



Perceptions of Chemistry Teachers at Pontianak City State High Schools in Utilizing Information and Communication Technology

Fatmawati^(✉), Hairida, Rini Muharini, Rody Putra Sartika, and Rahmat Rasmawan

Departement of Chemistry Education, Faculty of Teaching and Education,
Universitas Tanjungpura, Jl. Prof. Dr. H. Hadari Nawawi, Pontianak 78124, Indonesia
fatmawati06@student.untan.ac.id

Abstract. Information and communication technology (ICT) is very important in 21st-century education because it can improve students' understanding. The purpose of this study was to describe the perception of chemistry teachers at SMA Negeri Pontianak about the use of ICT in learning. The research method used is descriptive quantitative research with data collection techniques using surveys and data collection tools using a questionnaire consisting of 11 statement items adopted from Gebremedhin and Fenta (2015). The sample used in this study was 21 teachers with a saturated sample (census) sampling technique. The data analysis technique used is descriptive analysis with percentages, then described as a picture of the teacher's perception of utilizing ICT in learning. The data results are then classified into strong, strong, moderate, weak, and weak categories. The results obtained are that the chemistry teacher of the Pontianak City State Senior High School has a very strong perception of utilizing ICT and has reached the cognitive, affective, and conative dimensions. The average conclusion obtained is 84% and shows a very strong category. This research can contribute to providing information to the Ministry of National Education and related schools regarding the use of ICT in learning by chemistry teachers.

Keywords: Information and Communication · ICT · Perception · Teacher's Perception

1 Introduction

The 21st century has entered an era of very rapid openness with the development of science and technology, increasing the skills and competitiveness of the community. One of the developments is computer technology and communication technology. The development of information and communication technology (ICT) has influenced the education field in the learning process. This is shown by the increasing use of ICT. ICT use in learning includes audio programs, video programs, TV education, social networks, and e-learning. The use of ICT in learning is also described in the Minister of Education and Culture No. 69 of 2013 concerning the SMA-MA curriculum, that the 2013 curriculum requires an educator to apply information and communication technology (ICT) in their learning [1].

© The Author(s) 2023

A. Doyan et al. (Eds.): ICSES 2022, APR 8, pp. 249–262, 2023.

https://doi.org/10.2991/978-94-6463-232-3_26

ICT is an extension of Information Technology (IT) and is defined as a technology that enables access to information through telecommunications [2]. Yekini [3] states that ICT is defined as the integration of audio, visual, telephone, and computer networks through a connected system. Wise & O'Byrne [4] argue that ICT allows a person to store, handle, and disseminate information faster and more up-to-date. According to the research of Sinaga & Zainuddin [5], teachers' skills and understanding of ICT are very sensitive to perception. The perception of a teacher produces images as a result of mental processes and allows objects to be recognized through longer memory associations because the mental processes developed are positive. The teacher recognizes their existence and communicates values, ideas, and concepts to students. Teachers' perceptions play an important role in influencing the effectiveness of ICT education from various perspectives [6]. Perception is how people see and interpret events, objects, and people [7]. Suppose the teacher's attitude towards the use of teaching ICT is positive. In that case, the teacher can easily provide useful insights about introducing and integrating ICT into the teaching and learning process. Research by Hidayati et al. [8] shows that the higher the teacher's perception of ICT, the higher the utilization.

Conversely, the lower the teacher's awareness of ICT, the less ICT is used in learning. However, research conducted by Parlindungan Pardede & Sunarto [9] shows that teachers perceive ICT very well, but its utilization is not high. The researcher reveals that perception is closely related to assumptions, knowledge, acceptance, absorption, perception and interpretation, stimulation, and sensory processes. All this shows that perception is closely related to impression. Based on this, the understanding of perception intended in this study is the chemistry teacher's point of view and opinion on the use of ICT obtained through sensory processes.

Chemistry is one of the most important subjects in science, containing various abstract concepts that require complex concepts that cannot be applied outside the classroom. According to Zhou et al. [10], calling chemistry abstract means that to facilitate the learning of chemistry, one must have an intuitive sense, understand concepts, and believe in the existence of chemistry. In addition, students also get negative perceptions from the public that chemistry is a difficult subject. Therefore, teachers must address these negative thoughts by creating an engaging learning environment and involving students in the classroom [11]. As a chemistry teacher, assisting students in understanding scientific ideas and chemical phenomena is obligatory. One of the right ways is to involve students in information processing and problem-solving activities focusing on chemistry in everyday life. This method can be done by applying ICT, one of which is by using visualization tools that utilize ICT in the curriculum because combining ICT in chemistry learning, according to Barak, Miri, and Dori [12], can increase students' understanding of concepts, theories, and molecular structures.

