Leveraging Information and Communication Technology for Enhancing Students' Learning and Development of Scientific Works

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ABSTRACT

This study explores how integrating ICT into education can significantly improve students' learning experiences and foster the creation of scientific works. ICT tools, offer students enhanced access to information, promote critical thinking, and support the development of research and scientific writing skills. By incorporating ICT, educators can provide more interactive, personalized, and effective learning environments, ultimately enriching the academic and research capabilities of students. This study aims to explain how students in SMA Negeri 1 Torue learn to design scientific work using information and communication technology. This research is descriptive-qualitative in nature. The researchers used purposive sampling to collect the samples. The research subjects were 36 people, including one language teacher and 35 students. Observation, interviews, questionnaires, and documentation are data collection methods. Data reduction, data presentation, and conclusions are the three stages of data analysis. Based on observations, interviews, and documentation of Indonesian language teachers, it is evident that teachers are capable of adapting their approaches, media, and materials. This allows researchers to conclude that the use of information and communication technology in teaching students to design scientific work in class XI IPS 1 SMA Negeri 1 Torue is adequate.

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INTRODUCTION

Every current education implementation must prioritize superior human resources. The need for superior natural resources encourages creativity among education providers. To meet these needs, education is required that is designed in such a way that suits the conditions of the educational institution concerned.[1][2]

Education is a learning process to achieve change, which is the ultimate goal of teaching. Learning produces a complex formulation of the Indonesian education system, further complicated by the diverse nature of the curriculum. The intention is to elevate education as the cornerstone of national intelligence, fostering advancements in science, faith, and devotion to God Almighty. In a modern educational environment, teachers must be active and creative. They can explore, discover, and make decisions about effective learning methods to achieve learning goals related to learning processes and outcomes. One of the teacher's main responsibilities is to implement learning in the classroom, which can be defined as activities aimed at teaching students. Students usually do not do anything during the learning process. This happens because they tend to wait for instructions compared to seeking and developing attitudes towards knowledge or skills that they need themselves.

According to the Law of the Republic of Indonesia No. 14 of the year 2005[3] concerning teachers and lecturers' letters a, b, and c, the learning process serves as a guide for achieving learning outcomes. As part of their professional duties, teachers are required to organize and carry out learning, using appropriate methods quality, assess and reflect student learning outcomes; continuously improve and develop academic competencies and qualifications in accordance with advances in art, technology and science; act fairly without considering the student's religion, ethnicity, race, gender, physical condition, family background and socio-economic status; uphold religious and moral values, laws, codes of ethics and teacher ethics and encourage national unity.

The learning process significantly influences an individual's learning outcomes. Every human being undergoes a learning and teaching process, in

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[1]Lavrentieva, O. O., Rybalko, L. M., Tsys, O. O., & Uchitel, A. D. (2019). Theoretical and methodical aspects of the organization of students' independent study activities together with the use of ICT and tools. In Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, December 21, 2018 (No. 2433, pp. 102-125). CEUR Workshop Proceedings.

[2]Bucchi, M., & Trench, B. (Eds.). (2021). Routledge handbook of public communication of science and technology. Routledge

[3]Undang-undang Republik Indonesia Nomor 14 Tahun 2005 Tentang Guru dan Dosen, 2006. CV. Eka Jaya: Jakarta.

which there are two parties involved: the student and the educator. Both parties must foster interaction to build cooperation between educators and students.[456]

Likewise, Sadirman (2013)[7] explains that "results" are the main criteria for starting teaching. But keep in mind that assessing and translating "results" carefully and precisely requires considering what the process is. Various parties must pay attention to the implementation of learning to achieve the superior educational unit output previously expected. Teachers, as educators, tutors, and mentors, must understand their own competence in teaching. Observe the students' capacity to comprehend all the messages and concepts aimed at in each learning process, as the learning environment significantly shapes this ability.[89] A teacher's personality can reflect their ability and maturity as a profession.

Researchers discovered Rusdi (2019) study, the research results indicate that computers are used in the classroom to teach basic skills and provide computer knowledge according to the curriculum. For example, word processing is used to improve students' writing skills[10]. Computers are also widely used to convey material that requires motion, images, text, and color.

