickly and effectively through the use of digital media, are evident. The quality of learning continues to improve. This means that the use of digital media creates an efficient and effective learning process (Narpila et al., 2025).

The application of technology in education enhances the effectiveness and efficiency of learning. The effectiveness of technology in education is influenced by various enabling and hindering factors. Enabling factors include adequate facilities, digital competencies of educators and students, and technology-integrated learning systems. Hindering factors include limited facilities, insufficient digital skills, social and cultural challenges, and understanding of digital security and privacy. To improve the effectiveness of learning technology, the government needs to develop strategies to address all challenges and enhance existing strengths (Malay et al., 2025).

Information and Communication Technology (ICT)-Based Learning Supports Independent Learning

Systematic and structured learning media can be used by students to learn independently. The existence of technology facilitates access to knowledge and information for all people. This means that everyone can receive knowledge and information without having to wait for educators or mentors. Everyone can learn independently and gather a wealth of knowledge and information.

The use of technology, such as computers, the internet, or digital learning media, can increase students' interest in independent learning. Students can enhance their learning motivation by accessing digital learning media. Increased learning motivation can help achieve learning objectives (Sarah, 2024).

Technology in education plays a significant role in fostering students' independent learning. The integration of technology in online learning, educational applications, and digital media. The use of technology can be felt by students through broad access to learning materials, improved critical thinking skills, and the development of motivation and active participation among students. The use of technology helps students manage their learning time effectively for the development of self-regulated learning skills as a key element in lifelong learning (Febrianasari et al., 2024).

Technology supports the improvement and completeness of the learning process at all levels of education. The use of technology facilitates access to a wide and diverse range of learning resources. In addition, it is able to present information to the whole world in a practical manner. The internet and electronic devices, including computers, tablets, and mobile phones, support access to learning materials, references, and educational resources in a practical and instant manner. Thus, learning is not limited by geographical boundaries. Students will develop an interest in independent learning (Norpin et al., 2024).

Information and Communication Technology (ICT)-Based Learning Improves Learning Quality

Learning media makes learning more effective and efficient, automatically improving the overall quality of learning. Optimizing the use of technology in learning must be accompanied by adequate facilities, improving educators' digital literacy skills, and developing a curriculum that is adaptive to technological developments. Synergy between the government, schools, and the community is needed for digital transformation in education to run optimally.

Technology holds great potential for improving the quality of learning. The success of its implementation depends on the readiness and support of all parties involved. Improvements in the quality of technology-based learning are oriented towards the integration of technology in a more modern educational context. Technology makes it easier for students to obtain and access learning materials such as e-books, learning videos, simulations, and educational online platforms. This enhances the learning experience of

students and increases their interest in learning in line with their personal learning speed and style (Surwuy et al., 2024).

The role of educational technology in improving the quality of education includes, first, the provision of learning facilities in the process of planning, developing, utilizing, managing, and evaluating learning resources. Second, resolving learning problems and conducting universal studies by integrating various scientific disciplines. Third, utilizing technology in educational activities more effectively and efficiently, from the product to the process of solving learning problems. Fourth, presenting structured alternatives for resolving organizational performance issues in educational performance and instructional design. Fifth, fostering innovation in the field of education and teaching for problem-solving (Aridianti et al., 2024).

Educational technology significantly contributes to supporting interactive teaching and learning processes, ease of access to information, and improving the quality of education. The accuracy of technology strategies can create optimized, enjoyable, and relevant learning experiences. Facilitating access to information, enhancing interaction and collaboration, and adapting learning methods and materials, technology will build high-quality learning. The implementation of policies utilizing technology in the education curriculum, as outlined in the Minister of Education and Culture Regulation, emphasizes that technological and information competencies for educators and students are crucial for the quality of education (Dewi, 2024).

Information and Communication Technology (ICT)-based learning enables the learning process to be carried out flexibly.

The educational process, particularly teaching and learning, can take place anywhere and anytime. It certainly utilizes audio, video, and computer programs both online and offline as flexible learning media according to the conditions and situations of educators and students.

Learning with the use of technology, especially digital learning online, demonstrates flexibility. Especially with the E-Learning and M-Learning systems. Flexible learning is not only unlimited by space and time, but has also evolved to be unlimited by media. Many media provide for digital learning. Even these digital media are easily accessible (Akbar, 2024).

The role of technology in the learning process. The use of technology in education aims primarily to meet the needs of learners to learn flexibly, anytime and anywhere, and to increase learner participation and understanding. Digital technology also supports complex interactions between educators and learners. This is especially true when there are obstacles to direct or face-to-face meetings between educators and learners (Hariantoa et al., 2024).

The use of technology in learning, oriented toward the needs of students in the digital age, has an impact on learning techniques. Learners experience flexibility in learning and acquiring knowledge without being constrained by time and space. Not only do digital learning platforms like Google Classroom and Moodle support formal and informal teaching and learning processes, but there are also tools for personalized education with adaptive features and artificial intelligence (AI). AI plays a crucial role in helping learners access information through communication (Fajriati et al., 2024).

Information and Communication Technology (ICT)-Based Learning Creates Positive Attitudes Among Students Toward Learning

The design of media use is relevant to students' learning needs and creates a positive attitude toward the learning process. The use of Information and Communication Technology in education has a significant impact on learning. One of the most notable positive impacts of technology-based learning is the creation of a positive attitude among students toward learning. Students are more enthusiastic, motivated, and active in exploring lesson materials. Learning with technology integration opens opportunities for students to learn independently, in line with their learning styles and personal pace. This fosters self-confidence, a high level of curiosity, and increases student engagement in class discussions.

Technological developments have become a means of innovation in the application of learning media in line with the times. Learning media consists of audio media, visual media, and audio-visual media. The use of learning media is expected to activate the desire to learn

in the form of Self-Motivated Learning and Self-Regulated Learning. Self-Motivated Learning refers to active learning driven by intention or motivation to master a particular competency for problem-solving, built upon existing knowledge or competencies. Meanwhile, Self-Regulated Learning is a learning technique for students to achieve academic goals through behavioral control, involving individual motivation and cognitive application in learning (Firmadani, 2020).

The application of technology in the teaching and learning process, using LCD projectors, computers, and digital materials, facilitates students in receiving learning materials. Learners are encouraged to actively participate in the teaching and learning process. In the learning process utilizing technology, learners are able to explore learning inspiration optimally compared to learning without technology. This shows a positive reaction to the teaching and learning process in the use of technology (Raodah et al., 2024).

The learning process using animated cartoon videos has had a positive impact on students' interest in learning. This shows that the use of technology and animated videos is effective in the classroom learning process, improving students' thinking skills, creativity, and ability to understand concepts, which in turn has a positive impact on their learning outcomes (Cipta et al., 2023).

CONCLUSIONS

The implementation of an Information and Communication Technology (ICT)-based curriculum has been proven to create a more interactive, concrete, effective, and efficient learning system. ICT-based learning not only increases student engagement but also fosters learning motivation, reduces boredom, and facilitates the understanding of abstract concepts through the use of visual media such as images and videos. ICT acts as a collaborative tool that encourages interaction between educators and students, with educators as facilitators and students as the center of learning. This makes the learning process more meaningful, flexible, and in line with the needs of the times. The effectiveness of ICT-based learning is reflected in improved learning outcomes, savings in time, energy, and costs, and increased active student participation. However, the success of ICT implementation in education is greatly influenced by the availability of facilities, the digital competence of educators and students, and an understanding of digital security. Therefore, strategic support from various parties, including the government and educational institutions, is essential to optimize the benefits of ICT in supporting the quality of sustainable education in the digital era.

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