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Integrating ICT competencies into high-order thinking skills assessment for preparing students' mathematics learning autonomy in Indonesia

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Abstract

The objective of the current study was to determine the proficiency and challenges related to the development of ICT literacy skills and autonomy in mathematics learning for pupils attending secondary school in Indonesia. A survey was conducted with 560 students. The data was collected through interviews and questionnaires and analyzed using quantitative and qualitative methods. Respondents showed modest ICT proficiency, as indicated by the study. Twenty statements measured ICT literacy, whereas ten questions measured mathematics learning autonomy. Lack of enthusiasm and possession of digital media expertise, affordability for internet data assistance, lack of financial resources to use specific Mathematics-learning apps, unreliable internet access, and inadequate technology infrastructure at educational institutions hampered respondents' ICT satisfaction. Numerous obstacles hinder those with disabilities from being ICT literate. Secondary schools in Indonesia are suggested to overcome these obstacles and use them to improve students' mathematics skills and grades.

Keywords: HOTS, ICT challenges, ICT transformation, Learning autonomy, Mathematic instruction.

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1. Introduction

In modern society, it is imperative to possess an extensive understanding of technological advances. Anyone can acquire digital proficiency, because it affects everyone, including students at all different stages of instruction. With the rapid growth in computer technology, educational agents must respond to various learning preferences, such as completing tasks, establishing digital businesses, and obtaining media-based employment opportunities. Consequently, everyone must

develop comprehensive digital abilities to maximize their work efficiency. It helps to possess a high level of digital literacy if one wants to create an advanced understanding of mathematics, particularly when learning new non-routine math questions. Digital literacy improves, simplifies, encourages, and enhances math mastery. ICT, media, and information literacy are all components of digital well-being [1, 2].

Students need to have a thorough comprehension of all three types of literacy. In light of the restricted resources available to academics, this study is the only one that investigates the level of information and communication technology literacy regarding mathematics instruction. Modern educational institutions and their students face challenges caused by rapid technological advancements in the digital realm. Please immediately pay close attention to this adjustment, as it will have far-reaching consequences for how people learn, which continually changes due to developments in information and communication technology (ICT). Thus, it becomes essential to leverage ICT improvements to improve mathematics instruction [3, 4]. Acquiring proficiency in ICT is crucial across all domains. Thus, technology should motivate young people to pursue education, get ICT skills, and apply them to actual-life issues.

Students have a chance to build their professional profiles using ICT-based activities. Every worker must be able to use and understand various forms of information and communication technology [5, 6]. These researchers claimed that digital technology has transformed many parts of life, including how students are taught. Hence, it is imperative that all educational institutions promptly allocate the necessary IT resources to establish ICT-based courses. By empowering students to engage in more in-depth and relevant learning experiences at their own pace, technology for learning can fundamentally change the roles of instructors. To keep up with the times, most Indonesian schools teach students to be knowledgeable about technology and use digital tools appropriately. Proactive, logical, critical thinking and self-directed learning are more commonly associated with those proficient in information and communication technologies [7, 8]. It strongly encouraged pupils to use ICT appropriately to enhance their academic performance. Learning mathematics with the help of technology can improve classroom instruction, evaluation, and achievement [9, 10]. The Indonesian government authorized online learning platforms such as Moodle, YouTube, Webex, Zoom, and video conferencing for use in formal educational institutions. These digital media also provide more attractive, accessible, affordable, and technologically literate alternatives to school, which is a huge positive [11, 12].

With the use of information and communication technology (ICT), students are put in the spotlight and seen as valuable resources of information and data, learning is made easier to access, students are encouraged to take the initiative, and their digital literacy is enhanced [13]. Consequently, involvement in mathematical instruction centered on digital platforms is strongly encouraged from this point onwards. It allows students to become proficient in mathematics, adapt to various learning methods, and meet the demands of developing skills and responsibilities related to information and communication technologies while learning autonomously [14].

