



## Information And Communication Technology (ICT) Skills: Are They Important For Prospective Mathematics Teachers?

Putri Yulianti<sup>1</sup>, Rhomiy Handican<sup>2\*</sup>

<sup>1,2</sup> Institut Agama Islam Negeri Kerinci, Sungai Penuh, Indonesia

Email : putriyulianti300703@gmail.com <sup>1</sup>, handicanrhomiy@gmail.com<sup>2\*</sup>

### ARTICLE INFO

#### Article history:

Available online April 05, 2023

**Kata Kunci:** Persepsi, Kemampuan ICT, Media Pembelajaran, Guru Matematika

**Keywords:** Perception, ICT Capability, Learning Media, Mathematics Teacher



This is an open access article under the [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/) license.

Copyright © 2023 by Author. Published by Institut Agama Islam Negeri Kerinci

### Abstrak

*Pada saat ini tuntutan pendidikan semakin modern dimana para guru dituntut harus mampu menyesuaikan diri dengan perkembangan teknologi yang semakin canggih. Kemampuan dalam bidang Informasi and Technology (ICT) menjadi hal penting yang harus dikuasai untuk mampu menghasilkan guru matematika yang mampu menjawab tantangan abad 21 dibidang integrasi teknologi dalam pembelajaran. Tujuan dari penelitian ini adalah untuk melihat pandangan mahasiswa Tadris Matematika terhadap pentingnya kemampuan ICT untuk dapat dikuasai calon guru matematika dalam membuat media pembelajaran berbasis ICT. Penelitian ini merupakan penelitian kualitatif deskriptif jenis survey yang di lakukan di Institut Agama Islam Negeri Kerinci dengan menyebarkan angket kepada 67 mahasiswa di jurusan tadris matematika dari berbagai tingkatan. Dari penelitian yang di lakukan diperoleh 59.5% mahasiswa dapat membuat media pembelajaran berbasis ICT, 73% mahasiswa pernah membuat media pembelajaran, 72.4% mahasiswa menyatakan ingin memperdalam kemampuannya dalam memanfaatkan kemampuan ICT untuk membuat media pembelajaran. Peneliti dapat menyimpulkan dari hasil temuan bahwa pengetahuan Informasi dan Communication Tcnology ini sangat penting bagi mahasiswa sebagai calon guru pendidikan matematika yang nantinya akan menghadapi revolusi teknologi yang semakin berkembang pada saat ini.*

### Abstract

At this time the demands of education are increasingly modern where teachers are required to be able to adapt to the development of technology that is increasingly developed at this time. The ability in the field of Information and Technology (ICT) is an important thing at this time that must be mastered to be able to produce math teachers who have competence in the field of ICT. The purpose of this research is to see the views of mathematics tadriss students regarding the importance of ICT skills to be mastered by prospective mathematics teachers in making ICT-based learning media. This research is a descriptive qualitative research type of survey conducted at the Kerinci State Islamic Institute by distributing questionnaires to 67 students in the mathematics tadriss department from various levels. From the research conducted obtained 59.5% of students can make ICT-based learning media, 73% of students have made learning media, 72.4% of students stated that they wanted to deepen their ability to utilize ICT capabilities to make learning media. Researchers can conclude from the findings that the knowledge of Information and Communication Tcnology is very important for students as prospective mathematics education teachers who will face the technological revolution that is increasingly developing at this time.

### INTRODUCTION

Technology has undergone rapid development in the past few decades, and has influenced various aspects of life, including learning (Maslin, 2021). Online learning has become more common, with many schools and universities offering online classes and distance learning programs (Ali, 2020). Interactive learning software such as Kahoot and Quizlet have become popular to increase student participation and mastery of material (Ali, 2020). Mobile apps such

as Duolingo and Babbel have made learning foreign languages easier and more fun (Nushi & Eqbali, 2018). Virtual reality and augmented reality are also starting to be used in learning to increase student engagement and make learning more fun (Jumani et al., 2022). However, technology still has weaknesses and doubts in its implementation in learning, so research and evaluation are still needed to evaluate the effectiveness of technology in learning (Ayu Ardani et al., 2018).

ICT (Information and Communication Technology) is one of the important factors in the utilization of technology in learning (Salsabila et al., 2020). ICT allows quick and easy access to information, and provides the ability to communicate and coordinate remotely (Rodriguez Casal, 2014). With ICT, learning can be done online and is not limited by time and place. ICT can also be used to create and disseminate interactive learning content, such as videos, animations and simulations, which can enhance student engagement and mastery of the material (Handican & Setyaningrum, 2021). ICT can also be used to collect and analyze learning data, which can assist teachers in evaluating student progress and adjusting learning strategies (Ghavifekr & Rosdy, 2015). However, in order to make good use of ICT in learning, it requires sufficient infrastructure and resources as well as skills in using the technology. In addition, ICT also helps in the development of innovation and enhances global connectivity. As such, ICT capabilities are now a key factor in enhancing a country's competitiveness and economic growth (Chandra & Pouchous, 2017).