The second relevant research conducted by Sarker et al. (2019)[11], The study explores that the major technology associated delivery modes are lectures, tutorials and laboratory work. Incorporating technology in the teaching-learning process can be an effective way to develop the learners and educators for better learning and education outcomes. Our review of these studies reveals a consensus that particular strategies can promote significant improvement in student learning.

These results shed light on several similarities and differences. Previous researchers hold relevance to the current research because they have both examined and analyzed the application of communication and information technology in education. The difference is that the first researcher focused on computers which were used in the classroom to teach basic skills and provide

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[4]Ratheeswari, K. (2018). Information communication technology in education. Journal of Applied and Advanced research, 3(1), 45-47.

[5]Barbosa Granados, S. H., & Amariles Jaramillo, M. L. (2019). Learning styles and the use of ICT in university students within a competency-based training model. Journal of New Approaches in Educational Research, 8(1), 1-6.

[6]Shatrı, Z. G. (2020). Advantages and disadvantages of using ınformation technology in learning process of students. Journal of Turkish Science Education, 17(3), 420-428.

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[8]Alkamel, M. A. A., & Chouthaiwale, S. S. (2018). The use of ICT tools in English language teaching and learning: A literature review. Veda's journal of english language and literature-JOELL, 5(2), 29-33.

[9]Ugwu, N. P., & Nnaekwe, K. (2019). The concept and application of ICT to teaching/learning process. International Research Journal of Mathematics, Engineering and IT, 6(2), 10-22.

[10]Rusdi, M. (2019). Pemanfaatan Teknologi Informasi sebagai Media Pembelajaran. Al-Aulia: Jurnal Pendidikan dan Ilmu-Ilmu Keislaman, 5(2), 95-103.

[11]Sarker, M. N. I., Wu, M., Cao, Q., Alam, G. M., & Li, D. (2019). Leveraging digital technology for better learning and education: A systematic literature review. International Journal of Information and Education Technology, 9(7), 453-461.

computer knowledge according to the curriculum, whereas the second researcher focuses on the major technology associated delivery modes are lectures, tutorials and laboratory work. Meanwhile, researchers are focusing on the use of information and communication technology to teach students at the public high school in Torue how to design scientific work.

The aim of this research is to determine the use of information and communication technology in learning to design scientific work in SMA Negeri 1 Torue and to describe the obstacles experienced in the use of communication and information technology during the learning process.

Methods

The researchers employed a qualitative descriptive approach to accomplish the study's objectives. Leeming (2018)[12] stated that qualitative research is a way to explore and understand the meaning given by a number to an individual or group of individuals who are considered to be the source of a social problem or humanity. The descriptive research method seeks to solve problems or answer various questions about current issues. According to Sugiyono (2017)[13], this descriptive approach is to identify the presence of an independent variable, either on one or more different, known variables as a stand-alone variable or independent variable, without comparing the variables themselves or examining how these variables relate to other variables. The researcher deliberately determined the sample in this case, which included 1 Indonesian teacher and 35 students, based on assumptions and the belief that the 36 selected informants were ordinary and could provide the necessary information for the research. The primary purpose of research is data collection, and data collection techniques are the most strategic step in the research process. Researchers use data collection techniques such as observation, questionnaires, interviews, and documentation to gather data and information about the use of ICT in designing scientific research work. Researchers analyze the obtained data as soon as possible to gather information based on actual reality. There are four techniques for qualitative data analysis: data reduction, data presentation, questionnaire analysis, and conclusion drawing.[14]

RESULT AND DISCUSSION

This research directly observes the use of ICT in the classroom learning process, from the first lesson to the last. Naturally, an assessment component serves as a reference for the use of ICT in schools, regardless of its application to learning.

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[12]Leeming, D. (2018). The use of theory in qualitative research. Journal of Human Lactation, 34(4), 668-673.

[13]Sugiyono. (2017). Metode Penelitian Kuantitatif, Kualitatatif, dan R&D. Bandung: Alfabeta.

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Based on how students use ICT in their learning process, The scientific knowledge observed and interviewed by the teacher demonstrated the students' proficiency in designing scientific work, their understanding of teaching methods, the technology used during the learning process, and the challenges the teacher faced in incorporating technology into the learning process.