Previous investigation has demonstrated that learners who possess advanced skills in information and communication technology demonstrate a higher rate of mathematics acquisition, a higher level of engagement in educational activities, a greater openness to a variety of learning methods, and a stronger motivation to improve their digital capacities [15-17]. For learners with extensive knowledge of information and communications technology, the development of cognitive talents such as analytical thinking, critical thinking, and mathematical skills may be more readily available to them [18, 19]. Prior researchers failed to conduct comprehensive investigations on the efficacy of information and communication technology (ICT) and the challenges that secondary school pupils in rural Indonesia encounter in attaining autonomy in Mathematics instruction. The researchers of this study aimed to address shortcomings in their expertise. Consequently, researchers decided to conduct the study at hand.

Research on technological competency and challenges has thrived in mathematics classroom instruction. Previous research has produced pertinent findings on this topic, detailed as follows: Mastery of information and communication technology enables Mathematics students to engage actively and innovatively during the teaching-learning process [20, 21]. In contrast to other studies, this one focuses on the challenges people face in improving their ICT (information and communication technology) abilities. Additionally, it delves into how these obstacles impact the chances for distant regional secondary pupils to study mathematics independently. Mastering ICT knowledge can revolutionize students' cognitive processes and augment their abilities to achieve targeted goals in the classroom. Effectively employing technology for education can significantly benefit students in remote areas by increasing their drive and trust in themselves while providing them greater autonomy in their learning process and facilitating the application of learned knowledge in Mathematics skills [22, 23].

The investigation will concentrate on specific subjects to facilitate the collection of empirical data regarding the independent learning of Mathematics in six secondary schools in Ruteng City, Indonesia. The researchers have suggested the following research problems, which are based on the rationales and evidence that have been previously disclosed:

1. To what degree do learners possess ICT competencies?
2. What obstacles did students encounter in learning Mathematics and achieving ICT skills?

This study is divided into some sections: abstract, introduction, literature review, methods, ethical consideration, results, discussion, and conclusion. This research will add to a more expansive discussion on transforming mathematics-digital-based teaching methodologies for teachers both inside and outside the classroom.

2. Literature Review

2.1. ICT Literacy in Mathematics Instruction

The ability to perceive and understand any message, regardless of whether or not it is related to literacy, is what we mean when we talk about literacy. The concept of literacy covers domains, including but not limited to financial, business,

health, environmental, ecological, civic, and numerous other areas. Additionally, literacy has progressed in the field of information and communication technologies. Having the ability to read and write is only one aspect of what constitutes literacy. The development of one's intellectual capacity, the application of one's associated capacity, and the appropriate management of the challenges encountered in everyday life are all components of this process. Literacy abilities are essential for mathematics students because how well they can read and write directly impacts their ability to study mathematics. Literacy has many benefits, including expanding one's vocabulary, intellectual capacity, perspective, capacity for analysis, and exposure to a wide range of concepts. When taken as a whole, these advantages contribute to a wide range of educational issues [24].

Students ought to optimize their existing mathematical learning ability. Students are urged to employ various applications to demonstrate their information and communication technology proficiency, supported by Artificial Intelligence (AI). In today's age, artificial intelligence substantially impacts the cognitive processes and productivity of teachers and pupils. This idea is because numerous industries rely on applications to achieve the best possible outcomes [25]. These experts contend that all pertinent applications enabled by AI possess the capacity to conserve time and reduce expenses.

In addition, jobs that do not use information and communication technology or the incorporation of artificial intelligence will likely become obsolete soon and steadily fall behind. The argument arises from the unavoidable movement towards jobs performed by computers. People are considered to be digitally literate when they can use digital devices linked to the Internet to accomplish activities, comprehend, analyze, and distribute information [26, 27].

In the context of Mathematics instruction, digital literacy entails the creation of many forms of mathematical substance, including proficiency in mathematical formulas, diagrams, simulations, and other resources. Information and communication technology literacy enables students and educators to understand how digital applications can enhance educational experiences for learners. Acquiring this talent is essential for pupils to grasp Mathematics in their own ways [28, 29]. The ability of educators to effortlessly use instructional technology in their work is impacted by the knowledge presented here. As an immediate consequence, learning will be more efficiently organized. Literacy in information and communication technology (ICT) is a must for students today because these abilities are necessary for learning at all school levels, including mathematics. Mathematics educators should acknowledge the significance of Information and Communication Technology (ICT), given the recent digitization of numerous Mathematics learning tools.