In addition, ICT (Information and Communication Technology) skills are also very important in the field of education in the era of revolution 4.0 because it allows more flexible and interactive learning (Lase, 2019). ICT can be used to make learning materials more interesting and easy to understand, such as videos, animations and simulations (Suyatna, 2020). ICT also enables distance learning (online learning) which makes education more accessible for students around the world (Boruah, 2022). In addition, ICT also helps in data management and evaluation of learning outcomes, thus facilitating the learning process and curriculum development. Good ICT skills will improve the quality of education and help students to be better prepared to face the challenges of the 4.0 revolution era (Rahmatullah et al., 2022).

Teachers have a very important role in improving the quality of education and preparing students to face challenges in the 4.0 revolution era (Nababan et al., 2020). Therefore, teachers must have good ICT skills to be able to integrate technology in the learning process. Teachers' ICT skills will enable them to present more interesting and interactive learning materials, thereby improving student motivation and learning outcomes (Amin & Mustaqim, 2021). Teachers with good ICT skills can also manage data and evaluation of learning outcomes more efficiently, so as to identify student weaknesses and provide appropriate support (Ghavifekr et al., 2006). Good ICT skills can also help teachers communicate with students, parents and peers, strengthening collaboration in the learning process (Organisation for Economic Co-operation and Development, 2020). Overall, good ICT skills will help teachers improve the quality of education and prepare students to face the challenges of the 4.0 revolution (Nababan et al., 2020).

ICT (Information and Communication Technology) skills are also very important for students who will become prospective teachers in the 4.0 revolution era (Rohita, 2020). This ability will help them integrate technology in the learning process, so as to increase student motivation and learning outcomes (Winarto, 2020). Students who have good ICT skills will be able to present more interesting and interactive learning materials, such as videos, animations, and simulations. This ability will also help in data management and evaluation of learning outcomes, so as to identify student weaknesses and provide appropriate support (Haleem et al., 2022). Students who have good ICT skills can also participate in distance learning and connect with relevant learning resources, so as to improve the quality of learning and preparation to become teachers who are ready to face challenges in the era of revolution 4.0. Good ICT skills can also help students communicate with peers and parents, thus strengthening cooperation in the learning process (Lase, 2019). Overall, good ICT skills will help students prepare to become

teachers who are ready to face challenges in the 4.0 revolution era and can improve the quality of education.

Future teachers' understanding of ICT capabilities in learning is crucial as ICT has become an integral part of daily life and will continue to grow in the future (Garg, 2021). By understanding ICT capabilities in learning, prospective teachers will be able to evaluate and adjust their learning strategies to improve student learning outcomes. ICT can be used to create interactive and engaging learning content, increase student participation and mastery of material, and collect and analyze learning data (Ghavifekr et al., 2014). In addition, ICT can also be used to communicate and coordinate with students, parents and peers, and access diverse learning resources. Therefore, prospective teachers who understand ICT capabilities in learning will be able to provide more effective and efficient learning, and be ready to face future technological developments.

There are several advantages of ICT (Information and Communication Technology) based learning media that can improve the quality of learning and help students to learn more effectively (Al-Ansi et al., 2021) :

- 1) Interactive: ICT-based learning media can present more interactive and interesting learning materials, such as videos, animations, and simulations, which can make students more involved in the learning process;
- 2) Flexible: ICT-based learning media allows students to learn anytime and anywhere, thus increasing the flexibility of learning;
- 3) Accessibility: ICT-based learning media makes learning materials more accessible to students, especially through distance learning (online learning);
- 4) Evaluation: ICT-based learning media can assist in data management and evaluation of learning outcomes, so as to identify student weaknesses and provide appropriate support;
- 5) Collaboration: ICT-based learning media can be used to communicate and cooperate with peers and parents, so as to strengthen cooperation in the learning process.

Overall, ICT-based learning media can improve the quality of learning and help students to learn more effectively and be ready to face challenges in the era of revolution 4.0.

Low teacher proficiency in ICT (Information and Communication Technology) can have a negative impact on the quality of education and the preparation of students to face the challenges of the 4.0 revolution era. Some of the possible impacts are (Rohita, 2020) among others:

- 1) Lack of creativity in learning: Teachers who lack ICT skills will find it difficult to present interesting and interactive learning materials, which can reduce student motivation and learning outcomes;
- 2) Lack of efficiency in data management: Teachers who lack ICT skills will find it difficult to manage data and evaluate learning outcomes, which can reduce the quality of education and student preparation;
- 3) Lack of accessibility: Teachers who lack ICT skills will struggle to provide access to learning materials through technology, which can reduce the quality of education and student preparation;
- 4) Lack of collaboration: Teachers who lack ICT skills will find it difficult to communicate and collaborate with colleagues and parents, which can reduce the quality of education and student preparation;
- 5) Lack of preparation for the 4.0 revolution: Teachers who lack ICT skills will find it difficult to prepare students for the challenges of the 4.0 revolution.