Result of Observation

Based on observations conducted in the classroom, the use of ICT in the learning process at SMA Negeri 1 Torue has significantly supported students in developing their scientific knowledge and skills. Students demonstrated a good level of proficiency in designing scientific work, which includes activities such as reading the topic being taught, formulating questions, providing answers, and noting down important points during the lesson. This active engagement helps them draw conclusions and enhances their understanding of the material.

Furthermore, the integration of technology has played a critical role in improving the quality of learning. Information and communication technology (ICT) enables students to access a wide range of educational resources, such as e-books, learning videos, and digital references. This access not only improves their comprehension but also supports their interest and motivation in learning. Multimedia elements such as images, audio, and video make the learning process more dynamic and interactive, which contributes positively to their academic performance.

In addition, the use of ICT in designing scientific work makes it easier for students to manage their references and organize their writing. Technology assists students in searching for relevant information and helps them structure their ideas effectively. Overall, the use of ICT enhances both the learning experience and the outcomes achieved by students, particularly in the development of scientific papers and projects.

Result of Interview

Interviews with teachers and school staff provided deeper insights into the school's vision, mission, and teaching practices. SMA Negeri 1 Torue, which was established in 1987, aims to produce academically and non-academically superior students who can compete with peers from other educational institutions in Central Sulawesi Province. The school's mission emphasizes delivering quality education based on the integration of religious values (IMTAK), science, and technology, while maintaining a strong moral foundation. It also seeks to nurture graduates with strong personalities, enhance students' talents through extracurricular activities, and promote environmental awareness.

According to the teachers, their role in the classroom goes beyond delivering material. They serve as facilitators, motivators, classroom managers, and emotional supporters. Teachers are responsible for understanding the characteristics of their students, identifying their learning styles, and recognizing the challenges they face. To create an effective learning environment, teachers must prepare learning tools that support both administrative functions and classroom dynamics. They must also utilize media that helps students better understand the material and achieve learning success.

In terms of instructional planning, teachers regularly review the material to be taught and reflect on previous learning sessions to identify areas that need improvement. This helps them anticipate potential issues and enhance the delivery of lessons. Moreover, they ensure that assessments are aligned with learning objectives to accurately measure students' progress. Teachers also emphasized the importance of managing their own

emotions, as their behavior greatly influences the classroom atmosphere. A calm and patient teacher can create a more comfortable and supportive environment for students, whereas anger or frustration can lead to tension and hinder learning.

These interviews highlight the multifaceted role of teachers in supporting student learning, especially in integrating ICT into the educational process. Their ability to adapt, prepare, and respond to both academic and emotional needs is essential in ensuring the successful use of technology in the classroom.

DISCUSSION
Use of Information and Communication Technology in Learning

In the field of education, human needs for information technology and communication continue to increase, without exception. Trends in almost all fields have used the word "e," which means electronic. Teachers need to utilize technology more effectively to impart knowledge and foster a deeper comprehension of its beneficial applications for the future generation. Achieving quality education will lead to the achievement of educational goals. We must first focus on enhancing the quality of education, specifically by enhancing the learning experience.

Two perspectives that can enhance the quality of learning are the learning process and learning outcomes. On the other hand, improving the learning process can motivate teachers and students. Degeng (2015)[15] describes the learning mechanism, while Miarso (2015)[16] identifies components that either influence or support the processes of high-quality education in achieving academic goals. These components include the application of information and communication technology in the learning process. Educational technology refers to the use of technology and communication; UNESCO officially uses the term information and communication technology (ICT), Indonesia subsequently adopted this approach.

To transform the conventional learning system, it is crucial to alter the learning patterns. The conventional learning system is old-fashioned and irrelevant. Information and communication technology eliminates the learner's initial model and serves as an intermediary in the process of knowledge transfer. Users can utilize various networking features on social media to enhance their interaction with one another.[171819]

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[15]Degeng, N. S. (2015) Teori Pembelajaran, Malang, Jawa Timur: UM Press.

[16]Miarso, Y. H. (2015). Menyemai Benih Teknologi Pendidikan, Jakarta: Kencana.