Various studies have been carried out by several experts, both from within and outside the country, such as the research conducted by Anas & Firdaus [13] on the use of information and communication technology (ICT) in learning in Southeast Sulawesi province and it was found that teachers have good for the use of information and communication technology. Furthermore, research by Agrahari & Shailja [14] found that teachers perceive ICT programs as more attractive and effective than conventional learning regarding student achievement scores in chemistry subjects. Furthermore, research conducted by

Lipinge [15] found that teachers have a good perception and understanding of the benefits of combining technology in teaching and learning. Another study by Qohar [16] found that teachers have a good perception of using ICT tools in high school learning in the Demak Regency.

State SMA in Pontianak city should already have ICT facilities such as computers and the internet that can support the use of ICT in learning. Good internet access at public high schools in Pontianak city and supporting ICT facilities should also have a good perception. However, according to research conducted by Parlindungan Pardede & Sunarto [9], this is not yet known that teachers perceive ICT very well, but its utilization is not high. The results of the research on the perception of teachers at the Pontianak City Public High School in utilizing ICT are not yet known, and this research will be conducted to determine the perceptions of teachers in utilizing ICT.

Researchers are encouraged to research the perception of chemistry teachers in Pontianak City Senior High School using information and communication technology. This research is expected to understand the perception of chemistry teachers at SMA Negeri Pontianak City.

2 Method

The method used in this research is descriptive quantitative with data collection techniques using surveys. The population of this study was all chemistry teachers at the Pontianak City Public High School. At the same time, the sample was the chemistry teacher at the Pontianak City Public High School, with a total of 21 people. According to Sugiyono [17], saturated sampling is a technique in which all population members are used as samples. This is supported by the opinion of Suharsimi [18], which states that if the number of subjects is less than 100, it is better to take all of them as samples. The data collection tool used in this study was an online questionnaire via Google Forms.

The research procedure begins with adopting instruments from Gebremedhin & Fenta [19]. This instrument consists of 11 questions presented in the form of Google Forms. Then, a link is sent to each sample. Data analysis is carried out after the questionnaire is filled in and collected. The data analysis technique is carried out through the data scoring stage, where each answer obtained from the respondent is given a value according to a predetermined scale, namely the Likert scale 1–5. Then the presentation of data in the form of numeric data or numbers, the percentage process, namely calculating the data:

The percentage formula used is as follows [20]:

$$P = \frac{F}{n} \times 100\% \quad (1)$$

P indicates the percentage, F indicates the average score, and n indicates the maximum total score. The last stage is data analysis from the questionnaire results using a Likert scale which is then classified into calculation criteria. The classification table for calculation criteria can be shown in Table 1.

Table 1. Classification by Percentage

No.	Score (%)	Criteria
1.	81–100	Very strong
2.	61–80	Strong
3.	41–60	Enough
4.	21–40	Weak
5.	0–20	Very weak

Sugiyono [17].

3 Results and Discussion

This section will explain the results of the research and the discussion of the researchers in the order of the research questions. According to Sugiyono [20], descriptive statistics are intended to describe and analyze the collected data, not draw generally accepted conclusions. Descriptive statistics can be interpreted as describing the data produced by researchers without the need to draw conclusions that apply to the general public but draw factual conclusions from the results of the data. The presentation of the data analyzed in this descriptive analysis is a percentage calculation. The period from the questionnaires' distribution to the questionnaires' collection is approximately three weeks, from August 19, 2022, to September 12, 2022. The sample that has been collected includes 21 respondents. Of the 24 questionnaires distributed, only 21 returned. This is because three questionnaires were not returned. The three respondents have been contacted continuously, but there has been no response, so only 21 questionnaires were processed.

The questionnaire contains 11 statements and cognitive, affective, and conative dimensions. The dimension includes three components that make up the structure of attitudes, namely: the cognitive dimension contains a perceptual component, namely components related to knowledge, views, and beliefs, namely matters relating to how people perceive the attitude object. The affective dimension contains elements related to feelings of pleasure or displeasure with the attitude object. Happiness is a positive thing, while displeasure is a negative thing. The conative dimension contains components related to the tendency to act on the attitude object. This component shows the intensity of the attitude, which shows the size of a person's tendency to act or behave towards the object of attitude [21]. Based on this, the researchers divided the cognitive dimensions between the statement of item 1 and item 11 and the practical dimension on the statement of items 2, item 5, item 6, item 7, item 8, item 9, and item 10, while the conative dimension on item 3 statement and 4.