Overall, teachers' low proficiency in ICT can have a negative impact on the quality of education and students' preparation for the challenges of the 4.0 revolution.

There are several studies that also look at perceptions of ICT capabilities in learning, such as research by Pardede and Sunarto which explains that the use of ICT in learning is still very low (Parlindungan Pardede & Sunarto, 2020), research by Mawarni, et al, which states that the perception of prospective chemistry teachers in the use of ICT is categorized as very good (Mawarni et al., 2021), as well as research by Rizaldi, et al which states that ICT skills are very important for an English teacher to have as evidenced by the ability of English teachers to utilize ICT in learning (Rizaldi & Yana, 2022). However, none of the three studies above specifically explain the perceptions of prospective students who will become mathematics teachers in the future. This is important to see the direction of the development of the world of education, especially mathematics education.

Based on recent studies, there are several findings that show that the use of technology and innovation in mathematics teaching can increase students' motivation and engagement in

learning mathematics, improve problem-solving and critical skills, and help students to understand abstract mathematical concepts more easily. However, research also shows that the use of technology should not be the only way to teach mathematics. There are several studies that show that traditional teaching methods such as the use of textbooks and whiteboards remain effective in helping students understand complex mathematical concepts.

To understand the novelty of the research on "Are They Important For Prospective Mathematics Teachers?", more information on the topic and methodology of the research is needed. However, it can be assumed that this research may be concerned with the role of technology use in the training of prospective mathematics teachers, and the extent to which technology can help improve prospective teachers' teaching skills in facilitating effective mathematics learning. Based on the problems described above, researchers are interested in knowing the views of students as prospective mathematics teachers regarding how important ICT skills are to be applied in making mathematics learning media.

## **METHOD**

This research is a descriptive qualitative research that aims to see the views of students as prospective mathematics teachers about the use of ICT in the learning process. The subjects of this study were mathematics tadaris students of the Kerinci State Islamic Institute consisting of 67 students consisting of various semester levels of students who were carried out in the odd semester of 2022/2023. This research instrument is a questionnaire with several questions and statements regarding the Information And Communication Technology (ICT) capabilities possessed by students by utilizing Google form facilities in the distribution process.

Sampling using snowball sampling technique where students who access the google form link are sampled by spreading information through word of mouth. The instrument uses a 1-3 Likert scale with answer options, namely agree, neutral, and disagree. Some questions are shown in Table 1.

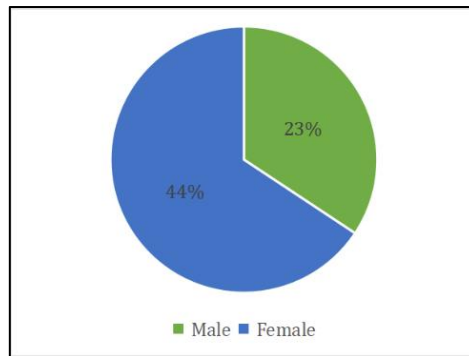
**Table 1.** Student View Questions And Statements

<b>Question/Statement</b>
I can create learning media based on Information and Communication Technology (ICT).
Have you ever made learning media based on Information and Communication Technology (ICT)?
I want to deepen my skills in creating learning media based on Information and Communication Technology (ICT).
Name the application/software you use to create Information And Communication Technology (ICT) based learning media.

Answers to questions and statements provided by respondents are processed into qualitative data using descriptive statistical analysis. Then the data is continued by describing the results of the processed data into a discussion in this study.

## **RESULT AND DISCUSSION**

Based on the results of research obtained by researchers on 67 (thirty-seven) students (respondents) about Information And Communication Technology capabilities. The respondent's picture can be seen in Figure 1.