2.2. The Integration of Artificial Intelligence in Mathematics Learning Autonomy

The speed at which our technological capabilities are expanding beyond the scope of our current knowledge. Even though artificial intelligence (AI) has been present in people's lives for an extended period, there has been a significant increase in the use of AI-mediated technology in educational settings. This concept is particularly relevant to students' literacy abilities in mathematics, as it enables pupils to tackle complex mathematical assignments [30, 31]. Artificial intelligence refers to the ability of machines to do tasks that are comparable to those performed by humans, learn through experience, and adjust to new information [32, 33]. In assessment, mentorship, curriculum development, and feedback, the growth of technology may lead to innovative teaching and learning possibilities for teachers and students. A strategy that is becoming increasingly common in math instruction is the utilization of technology driven by artificial intelligence to improve the content of abstract, semi-concrete, and concrete mathematical topics [34, 35]. In this instance, artificial intelligence technology assists students in their mathematical learning activities. This technology is frequently called applications or tools (for example, Photomath, Prodigy, ChatGPT, Mathway, and several others).

Digital technology makes it easier for teachers and students to work together and have discussions during face-to-face contact in the classroom and through online platforms outside of the classroom. Incorporating digital technology into the classroom allows teachers and students to work together and interact in person within the classroom and virtually through online platforms. Expanding knowledge, sharing ideas, and facilitating active participation are all possible outcomes of online discussions, which do not fall under the category of time limits [36, 37]. This idea is happening as a consequence of the fact that traditional instructional materials are now a common method of obtaining information literacy while one is in the process of learning. Students can access a wide variety of educational resources through digital technology. These resources include e-books, online journals, instructional videos, and other e-learning platforms [38, 39]. Additionally, thanks to the advent of digital technology, students can participate in online debates, collaborate on projects, and share their thoughts with their classmates and teachers worldwide. Digital technology makes it possible to acquire and improve digital skills, such as managing digital information, utilizing digital technologies, and the knowledge of online principles.

Using applications mediated by artificial intelligence can expose students' capacity for analytical thinking. Students are motivated to examine, evaluate, and comprehend content within the framework of the real-world scenario when they use appropriate mathematical learning tools. Throughout the process, students are encouraged to engage in critical analysis, and solutions to problems, and make well-informed decisions by considering their observations and interactions inside the digital system. Trait thought encompasses adequate preparation, the implementation of suitable reasoning techniques, the practice of self-monitoring to assess comprehension and learning advancement, the utilization of continuous efforts to overcome challenges, and the cultivation of students' confidence in their talents [40, 41]. Every single one of these factors has an enormous effect on the student's mindsets, which in turn adds to the success they achieve in their academic endeavors.

Students can achieve the fluency criteria for mathematics better when they have literacy abilities in mathematics. To be considered "ICT-savvy," students must demonstrate skill in using digital tools or applications. Literacy in mathematics is improved by literacy in information and communication technology. During COVID-19, Indonesian secondary school

students used digital multimedia rather than printed materials [3, 4]. The information and communication technology (ICT) that has been mastered has had a significant impact on how technology is utilized for math instruction and how students study mathematical concepts. Students' adept in using computers, other technological devices, and a wide range of software applications can improve their mathematical abilities through continuous practice and training [42, 43]. Students are strongly encouraged to study mathematics and English to understand better instructional programs when computer instructions are presented in English. Students who are learning quickly comprehend abstract concepts. Changing how students study mathematics is the goal of this technique, which also intends to increase students' reading and physical activity. Additionally, students' literacy abilities in mathematics will improve as they learn how to employ computers.