The perception data of chemistry teachers at the Pontianak City Senior High School can be shown in Fig. 1.

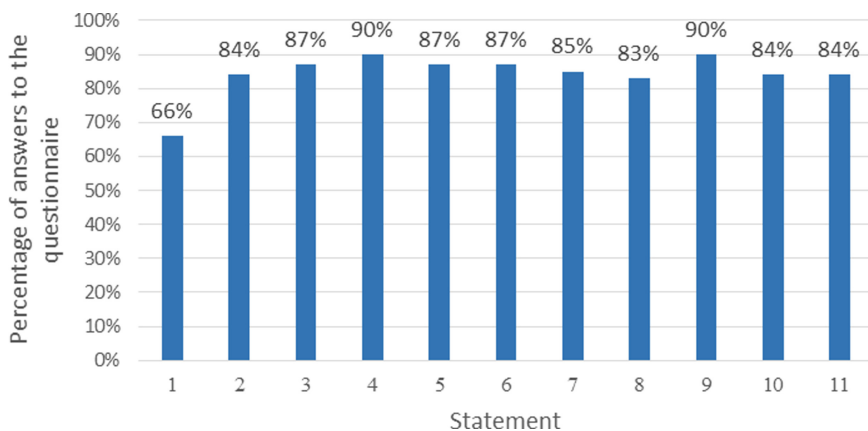


Fig. 1. Percentage of Chemistry Teachers' Perceptions in Pontianak City Senior High Schools in Utilizing ICT

3.1 Cognitive Dimension

Chemistry teacher's perception based on cognitive dimension. The cognitive dimension statement consists of the use of ICT in learning being more important than the use of printed materials, and the use of ICT makes it easier to achieve learning objectives. The results of the research from the statement are as follows:

3.1.1 The Use of ICT in Learning is More Important than Using Printed Materials

Based on the data that researchers have obtained from the questionnaires that have been distributed, the average is 66% which can be seen in Fig. 1 and shows a strong category. Based on the dimensions, this has reached the cognitive dimension. Namely, the teacher is convinced that learning with ICT is more important than using printed materials. So with this, it can be said that the chemistry teacher at the Pontianak City Senior High School strongly perceives that using ICT in learning is more important than using printed materials.

This is to research conducted by Wicaksono et al. [22] stating that print media in teaching and learning is very important. Still, learning objectives cannot be achieved optimally without using media to present the material. The presence of ICT-based media can accelerate student understanding, thereby accelerating the learning process. In addition, by using ICT, teaching materials in printed books can be accessed by students easily and anywhere and anytime. By using ICT, students can obtain more information than printed materials. Line with research conducted by Jamaluddin et al. [23] stated that students are more motivated to learn by utilizing teaching materials in the form of ICT and print. In other words, these teaching materials can be combined in the learning process. ICT-based and printed teaching materials cannot be separated from each other. In other words, these two teaching materials synergize to create efficient, fun, and dynamic learning to create maximum student learning motivation.

3.1.2 The Use of ICT Makes it Easy to Achieve Learning Objectives

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 84% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the cognitive dimension. Namely, the teacher is convinced that using technology makes it easier to achieve learning objectives. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception of using technology to make it easier to achieve learning goals.

Using ICT can make it easier to achieve learning goals because there are many ways to apply ICT to achieve learning goals. Obtaining maximum results in learning is not easy, but teachers must carry out learning to achieve learning objectives. Teachers as educators need to use the right media to attract students' interest and are easy to reach, one of which is ICT [24]. The research of Mislinawati et al. [25] shows that in preparing learning tools, teachers use ICT as a source and learning media that provides space to develop teacher creativity in designing learning that can support the achievement of the learning objectives set. From the explanation above, the researcher concludes that using media in the teaching and learning process will facilitate the teacher in delivering the material, and students are expected to understand the material presented and achieve learning objectives.