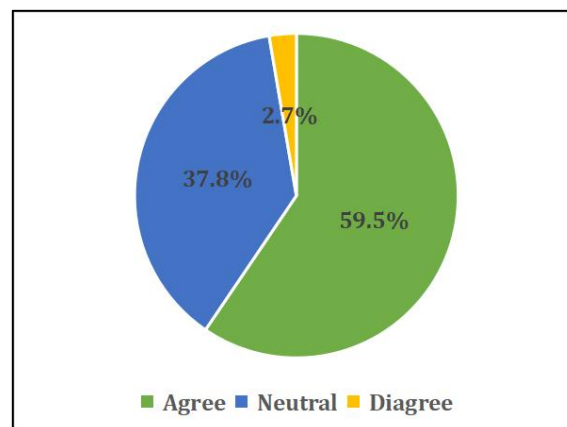


**Figure 1:** Research Respondents

Based on Figure 1, it can be seen that the majority of respondents are female with a percentage of 44%. This indicates that the tendency to become a math teacher is female. Females are more interested in becoming math teachers for several reasons. Firstly, women tend to do better in mathematics than men. Several studies have shown that women tend to get better grades in math during school and are more likely to pursue a career in math (Shadreck Mandina et al., 2013). Secondly, women are often expected to be kind and caring educators, which is a trait that suits the teaching profession. Women also tend to be more interested in subject areas that include cognitive development, such as mathematics, which is closely related to learning (Stewart-Williams & Halsey, 2021). Third, women tend to be more attracted to professions that are expected of them that match their interests and talents, education is an expected field for women, so more women are interested in pursuing education careers compared to men (Carroll et al., 2021). However, these are just some of the reasons that may influence women to be more interested in becoming math teachers, and do not apply to all women. Every individual has different interests and talents, so it is important to respect individual career choices and provide the necessary support to reach their potential.

**Question 1: I can create learning media based on information and communication technology (ICT).**

The results of research on 67 students about student knowledge about learning media based on information and communication technology. Can be seen in Figure 2 below.



**Figure 2:** Data On The Ability To Utilize ICT For Learning Media

Based on Figure 3.1 shows that 59.5% of students who stated "Agree" made ICT-based learning media, 37.8% who stated "Neutral", and only 3.3% who stated "disagree". Meanwhile, this ICT ability is very important for students who will later become prospective teachers in order to be able to create a creative and innovative generation (Maylitha et al., 2022). ICT allows teachers to provide more interactive and engaging learning materials and help students learn in a more effective way. ICT also allows teachers to provide quick and detailed feedback and assist

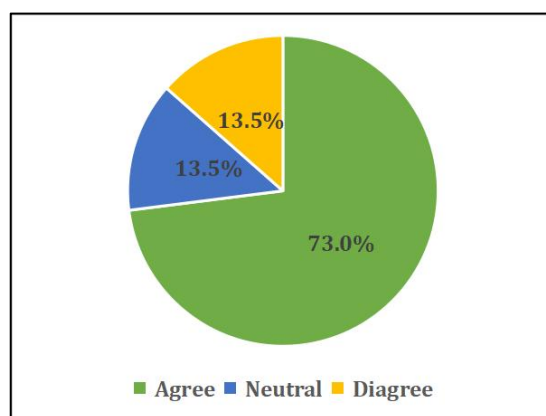


in classroom management. By mastering ICT, teachers can improve the quality of learning and help students to learn in a more effective and enjoyable way (Setyoningsih, 2015). Therefore, as prospective teachers, we must equip ourselves with the ability to use technology as an educational tool.

According to the author's assumption, teachers should optimize ICT (Information and Communication Technology) skills to improve the quality of learning and help students learn in a more effective and enjoyable way. This is in line with research by Mulatsih who said that in the learning process at this time using various applications and technology tools available such as Google Classroom, Kahoot, Quizlet, etc. to provide interactive and interesting learning materials. (Mulatsih, 2020). ICT skills are very important for prospective mathematics teachers in implementing learning. ICT can be used to create interactive and engaging mathematics learning content, such as animated videos, simulations, and mathematics software that can be used to present abstract concepts in visual form (Kramarenko et al., 2021). ICT capabilities can also be used to collect and analyze learning data, which can assist teachers in evaluating student progress and adjusting learning strategies (Redecker, 2013). ICT also allows prospective teachers to communicate and coordinate with students, parents and peers, and access diverse learning resources (Ghavifekr et al., 2014). In addition, ICT can also be used to increase student participation and mastery of material through interactive learning software such as Kahoot and Quizlet. ICT skills will help prospective mathematics teachers to provide more effective and efficient learning, and to be ready for future technological developments.

**Question 2: Have you ever made learning media based on Information and Communication Technology (ICT)?**

The results of research on students' ability to create ICT-based learning media can be seen in Figure 2:



**Figure 3.** Data Of Students Who Have Made ICT-Based Learning Media

Based on Figure 3.2 shows that of the 73% of students who stated "Agree", 13.5% of students who stated "Neutral" and 13.5% of students who stated "Disagree". This student answer should be considered regarding the material taught in college in order to optimize students' abilities in the field of ICT which will later affect the competence of teachers in using ICT in the teaching process. This is in line with research (Astini, 2019) which states that teacher competence in the field of ICT is very important to prepare students to adapt to an increasingly developing environment and be able to compete in the world of work. This can also be the first step to equip students to optimize knowledge in the field of ICT in order to be able to face revolution 4.0.