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At SMA Negeri 1 Torue, the use of ICT improves the learning process. In the end, the researchers anticipated that the use of this technology enhanced students' scientific research outcomes and personal attributes, owing to its efficiency and practicality. The use of ICT in learning at Torue 1 Public High School aims to enhance or inspire students to harness their inherent abilities and potential for autonomous and sustainable learning. The Internet, as a new educational method, opens up a lot of opportunities for student independence.[20][21][22] The use of the internet as an educational method is very useful because it can help students in the learning process. One example is e-mail. Teachers can make their work easier by using e-mail to send information to students without having to meet face-to-face. In this scenario, students have the freedom to engage in discussions at any time and from any location. Social networks are examples. Students at SMA Negeri 1 Torue commonly use WhatsApp. During the teaching process, teachers can form groups with their students. Teachers can share materials in class using educational files such as pdf, word, and PowerPoint, and students can download material files at any time they want to. Thus, when students struggle with understanding the teacher's material, they can engage in direct communication with the teacher to discuss concepts they find challenging to grasp.[23][24] They also understand these questions with other groups, like the teacher in class.

The use of ICT in the learning process for designing scientific work has several main objectives. First, ICT can make it easier to interact and communicate with students, whether face-to-face or online. Second, the use of ICT can increase the effectiveness and efficiency of the learning process using various modern community facilities, such as computers, cell phones, and the internet. Third, the use of technology Information and communication technology can facilitate students' access to a wide range of information, material, and references in

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[20]Gilakjani, A. P. (2017). A review of the literature on the integration of technology into the learning and teaching of English language skills. International Journal of English Linguistics, 7(5), 95-106.

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[22]Erizar, E., Marzuki, A. G., Hidayati, T., Juliana, R., & Yulia, A. (2024). The Impact of Online Learning on Undergraduate English Students' Achievement. Journal of English Education and Teaching, 8(2), 288-302.

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[24]Alek, A., Marzuki, A. G., Farkhan, M., Surahman, D., Daryanto, D., & Febrianto, S. (2020). Computer Based Testing in Senior High School on National Examination. Indonesian Journal of Learning Education and Counseling, 2(2), 204-210.

modern education.[25][26][27] It is critical to improve education by utilizing information and communication technology. With ICT, the relationship between students and teachers becomes more flexible and freer. Therefore, the use of information and communication technology is critical to improving the quality and effectiveness of student learning. What if professionals were responsible for the design and implementation of the learning process? This would significantly impact the educational objectives. Teachers create a systematic and sustainable learning environment for students. As a result, students will feel more at ease studying in the space the teacher provides. In other words, improvement. Education and development are crucial for the successful implementation of an ICT-based curriculum.

Designing Scientific Work in SMA Negeri 1 Torue

The researchers must prepare learning materials about scientific work design to enhance students' knowledge and comprehension of previously studied scientific work design. Therefore, students can develop their own methods for compiling scientific work in an orderly and precise manner based on standard scientific work rules.[28]

Scientific papers usually have an introduction, body, and conclusion. Alek and Achmad[29] defined scientific work as a collection of ideas, opinions, responses, or research findings relevant to a scientific discipline. Understanding and designing scientific work can be defined as a report or written article that explains the findings of research or studies. Writing scientific work requires a systematic, scientific, logical, correct, and balanced approach, along with precise and correct language. Students need to assume responsibility for designing scientific work, both technically and materially. Successful study based on diverse literature, a compilation of experiences, enables the production of scientific work.

An article is one form of designing scientific work at SMA Negeri 1 Torue. Articles, whether published in journals, newspapers, or magazines, aim to persuasively, educationally, and entertainingly convey ideas or issues. This study refers to articles published in journals as "journal articles." Journal articles are

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[25]Wu, J., Guo, S., Huang, H., Liu, W., & Xiang, Y. (2018). Information and communications technologies for sustainable development goals: state-of-the-art, needs and perspectives. IEEE Communications Surveys & Tutorials, 20(3), 2389-2406.

[26]Modlo, Y. O., Semerikov, S. O., Nechypurenko, P. P., Bondarevskyi, S. L., Bondarevska, O. M., & Tolmachev, S. T. (2019). The use of mobile Internet devices in the formation of ICT component of bachelors in electromechanics competency in modeling of technical objects. In Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, December 21, 2018 (No. 2433, pp. 413-428). CEUR Workshop Proceedings.

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[28]Aceto, G., Persico, V., & Pescapé, A. (2018). The role of Information and Communication Technologies in healthcare: taxonomies, perspectives, and challenges. Journal of Network and Computer Applications, 107, 125-154.