3.2 Effective Dimension

A chemistry teacher's perception is based on the effective dimension. The statement of effective dimensions consisting of ICT can have a great impact on the chemistry learning environment for students, ICT-supported learning can be more effective, the use of ICT as a learning tool can increase student interest in learning, students can actively gain knowledge if ICT is integrated with the field curriculum, the use of ICT can improve the quality of learning, the use of ICT can make it easier for teachers to prepare subject matter (assignments, handouts, etc.), and the use of ICT can make students more productive. The results of the research from the statement are as follows:

3.2.1 ICT can have a Great Impact on Student's Chemistry Learning

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 84% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that ICT can have a major impact on the chemistry learning environment for students. So with this, it can be said that the chemistry teacher at Pontianak City Senior High School has a very strong perception that ICT can have a major impact on the environment. Student learning.

This aligns with the research of Siahaan, Sudirman & Rivalina [26], who found that ICT is an integral part of people's lives in underdeveloped, remote, and developed areas, or areas better known as 3T. As a result, ICT affects not only the lives of the upper middle class but also the lives of the lower middle class. This situation means that ICT affects education and learning activities in urban and rural areas under the 3Ts. The rapid development of technology at this time has a major impact on the world of education,

such as using the internet as a learning resource. Today, books are no longer the only source of learning. We can use many other things as learning resources, including the internet, because the internet can reach various things worldwide. Furthermore, Supiandi et al. [27] suggest that the existence of ICT can have a big impact on students, for example, by making it easier for students to search for various disciplines. Using ICT as a learning resource proves that students are literate in ICT, which is the main focus of 21st-century learning competencies, fosters independence in students, and grows skills in digital literacy that students will need when working.

3.2.2 ICT-Supported Learning Can Be More Effective

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 87% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that ICT-supported learning can be more effective. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception that ICT-supported teaching can make learning more effective.

This is to research from Goswami et al. [28], which states that ICT learning can create active and effective learning, indirectly motivating students to learn more chemistry. According to Sadykov, T & Ctractova [29], ICT is a flexible tool for students searching for chemistry-related information. Frydrychova & Poulouva [30] argue that applying ICT in teaching and interesting media for students can help teachers make learning challenging and fun, which prevents the monotony of learning activities while increasing student activity and making learning more effective.

3.2.3 The Use of ICT as a Learning Tool can Increase Student's Interest in Learning

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 87% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that using ICT as a learning tool can increase students' interest in learning. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School strongly perceives using ICT as a learning tool to increase student interest in learning.

This is to research conducted by Nursyam [31], which states that learning using ICT can increase students' interest in learning. The results of this study are also supported by Hollman's research [32], which states that using technology-based learning media can increase students' interest in learning. Arghya Ray and Pradip Kumar Bala [33] also found the same result: a learning model involving technology as a learning medium that can help increase student interest and achievement.

3.2.4 Students Can Actively Know Knowledge if ICT Is Integrated into the Curriculum Field

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 85% which can be seen in Fig. 1 and showed a very strong

category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that students can actively pursue knowledge if ICT is integrated into the curriculum area. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception of students being able to pursue knowledge if ICT is integrated into the curriculum actively.

This is in line with research conducted by Miarso [34] which shows that the use of ICT is expected to increase the effectiveness and motivation of students' learning. Furthermore, Iman [35] states that when planning to learn, teachers must be able to integrate and utilize ICT in an integrated, systematic, and effective manner according to the situation and conditions. Designed to enable students actively to know the knowledge in their studies.

3.2.5 The Use of ICT Can Improve the Quality of Learning

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 83% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that using ICT can improve the quality of learning. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception of using ICT to improve the quality of learning.

Currently, through ICT, the learning process in schools will be of higher quality. The quality of learning can be interpreted as a condition that describes the level of learning effectiveness. The quality of learning can be improved with the help of a large number of references that teachers obtain in their preparation for learning and appropriate approaches according to the characteristics of their students. In addition, if the material is presented in visualization or animation, students will understand it faster because it can attract students' attention [36]. Helping to advance learning, solving learning problems, and advancing learning through scientifically designed and developed learning processes and resources in various forms of technology are the areas of cultivation and goals of learning technology. Learning technology is important in improving the quality of the learning process and its results [37].

3.2.6 ICT Can Make it Easier for Teachers to Prepare Lesson Materials (Assignments, Handouts, etc.)

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 90% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that using ICT can make it easier for teachers to prepare subject matter (assignments, handouts, etc.). So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception of using ICT to make it easier for teachers to prepare subject matter such as assignments, handouts, and so on.