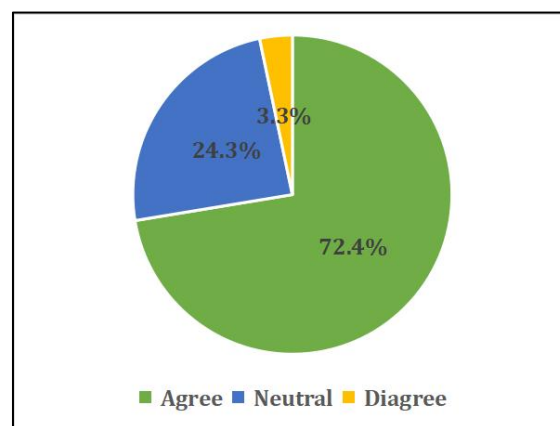
According to the author's assumption, students as prospective teachers must master ICT skills because they can help improve the effectiveness and efficiency of the learning process. With the ability to use ICT in learning, teachers can increase student participation and

motivation, as well as provide access to wider and more diverse learning resources. This is reinforced by research (Myori et al., 2019) Teachers' competence in ICT can also help in improving the quality of learning by providing more interactive and fun learning methods. It also helps in improving students' skills in using technology which is essential in modern life.

Mathematics teachers need the ability to create learning media for several reasons. First, learning media can be used to present abstract mathematical concepts in a visual form that is more easily understood by students (Witaharahap & Surya, 2017). Learning media such as animated videos, simulations, and math software can help students to understand mathematical concepts better and improve mastery of the material. Second, learning media can be used to increase student participation and learning motivation (Puspitarini & Hanif, 2019). Interactive learning media such as interactive learning software like Kahoot and Quizlet can increase students' participation in learning math and increase their motivation to learn. Third, learning media can be used to collect and analyze learning data, which can help mathematics teachers to evaluate students' progress and adjust learning strategies (Witaharahap & Surya, 2017). The ability to create learning media will help mathematics teachers to provide more effective and efficient learning, and be ready to face the upcoming technological developments.

**Question 3: I want to deepen my skills in creating learning media based on Information and Communication Technology (ICT).**

Based on the results obtained about student interest in learning and expanding knowledge in the field of Information And Communication Technology. Can be seen in Figure 4:



**Figure 4.** Saya Ingin Memperdalam Kemampuan Dalam Membuat Media Pembelajaran Berbasis Information And Communication Technology (ICT)

Based on Figure 4 shows that 72.4% of students who stated "Agree", 24.3% of students who stated "Neutral", and only 2.7% of students who stated "Disagree". From the data exposure above, in general, student interest in improving ICT skills is very large, this is supported by the opinions of students who state that ICT skills are important for prospective teachers. ICT skills can help students improve pedagogical competencies, such as managing ICT resources and evaluating and adjusting their use to meet the needs of students (Rivalina, 2015). ICT skills are very important for students as prospective educators to be able to provide relevant education and prepare students to adapt to an increasingly developing environment and be able to compete in the world of work (Hidayat et al., n.d.).

According to the author's assumption, there are students who do not agree with the existence of this ICT capability because they do not master ICT skills. This is in line with research (Tina Arantika, 2018) which states that there is a lack of knowledge about the benefits of ICT technology in a career or profession. Lack of practical experience in using ICT technology is one of the factors in students' lack of interest in improving their ICT skills (Kidi, 2018).

Mathematics students are very interested in being able to use ICT in learning mathematics for several reasons. First, ICT can be used to present abstract mathematical concepts in a visual form that is easier to understand, such as animated videos, simulations, and math software (Sivakova et al., 2017). This can help students to understand mathematical concepts better and improve mastery of the material. Second, ICT can be used to increase student participation and motivation to learn. Interactive learning media such as interactive learning software like Kahoot and Quizlet can increase students' participation in learning mathematics and increase their motivation to learn (Puspitarini & Hanif, 2019). Third, ICT can be used to access diverse learning resources and improve the quality of learning (Bera, 2015). Students can access diverse learning resources through the internet, such as video tutorials, learning applications, and scientific articles that can help them to deepen their understanding of mathematics.

**Question 4: Name the application/software you use to create Information And Communication Technology (ICT) based learning media.**

The following table presents a recap of the ICT used by students in making learning media. This answer is reduced based on the type of application used.