The student's adept in information and communication technology are inspired to become standalone, forward-thinking, and innovative when they use or develop apps for learning. Learners of mathematics who are self-directed offer aid to other students who are studying the subject. Students are motivated to attain their goals by participating in autonomous learning, which combines learning skills with responsibility to make learning more engaging, fun, and valuable. This idea is due to autonomous learning combining learning abilities with responsibility [44, 45]. Students can improve their knowledge acquisition and obtain outstanding outcomes by capitalizing on the resources that are accessible to them and adhering to the innate desire that they have to succeed. To ensure that students can evaluate their progress, maintain their drive to study, and take full responsibility for what they learn, learning autonomy must be incorporated into every learning course c [46, 47]. Mathematical programs that are accessible via the web give teachers the ability to prioritize student autonomy. Similarly, the research found that providing students with learning modes improved their literacy skills in mathematics and information technological advances.

2.3. Artificial Intelligence Strengthens Students' Higher-Order Thinking Skill Assessment

The transformation of ICT influences the assessment of learning, including mathematics. Teacher implementation of learning focused on developing higher-order thinking skills is challenging in the Math instruction context in Indonesia. The Math instruction context in Indonesia presents a challenge for the teacher in implementing learning focused on developing higher-order thinking skills. Higher-order thinking skill (HOTS) helps students comprehend abstract concepts in Math instruction. Students can understand abstract concepts in Math instruction through HOTS implementation.

To cultivate HOTS, students have to become familiar with activities that train HOTS itself. These activities require students to remember and understand a concept and analyze, synthesize, evaluate, and construct it. Students may retain concepts in their memories for an extended period when they are comprehended; therefore, HOTs are necessary [48, 49]. The HOTS consists of three categories: synthesis or analysis (C4), evaluation (C5), and innovation or creativity (C6) [50].

High-level thinking skills are essential for students to understand a concept successfully. This concept is because students' memories retain comprehended concepts for a longer time; thus, they should have HOTs. Creative thinking in problem-solving has an unbreakable connection to the exceptional academic performance of students. To effectively resolve mathematical problems, learners must possess a high level of creativity [51, 52]. This skill is indispensable, as all individuals must address daily challenges, particularly uncommon math challenges. The learning process will be enhanced if learners can fully understand the issues. This concept should enable math instructors to identify and implement applications that bolster students' HOTs through relevant AI. HOTS underscores the importance of critical, logical, literal reasoning and problem-solving. Math instruction necessitates student engagement and challenging topics. The HOTS assessment teaches students to be communicative, creative, collaborative, independent, and responsible, as well as to think critically, solve problems systematically, and comprehend their role in everyday life.

The ideas behind HOT-oriented tests were presented as problems. Teachers need to learn how to use the HOTS test to teach math trends, like (1) how to help students think about problems; (2) Teachers design the activities for learners, including subject selection, assignment completion techniques, and evaluation styles; (3) Provide guidance to students; and (4) Compile and present students' work. Educators will assist students in analyzing and evaluating the problem-solving process, formulating results, and then communicating the results to the students.

3. Methodology

3.1. Research Design

A cross-sectional survey was applied to this study. In July 2023, it was carried out by six secondary schools in Ruteng, Indonesia. The purpose of this design is to determine the shortcomings of the educational system. The researchers used this design to investigate the hurdles to studying mathematics and information and communication technologies at six secondary schools in the rural area of Ruteng, Indonesia. The researchers believe that the findings of this study could help the educational stakeholders, particularly at the secondary level in exploring further mathematics-digital-based teaching methodologies and overcoming students' ICT barriers.

3.2. Sample Technique

The study population consisted of 14,124 students, while the sample comprised 560 students who were chosen using the Multistage Cluster Random Sampling. As shown in Table 1, the sample was collected from six different secondary schools in the Ruteng region.

Table 1.
Sample total.