For various reasons, such as abstract concepts, every teacher has limitations in presenting learning materials to students. These limitations can be overcome by using ICT to achieve learning objectives. Some examples of the use of ICT in learning today include

the use of audio learning programs, video learning programs, the use of educational television, the use of social networks, and e-learning. Through the use of ICT in learning, teachers' pedagogic needs can be better met, making the teaching and learning process easier, more enjoyable, and exciting, which in turn has a good impact on achieving optimal learning outcomes [38]. Fatmawati [39] shows that teachers can use teaching aids or simulations provided by ICT to make it easier to convey material so that it can attract the attention and interest of students to pay attention in line with Cholikh's opinion [40] where the use of ICT-based learning media arouses thoughts and attracts the focus of participants. Teach learning to run optimally, especially by utilizing laptops and LCD projectors to display images, films, practice questions, and ice-breaking videos that attract students' attention to learning because students have different ways of learning and capacities [41].

3.2.7 Use of ICT Can Make Students More Productive

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 84% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the effective dimension, namely, the teacher assesses that using ICT can make students more productive. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very good perception of ICT can make students more productive.

Using simulation-based ICT-based learning methods can overcome students' negative attitudes, increase enthusiasm for learning, enable students to learn independently according to their interests and abilities, and allow students to interact more directly with students. They learn more in context. According to Sudjana & Rivai [42], learning media is used for students because learning will be more fun, thus fostering motivation, and the meaning of learning materials will be clearer for students to understand to enable them to master and achieve satisfactory results and make students more productive. The learning process should be oriented to the active role of students. In other words, learning is an active process. In line with the development of ICT, the learning process in schools should be designed by utilizing ICT. The role of ICT in active learning is quite significant because ICT can help the learning process become active and students become more productive [43].

3.3 Conative Dimension

A chemistry teacher's perception based on the conative dimension. The statement of the conative dimension consisting of ICT provides increased awareness of teachers about opportunities to use technology in learning and use ICT in learning more effectively. The results of the research from the statement are as follows:

3.3.1 ICT Provides Increased Teacher Awareness About Opportunities to Use Technology in Learning

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 87% which can be seen in Fig. 1 and showed a very strong

category. Based on the dimensions, this has reached the conative dimension, namely, the teacher feels that ICT increases teacher awareness about the opportunities for using technology in learning. So with this, it can be said that the chemistry teacher at the Pontianak City Public High School has a very strong perception of ICT providing increased awareness of teachers about the opportunities for using technology in learning.

This is in line with research conducted by Siahaan [44], which shows that teachers are increasingly utilizing ICT in their learning activities, both in terms of the availability and affordability of ICT equipment procurement, as well as in increasing teacher participation in potential education for the application of ICT in learning activities. Siahaan [45] states that teachers who have been trained on the use of ICT, supported by the network infrastructure and guidance on utilizing ICT, can make teachers more aware and focused on using ICT in the implementation of learning.

3.3.2 Use of ICT Learning More Effectively

Based on the data that the researchers got from the questionnaires that had been distributed, the average was 90% which can be seen in Fig. 1 and showed a very strong category. Based on the dimensions, this has reached the conative dimension: the teacher feels interested in using ICT in learning more effectively. So with this, it can be said that the chemistry teacher at SMA Negeri Pontianak strongly perceives using ICT in learning more effectively.

This is in line with research conducted by Warsihna [46], which states that teachers are responsible for creating space for students to use ICT to develop into the nation's successors with character. The ability of teachers to use ICT effectively to improve the quality of learning is very important. These professional development opportunities through the use of ICT need to accommodate a culture of reflection and innovation and reduce the time they need to complete other tasks outside of teaching.

Based on the explanation above, it is known that the 11 statements in the questionnaire have reached the cognitive, affective, and conative dimensions. This proves that the perception of chemistry teachers at SMA Negeri Pontianak City has reached a very strong category, with an overall average percentage of 11 statements of 84%. The chemistry teacher at SMA Negeri Pontianak City has fulfilled the cognitive, affective, and conative dimensions. Among others, teachers believe, feel, and assess that ICT is useful in learning and teaching. This is in line with research conducted by Anas & Firdaus [13] which found that teachers have a good perception of the use of information and communication technology. Research by Aghari & Shailja [14] also found that teachers perceive ICT programs as more attractive and effective than conventional learning regarding student achievement scores in chemistry subjects. Furthermore, research conducted by Lipinge [15] found that teachers have good perceptions and understand the benefits of combining technology in teaching and learning. In addition, another study conducted by Qohar [16] found that teachers have a good perception of the use of ICT tools in high school learning in the Demak Regency.