**Table 2.** Applications Utilized In Creating Learning Media

No	Applications used	Frequency	Percentage
1	Animated Video (Youtube, powerpoint, etc.)	14	20.9%
2	Simulation (e.g. educational games, macromedia, quiz, khot, etc.)	31	46.3%
3	Math Software (e.g. Geogebra, delphi, matlab, maple, etc.)	17	25.4%
4	e-books (e.g. e-LKPD, e-materials, etc.)	5	7.5%

From the questions asked by researchers to see what applications (software) are used to create learning media such as: macromedia flash, delphi, matlab, etc.. Researchers obtained data that the applications (software) used by students in the process of making ICT-based learning media such as animated videos, simulation applications, math software, and e-books. This skill is what will help students in facing an increasingly modern education system, besides that the teaching and learning process is now not only done face-to-face but can be done online. In addition, not only the learning process is ICT-based, but computer-based tests/evaluations with various application models are starting to be developed (Imania & Bariah, 2019).

According to the author's assumption, the application/software can be accessed from anywhere and anytime, so that students can learn outside of school hours or outside of class, can be tailored to the individual needs of students, such as difficulty level, learning speed, and learning preferences. This is reinforced by research stating that educational applications can be used to measure student performance and provide fast and accurate feedback (Manongga et al., 2022).

The results of the study "Are They Important For Prospective Mathematics Teachers?" provide important implications for further research in the field of mathematics education. This study shows that the ability of prospective mathematics teachers to understand and apply basic mathematical concepts is important in their preparation as teachers. The first implication is that further research needs to be conducted to explore the factors that influence students' ability to understand and apply basic mathematical concepts. These include factors such as previous mathematics education, learning environment, and individual characteristics. The second implication is that research needs to be conducted to develop effective learning strategies to help student teachers gain a better understanding of basic mathematical concepts. These strategies could involve the use of modern technology such as interactive math software,



project-based learning methods, and integrated learning approaches. The third implication is that further research is needed to evaluate the effectiveness of current mathematics teacher preparation programs in helping student teachers to understand and apply basic mathematical concepts. This evaluation can help improve mathematics teacher preparation programs and ensure that pre-service teachers have a solid understanding of basic mathematical concepts before they enter the classroom as teachers.

Thus, the results of the study "Are They Important For Prospective Mathematics Teachers?" have important implications for further research in the field of mathematics education, and indicate the need for continued research in developing effective learning strategies and effective mathematics teacher preparation programs.

## CONCLUSION

From the exposure to the discussion above, it can be concluded that tadriss matemathematics students think that learning and increasing knowledge about ICT is very important for prospective teachers. From the research conducted, 59.5% of students can make ICT-based learning media, 73% of students have made learning media, 72.4% of students stated that they wanted to deepen their ability to utilize ICT capabilities to make learning media. This is because students think that as prospective mathematics teachers, this ability can facilitate teaching and learning activities, the material provided is also easy to understand, not monotonous, learning can take place pleasantly and disappear negative assumptions about mathematics and reinforced by research which states that students will be more interested and also adaptive to mathematics material taught using technology-based learning media. This also has a positive impact on prospective math teachers who can form professional, innovative, creative teachers, and facilitate student learning effectively and efficiently.

## REFERENCES

- Al-Ansi, A. M., Garad, A., & Al-Ansi, A. (2021). ICT-Based Learning During Covid-19 Outbreak: Advantages, Opportunities and Challenges. *Gagasan Pendidikan Indonesia*, 2(1), 10. <https://doi.org/10.30870/gpi.v2i1.10176>
- Ali, W. (2020). Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic. *Higher Education Studies*, 10(3), 16. <https://doi.org/10.5539/hes.v10n3p16>
- Amin, M., & Mustaqim, B. (2021). Vocational Teachers Readiness in Integration The Principles of Industrial Revolution 4 . 0 into The Learning Process. *Elinvo (Electronics, Informatics, and Vocational Education)*, 6(2), 106–119.
- Astini, N. K. S. (2019). Pentingnya Literasi Teknologi Informasi Dan Komunikasi Bagi Guru Sekolah Dasar Untuk Menyiapkan Generasi Milenial. *Prosiding Seminar Nasional Dharma Acarya*, 1(2018), 113–120.
- Ayu Ardani, R., Humaira Salsabila, N., Handican, R., & Setyaningrum, W. (2018). *The Perceptions of Students and Teachers About The Use of Edutainment Instructional Media in Mathematics Learning*. 160(Incomed 2017), 228–234. <https://doi.org/10.2991/incomed-17.2018.49>
- Bera, S. (2015). Enhancing Quality of Teaching Learning By Using Information and Communication Technology (Ict). *Scholarly Research Journal For Interdisciplinary Studies*, 3(18), 100–101. [www.srjis.com](http://www.srjis.com)
- Boruah, N. (2022). Impact of ICT in education. *International Journal of Health Sciences*, 6(March), 1818–1822. <https://doi.org/10.53730/ijhs.v6ns2.5397>
- Carroll, D., Parasnis, J., & Tani, M. (2021). Why do women become teachers while men don't? *B.E. Journal of Economic Analysis and Policy*, 21(2), 793–823. <https://doi.org/10.1515/bejeap-2020-0236>
- Chandra, A. C., & Pouchous, K. I. (2017). Information and Communication Technology (ICT)

Industry in the Fourth Industrial Revolution. ... and Challenges for Workers in Asia ..., January 2017, 1-29.