[29]Alek dan Achmad, (2012). Bahasa Indonesia Untuk Pendidikan Tinggi, Jakarta: Kencana.

scientific articles published in special journals published in certain scientific fields. Articles in this category include articles resulting from an analysis of a topic without ties to another research related to that topic.

Designing scientific work must use appropriate scientific principles and structures, prioritize rationality, and involve objective and factual problems. Scientific work can also take the form of a paper discussing a specific topic. The production of scientific work necessitates adhering to a set of scientific principles. Writers of scientific papers must also use correct writing systems.

Obstacles experienced in the use of Information and Communication Technology for students in designing scientific work in SMA Negeri 1 Torue

Current learning technology is not only required to improve learning, but can also help students prepare themselves for the contemporary world. Students can utilize IT and communications as pedagogical tools to aid learning. Ertner & Ottenbreit-Leftwich (2012)[30] refer to this as good learning. This implies allowing students to utilize technology for learning, innovation, collaboration, problem-solving, and critical thinking.[31] In this context, students and teachers frequently face challenges when integrating ICT into the learning process, as outlined below:

- The problem of an unstable internet network has disrupted the student learning process in the classroom.
- At SMA Negeri 1 Torue, the next challenge teachers face when using ICT is their belief that they can teach using learning media. Teachers must be more creative and better prepared to teach. After experimenting with the media, teachers must familiarize themselves with it to prevent any discomfort in the classroom. After getting used to it, the teacher must prepare for a longer and quieter time to teach.
- Not all teachers have the ability to manage this medium due to the limited number of operational staff available. Limited operational personnel to stop maintenance and operation when teachers use media also makes this condition a new challenge that is difficult to handle. The teacher's inability to integrate various facilities and teacher competency, such as age, influence what these schools provide. Older teachers may find it challenging to keep up with such rapid developments, so they may resort to using these devices to support course material.
- Funding problems, IT use, and communication-based learning all have a significant impact on the quality of teacher learning in schools. The availability of learning tools supports teacher professionalism in implementing ICT.

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[30]Ertmer, P. A. & Ottenbreit-Leftwich, A. T. (2012). Teacher Technology Change. Journal of Research on Technology in Education, 42(3).

[31]Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambret, M. C., & Makitalo- Siegl,, K. (2017). TPACK updated to measure pre-service teachers' twenty- first century skills. Australasian Journal of Education Technology.

- Therefore, to overcome these obstacles, it is important to support students in developing skills using technology, providing equal access to devices and the internet, as well as educating them about digital literacy and digital life balance, both online and offline. Given the obstacles to the use of ICT at SMA Negeri 1 Torue, students' expectations for the use of IT and communications in schools are as follows:

1). More varied use of technology

ICT makes learning resources more varied, allowing students to understand the material in a more interactive and flexible way. Therefore, the use of technological tools needed by schools must be more varied than those provided by the school, for example:

a) Television

Few schools have televisions installed in their classrooms or offices. However, the presence of televisions can significantly enhance learning activities and teaching at school, particularly by providing greater material and clarity.

b) Audio

Learning resources now extend beyond books and teacher explanations in the classroom; teachers can enhance the learning experience by utilizing laptops and audio speakers. For example, when playing videos in class, the teacher can use a laptop and audio speakers so students can pay attention and learn well. The role of audio speakers is crucial, as they can be Make sure students sitting in the back row can hear clearly.

2). Creativity and Activity

The use of information technology can help students increase creativity and activity in the learning process by helping them understand the material and enabling them to participate more actively in the learning process.

3). Access to Information

Information and communication technology provides wider and faster access to information, such as the availability of a more adequate internet network, thus enabling students to access more diverse and up-to-date information. Thus, students' hopes regarding the use of information and communication technology in schools are to improve the quality of education and increase digital skills.

CONCLUSION

Based on observations in learning, it appears that the teacher has been able to adjust the approach, media, and material. The school provides facility support to facilitate student learning activities. The results of research on the use of IT and communication for students in learning to design scientific work in 1 SMA Negeri 1 Torue show that teachers have quite good abilities to use IT and communication in the learning process to design scientific work. The results of observations, interviews, and documentation on Indonesian language teachers

demonstrate this. Although researchers have effectively implemented ICT in the learning process, students and teachers still face obstacles such as inadequate internet networks and limited availability of school facilities.

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