4 Conclusion

The benefits of ICT in everyday life, including teaching and learning, are unquestionable. As explained in the description of the data and discussion of learning outcomes above, the researchers concluded that the chemistry teacher at Pontianak City Senior High School had a positive perception of the use of ICT in the teaching and learning process, with an average score of 84% and showed a very strong category, meaning that teachers have a very strong perception of using ICT, thus based on the average results above, it is known that the chemistry teacher at Pontianak City Senior High School has fulfilled the cognitive, affective and conative dimensions, among others teachers believe, feel and assess that ICT is very useful in the learning and teaching process. This was stated in the researchers statement to the chemistry teacher at the Pontianak City Public High School, which was contained in 11 questionnaire statements distributed.

Given the important role of ICT in learning, teachers need to continue to improve their knowledge, understanding, and application in the learning process. Resource availability is a key factor for using ICT in learning. Teachers can optimize the use of ICT in learning by participating in technology-based training programs. This will help teachers in using technology. In addition, teachers will also get information about the use of ICT in learning. In addition, this research can contribution to providing information to the Ministry of National Education and related schools regarding the use of ICT in learning by teachers.

Acknowledgments. Thank you to the Comdev and Outreaching and the Directorate General of Belmawa Kemenristekdikti who have provided the Bidikimisi Scholarship while studying at Tanjungpura University and facilitated researchers by providing research funds to complete this research. The researcher would also like to thank the researcher's parents, supervisors, and all parties involved in this research.

References

1. Istiningsih, *Pemanfaatan TIK dalam Proses Pembelajaran*. Yogyakarta: Skripta Media Creative, 2012.
2. Tech Terms, *Internet Terms. ICT Definition*, 2010.
3. N. Yekini, "Communication [Concepts and Application] By Yekini Nureni Asafe Department of Computer Technology," no. March, pp. 1–288, 2010, <https://doi.org/10.13140/RG.2.1.1802.7289>.
4. J. B. Wise and W. I. O'Byrne, "Social Scholars," *Lit. Res. Theory, Method, Pract.*, vol. 64, no. 1, pp. 398–414, 2015, <https://doi.org/10.1177/2381336915617607>.
5. A. Sinaga and Zainnudin, "Persepsi dan Implementasi Kebijakan Teknologi Informasi Dan Komunikasi Sebagai Sarana Pembelajaran dan Pengaruhnya Terhadap Peningkatan Kualitas Pendidikan Pada SMA Negeri Kota Pematang Siantar," *J. Adm. Publik Univ. Medan Area*, vol. 3, no. 1, pp. 17–44, 2013, [Online]. Available: <http://ojs.uma.ac.id/index.php/adminpublik/article/view/192/145>
6. K. Kusano et al., "The Effects of ICT Environment on Teachers' Attitudes and Technology Integration in Japan and the U.S.," *J. Inf. Technol. Educ. Innov. Pract.*, vol. 12, pp. 029–043, 2013, <https://doi.org/10.28945/1768>.