Garg, R. (2021). *Role of ICT in Teaching and Learning*. March.

Ghavifekr, S., Ahmad Zabidi Abd Razak Muhammad Faizal A. Ghani, Ng Yan Ran, Yao Meixi, & Zhang Tengyue. (2014). ICT Integration In Education: Incorporation for Teaching & Learning Improvement. *Malaysian Online Journal of Educational Technology*, 2(2), 24-54. <http://www.mojet.net/article.php?volume=2&issue=2&vid=34&article=80>

Ghavifekr, S., Kunjappan, T., Ramasamy, L., Anthony, A., & My, E. (2006). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. *Malaysian Online Journal of Educational Technology*, 4(2), 38-57. [www.mojet.net](http://www.mojet.net)

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, 1(2), 175-191. <https://doi.org/10.21890/ijres.23596>

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3(February), 275-285. <https://doi.org/10.1016/j.susoc.2022.05.004>

Handican, R., & Setyaningrum, W. (2021). Developing a Mobile Game Using Scientific Approach to Support Mathematics Learning. *Edumatika : Jurnal Riset Pendidikan Matematika*, 4(1), 47-58. <https://doi.org/10.32939/ejrpm.v4i1.607>

Hidayat, R., Ag, S., & Pd, M. (n.d.). *Buku Ilmu Pendidikan Rahmat Hidayat & Abdillah*.

Imania, K. A., & Bariah, S. K. (2019). Rancangan Pengembangan Instrumen Penilaian Pembelajaran Berbasis Daring. *Jurnal Petik*, 5(1), 31-47. <https://doi.org/10.31980/jpetik.v5i1.445>

Jumani, A. K., Siddique, W. A., Laghari, A. A., Abro, A., & Khan, A. A. (2022). Virtual Reality and Augmented Reality for Education. *Multimedia Computing Systems and Virtual Reality*, March, 189-210. <https://doi.org/10.1201/9781003196686-9>

Kidi. (2018). Teknologi Dan Aktivitas Dalam Kehidupan Manusia. *Jurnal Pendidikan*, 28, 1-28.

Kramarenko, T., Bondar, K., & Shestopalova, O. (2021). The ICT usage in teaching mathematics to students with special educational needs. *Journal of Physics: Conference Series*, 1840(1). <https://doi.org/10.1088/1742-6596/1840/1/012009>

Lase, D. (2019). Education And Industrial Revolution 4.0 Delipiter. *Jurnal Handayani (JH)*, 10(1), 48-62. <https://doi.org/10.24114/jh.v10i1>

Manongga, D., Rahardja, U., Sembiring, I., Lutfiani, N., & Yadila, A. B. (2022). Dampak Kecerdasan Buatan Bagi Pendidikan. *ADI Bisnis Digital Interdisiplin Jurnal*, 3(2), 41-55. <https://doi.org/10.34306/abdi.v3i2.792>

Maslin, N. M. (2021). Impact of Modern Technology. *HF Communications*, 3, 165-182. <https://doi.org/10.1201/b12574-14>

Mawarni, P., Milama, B., & Sholihat, R. N. (2021). Persepsi Calon Guru Kimia Mengenai Literasi Digital Sebagai Keterampilan Abad 21. *Jurnal Inovasi Pendidikan Kimia*, 15(2), 2849-2863. <https://doi.org/10.15294/jipk.v15i2.28394>

Maylitha, E., Hikmah, S. N., Hanifa, S., Guru, P., & Dasar, S. (2022). Pentingnya Information and Communication Technology bagi Siswa Sekolah Dasar dalam Menghadapi Abad 21. *Jurnal Pendidikan Tambusai*, 6(1), 8051-8062.

Mulatsih, B. (2020). Penerapan Aplikasi Google Classroom, Google Form, dan Quizizz dalam Pembelajaran Kimia di Masa Pandemi Covid-19. *Ideguru: Jurnal Karya Ilmiah Guru*, 5(1),

16–26.

- Myori, D. E., Chaniago, K., Hidayat, R., Eliza, F., & Fadli, R. (2019). Peningkatan Kompetensi Guru dalam Penguasaan Teknologi Informasi dan Komunikasi melalui Pelatihan Pengembangan Media Pembelajaran Berbasis Android. *JTEV (Jurnal Teknik Elektro Dan Vokasional)*, 5(2), 102. <https://doi.org/10.24036/jtev.v5i2.106832>
- Nababan, T. M., Purba, S., & Siburian, P. (2020). The Challenge of Being a Teacher in Industrial Revolution 4.0. *Advances in Social Science, Education and Humanities Research*, 488(Aisteel), 219–223. <https://doi.org/10.2991/assehr.k.201124.047>
- Nushi, M., & Eqbali, M. H. (2018). Babel : A Mobile Language Learning App Babel : A Mobile Language Learning App Review by Musa Nushi and Mohamad Hosein Eqbali. *TESL Reporter*, 51(1), 109–119.
- Organisation for Economic Co-operation and Development. (2020). ICT resources in school education: What do we know from OECD work? *European University Institute*, 2, 2–5.
- Parlindungan Pardede, & Sunarto. (2020). Persepsi Guru Dan Siswa Terhadap Penggunaan Tik Dalam Pembelajaran Di Sekolah Menengah Di Jakarta Dan Sekitarnya. *Jurnal Dinamika Pendidikan*, 13(3), 226–237. <https://doi.org/10.33541/jdp.v12i3.1295>
- Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, 4(2), 53–60. <https://doi.org/10.29333/aje.2019.426a>
- Rahmatullah, A. S., Mulyasa, E., Syahrani, S., Pongpalilu, F., & Putri, R. E. (2022). Digital Era 4.0: The Contribution to Education and Student Psychology. *Linguistics and Culture Review*, 6(S3), 89–107.
- Redecker, C. (2013). *The Use of ICT for the Assessment of Key Competences* (Issue October). <https://doi.org/10.2791/87007>
- Rivalina, R. (2015). Kompetensi Teknologi Informasi Dan Komunikasi Guru Dalam Peningkatan Kualitas Pembelajaran. *Jurnal Teknodik*, 4, 165–176. <https://doi.org/10.32550/teknodik.v0i0.121>
- Rizaldi, D. B., & Yana, D. (2022). Persepsi Guru Bahasa Inggris terhadap Teknologi Informasi dan Literasi Digital. *Jurnal Pendidikan Tambusai*, 6(2010), 1302–1307. <https://jptam.org/index.php/jptam/article/view/3108>
- Rodriguez Casal, C. (2014). ICT for education and development. In *The Challenges of meeting the Millennium Development Goals in Africa* (Vol. 9, Issue 4). <https://doi.org/10.1108/14636690710762093>
- Rohita, R. (2020). The Ability of Ece Teachers to Use ICT in The Industrial Revolution 4.0. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 4(2), 502. <https://doi.org/10.31004/obsesi.v4i2.339>
- Salsabila, N. H., Wulandari, N. P., Lu, U., Wahyu, T., & Kerinci, I. (2020). Pandangan Mahasiswa Pendidikan Matematika : Apakah Siswa akan Mudah Belajar dengan Permainan Edukasi? *Jurnal Karya Pendiidkan Matematika*, 7(2), 1–5.
- Setyoningsih. (2015). E Learning : Pembelajaran Interaktif Berbasis Teknologi. *Elementary*, 3(1), 39–58.
- Shadreck Mandina, S. S. Mashingaidze, & Mafuta, J. (2013). Increasing female participation in advanced level mathematics: A perspective from students and teachers in Zimbabwe. *African Educational Research Journal*, 1(3), 183–190.
- Sivakova, D., Kochoska, J., Ristevska, M., & Gramatkovski, B. (2017). ICT- the educational programs in teaching mathematics. *TEM Journal*, 6(3), 469–478.

<https://doi.org/10.18421/TEM63-06>

Stewart-Williams, S., & Halsey, L. G. (2021). Men, women and STEM: Why the differences and what should be done? *European Journal of Personality*, 35(1), 3–39. <https://doi.org/10.1177/0890207020962326>

Suyatna, A. (2020). ICT learning media comparative studies: Simulation, e-modules, videos. *Journal of Physics: Conference Series*, 1572(1). <https://doi.org/10.1088/1742-6596/1572/1/012036>

tina Arantika, R. (2018). Peran Teknologi untuk Pengembangan Karir Sekretaris (Rosidah & Tina Arantika) PERAN TEKNOLOGI UNTUK PENGEMBANGAN KARIR SEKRETARIS. *Jurnal Efisiensi-Kajian Ilmu Administrasi Edisi Februari*, 1(1), 43–50.

Winarto, Y. J. (2020). *Efforts to Increase the Pedagogics of Teachers in Making IT-Based Learning Media in the 4.0 Era*. 387(Icei), 113–116. <https://doi.org/10.2991/icei-19.2019.27>

Witaharahap, L., & Surya, E. (2017). Development of Learning Media in Mathematics for Students with Special Needs. *International Journal of Sciences: Basic and Applied Research (IJSBAR)* *International Journal of Sciences: Basic and Applied Research*, 33(3), 1–12. <http://gssrr.org/index.php?journal=JournalOfBasicAndApplied>