7. A. L. Lubis, *Akuntansi Keperilakuan*. Jakarta: Salemba Empat, 2010.
8. N. Hudayati, Y. Andayani, and E. Junaidi, "Pengaruh Persepsi Guru Tentang TIK Terhadap Pemanfaatan Teknologi Informasi dan Komunikasi dalam Pembelajaran IPA SMA/MA Se-Kecamatan Gerung," *Chem. Educ. Pract.*, vol. 4, no. 1, p. 84, 2021, <https://doi.org/10.29303/cep.v4i1.2233>.
9. Parlindungan Pardede and Sunarto, "Persepsi Guru Dan Siswa Terhadap Penggunaan Tik Dalam Pembelajaran Di Sekolah Menengah Di Jakarta Dan Sekitarnya," *J. Din. Pendidik.*, vol. 13, no. 3, pp. 226–237, 2020, <https://doi.org/10.33541/jdp.v12i3.1295>.
10. Q. Zhou, J. Hu, and S. Gao, "Chemistry teachers' attitude towards ICT in Xi'an," *Procedia - Soc. Behav. Sci.*, vol. 2, no. 2, pp. 4629–4637, 2010, <https://doi.org/10.1016/j.sbspro.2010.03.741>.
11. Yusuf, "Learning Chemistry by ICT (Virtual Animation) at Maumere High School, East Nusa Tenggara," *J. Educ. Teach. Learn.*, vol. 2, pp. 67–70, 2017.
12. Y. J. Barak, Miri dan Dori, "A Web-Based Chemistry Course as a Means To Foster Freshmen Learning," *J. Chem. Educ.*, vol. 80, 2003.
13. M. Anas, M. T, and Firdaus, "Pemanfaatan Teknologi Informasi dan Komunikasi (TIK) dalam Pembelajaran di Provinsi Sulawesi Tenggara (Studi tentang Persepsi terhadap TIK bagi Guru SMPN se Kota Kendari dan se Kabupaten Kolaka)," *Simp. Pendidik.*, pp. 1–36, 2008, [Online]. Available: [http://directory.umm.ac.id/tik/MuhammadAnas_PemanfaatanInformasiDanKomunikasi\(TIK\).pdf](http://directory.umm.ac.id/tik/MuhammadAnas_PemanfaatanInformasiDanKomunikasi(TIK).pdf)
14. A. Agrahari and S. Shailja, "The impact of ICT on achievement of students in chemistry at secondary level of CBSE and up board in India," *J. Educ. Media*, vol. 2, no. 8, pp. 123–135, 2013.
15. S. Lipinge, "The Integration of Information and Communication Technologies (ICTs) in the Preparation of Teachers at Colleges of Education in Namibia," University of Namibia, Windhoek, 2010.
16. A. Qohar, "Persepsi Guru Dan Siswa Tentang Pemanfaatan Perangkat Teknologi Informasi Dan Komunikasi (TIK) Dalam Pembelajaran Fisika SMA Di Kabupaten Demak," Universitas Negeri Semarang, 2016.
17. Sugiyono, *Metode Penelitian Pendidikan Pendidikan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta, 2011.
18. A. Suharsimi, *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: PT. Rineka Cipta, 2006.
19. M. A. Gebremedhin and A. A. Fenta, "Journal of Education and Practice www.iiste.org ISSN," Online, 2015. [Online]. Available: www.iiste.org
20. Sugiyono, *Metode Penelitian Pendidikan Pendidikan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta, 2017.
21. B. dan Byrne, *Psikologi Sosial*, 10 jilid 2. Jakarta: Pt. Erlangga, 2005.
22. D. Wicaksono, A. Munib, and D. April, "Keefektifan Guru Dalam Membuat Media Pembelajaran Untuk Siswa SMA Negeri 2 Semarang," *Indones. J. Curric. Educ. Technol. Stud.*, vol. 1, no. 1, 2014.
23. J. Jamaluddin, M. K. Mustami, M. I. Ismail, and S. Mania, "Pengaruh Pemanfaatan Bahan Ajar Berbasis Tik dan Bahan Cetak Terhadap Motivasi Belajar pada Mata Pelajaran Aqidah Akhlak di MAN 1 Sinjai," *Edukasi Islam. J. Pendidik. Islam*, vol. 11, no. 01, p. 621, 2022, <https://doi.org/10.30868/ei.v11i01.1956>.
24. A. Arsyad, *Media Pembelajaran*. Jakarta: PT. Raja Grafindo Persada, 2013.
25. L. Mislinawati, Sahelatua, L. S., Vitoria, "Kendala Guru Memanfaatkan Media IT Dalam Pembelajaran DI SDN 1 Pagar Air Aceh Besar," *J. Ilm. Pendidik. Guru Sekol. Dasar*, vol. 3, pp. 131–140, 2018.
26. R. Siahaan, Sudirman & Rivalina, "Perkembangan Pendidikan Terbuka Dan Jarak Jauh Di Indonesia," *J. Teknodik*, vol. 8, pp. 59–72, 2013.

27. Supiandi, M. Iyus, and Y. Lisa, "The Utilization of Information and Communication Technology (ICT) on Learning in the 21st Century," *Int. J. Acad. Res. Dev. Int.*, vol. 3, no. 2, pp. 869–875, 2018, [Online]. Available: <file:///C:/Users/Admin/Downloads/3-2-27-207.pdf>
28. S. Goswami, M. S. Uddin, and M. R. Islam, "Implementation of Active Learning for ICT Education in Schools," *Int. J. Innov. Sci. Res. Technol.*, vol. 5, no. 9, pp. 455–459, 2020, <https://doi.org/10.38124/ijisrt20sep236>.
29. H. Sadykov, T dan Ctractova, "Interactive lessons with ICT in chemistry education," *Eruditio-Educatio*, vol. 15(1), pp. 095–110, 2020.
30. Frydrychova Klimova dan Petra Poulova, "STUDENTS ' PREFERENCES FOR ONLINE STUDY MATERIALS," 2014.
31. A. Nursyam, "Peningkatan Minat Belajar Siswa Melalui Media Pembelajaran Berbasis Teknologi Informasi," *Ekspose J. Penelit. Huk. dan Pendidik.*, vol. 18, no. 1, pp. 811–819, 2019, <https://doi.org/10.30863/ekspose.v18i1.371>.
32. and M. A. Hollman, Angela, Travis J Hollman, Frank Shimerdla, Matthew R Bice, "Information Technology Pathways in Education: Interventions with Middle School Student," *Comput. Educ.*, 2019.
33. S. A. D. Arghya Ray, Pradip Kumar Bala, "Role of authenticity and perceived benefits of online courses on technology based career choice in India: A modified technology adoption model based on career theory," *Int. J. Inf. Manage.*, vol. 47, pp. 140–151, 2019.
34. Y. Miarso, *Menyemai Benih Teknologi Pendidikan*. Jakarta: Kencana, 2009.
35. F. N. Iman, "Indonesian Journal of Curriculum and Educational Technology Studies Evaluating The Use Of ICT For Evaluating The Use Of ICT For Learning Process By Teachers Of SMPN 1 Ungaran In Order To Implement The Curriculum 2013," *Ijceets*, vol. 3, no. 1, p. 50229, 2015, [Online]. Available: <http://journal.unnes.ac.id/sju/index.php/jktp>
36. I. A. Huda, "Irkham Abdaul Huda,Perkembangan Teknologi Informasi Dan Komunikasi (Tik) Terhadap Kualitas Pembelajaran Di Sekolah Dasar,Jurnal Pendidikan dan Konseling,Vol2No1,2020:hal121.," *J. Pendidik. dan Konseling*, vol. 2, no. 1, pp. 121–125, 2020.
37. C. Ismaniati, "Penggunaan teknologi dalam proses pendidikan jasmani merupakan salah satu bentuk dari transpormasi pada dunia pendidikan," *J. Univ. Negeri Yogyakarta*, 2010.
38. W. Imam Subakti, "Pengaruh Pembelajaran Diluar Kelas Dan Didalam Kelas Dengan Model Pembelajaran Problem Based Learning (PBL) Terhadap Hasil Belajar Mata Pelajaran Matematika Pada Siswa Kelas VII," *Universitas Muhammadiyah Ponorogo*, 2016.
39. Fatmawati, "Pemanfaatan Media Teknologi Informasi Sebagai Akses Meningkatkan Mutu Pendidikan Dalam Persaingan Dunia Pendidikan di Era Global," *Pros. Semin. Nas. 21 Univ. PGRI Palembang*, 2018.
40. A. C. Cholik, "Pemanfaatan Teknologi Informasi dan Komunikasi untuk Meningkatkan Pendidikan di Indonesia," *Syntax Lit. J. Ilm. Indones.*, vol. 2, 2017.
41. W. Sanjaya, *Media Komunikasi Pembelajaran*. Jakarta: Kencana Prenada Media group, 2014.
42. N. & Sudjana and A. Rivai, *Media Pembelajaran*. Jakarta: Sinar Baru Algensindo Offset, 2010.
43. J. Warsihna, "Pemanfaatan TIK untukPendidikan (e-learning) di SMP," *J. Teknodik*, vol. 17 Nomor 1, 2013.
44. S. Siahaan, "Pemanfaatan Teknologi Informasi Dan Komunikasi Dalam Pembelajaran: Peluang, Tantangan, Dan Harapan," *J. Teknodik*, pp. 321–332, 2015, <https://doi.org/10.32550/teknodik.v19i3.173>.
45. S. Siahaan, "Menuju Arah Pendidikan Berkualitas di Daerah Tertinggal dan Perbatasan Melalui Pemanfaatan TIK," *J. Teknodik*, vol. 17, no. 1, pp. 596–605, 2013.
46. J. Warsihna, "Peranan Tik Dalam Pembelajaran Di Sekolah Dasar Sesuai Kurikulum 2013," *J. Teknodik*, vol. 18, pp. 156–164, 2015, <https://doi.org/10.32550/teknodik.v0i0.120>

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