No	School	Sex		Sample numbers
		Female	Male	
1	Secondary school A	62	28	90
2	Secondary school B	64	26	90
3	Secondary school C	76	25	101
4	Secondary school D	50	42	92
5	Secondary school E	54	38	92
6	Secondary school F	60	35	95
Total				560

3.3. Data Collection Tool

This information was gathered through the use of surveys and interviews. The questionnaire contains several statements that evaluate the respondents' level of knowledge in information and communication technology. They are based on information and communication technology literacy, a theory established by Trilling and Fadel [1]. During this time, a number of statements involving self-directed mathematics learning were derived from concepts explored by Zimmerman [53]. Twenty questions covered the difficulties and capabilities of studying mathematics, information and communication technologies, and literacy. Those who responded to closed-ended questions were obliged to select one of the five options that were supplied. Authorities carried out three rounds of review before distributing the questionnaire to individual participants. Whether or not each item was relevant to the content validity was determined.

3.4. Data Analysis

For this study, a score was utilized to indicate the respondents' information and communication technology (ICT) proficiency and their techniques for studying mathematics. High ranges range from 4,2 to 5,0; medium ranges range from 3,2 to 4,1; low ranges, which range from 2,2 to 3,1; and extremely low ranges, which range from 1,1 to 2,1, are the four categories that can be utilized. Numerical procedures were utilized to determine the percentage, and the survey results were utilized as the basis for the computation. After applying the Excel chart data series tool to analyze the percentage, the results were then displayed for qualitative analysis.

3.5. Ethical Consideration

This research has adhered to the norms for conducting research in Indonesia. It has been accepted by research committees of the Universitas Katolik Indonesia Santu Paulus Ruteng, Indonesia.

Table 2.
ICT literacy skills of the respondent.

No	Item	Mean
1	Get familiar with the usage of graphical applications for learning mathematics	2.6
2	Know the practice of using software applications for learning mathematics	2.5
3	Get the knowledge necessary to utilize Matway programs to practice mathematical patterns	3.7
4	Understand how to make use of the blog for learning mathematics	3.8
5	Know the utilization of computer games	3.7
6	Acquire the knowledge necessary to interpret mathematical challenges using an electronic dictionary on your device	4.4
7	Learning mathematics requires that you have a working knowledge of the Skype application	2.7
8	Become familiar with the Dropbox applications	2.5
9	Learning mathematics requires that you have a working knowledge of how to use photo-sharing apps	4.6
10	Utilise YouTube as a medium for learning mathematics	4.3
11	In the field of math instruction, having the capacity to collaborate with your Google Classroom	3.4
12	Use Google Classroom to acquire knowledge in the area of mathematics	2.8
13	Utilize the Ruang Guru apps to acquire insight into mathematics	3.2
14	Become familiar with Mathematics via Edmodo apps	2.6
15	Become familiar with Mathematics through the WhatsApp video call group	4.4
16	Develop your mathematical skills with the use of Zoom	4.6
17	Discover mathematical concepts through the use of Prodigy apps	3.2
18	Make use of the Kahoot App to acquire skills in mathematics	3.1
19	Having the ability to study mathematics through the use of CanvaAI applications	2.8
20	ChatGPT apps allow you to acquire knowledge of mathematics	2.8
	Average	3.4

4. Results and Discussion

4.1. Result

For the most part, this section is devoted to the findings regarding the respondents' information and communication technology capabilities and the difficulties they face. The respondents' information and communication technology (ICT) literacy skills are summarised in Table 2.

Statements 1–20 in Table 2 illustrate the literacy level of information and communication technology (ICT) among 560 respondents. The average score for participants' information and communication technology (ICT) skills was 3.4, which placed them in the medium ability category.

The study also discovered that respondents had a medium level of information and communication technology literacy due to several factors. These factors included a lack of access to digital media computers, poor internet connectivity, insufficient time to use specific applications in mathematics classes, paying a lot for internet data packages, having limited ICT infrastructure, and not having a lot of enthusiasm for learning or creativity. This study focuses on the six needs that secondary school students need to fulfill to be literate in information technology despite the many challenges they face. The researchers utilized the Guttman scale, which only allowed for yes/no replies, to evaluate these six topics [54]. The following table, Table 2, explains the typical percentage of questions about the six restriction criteria.

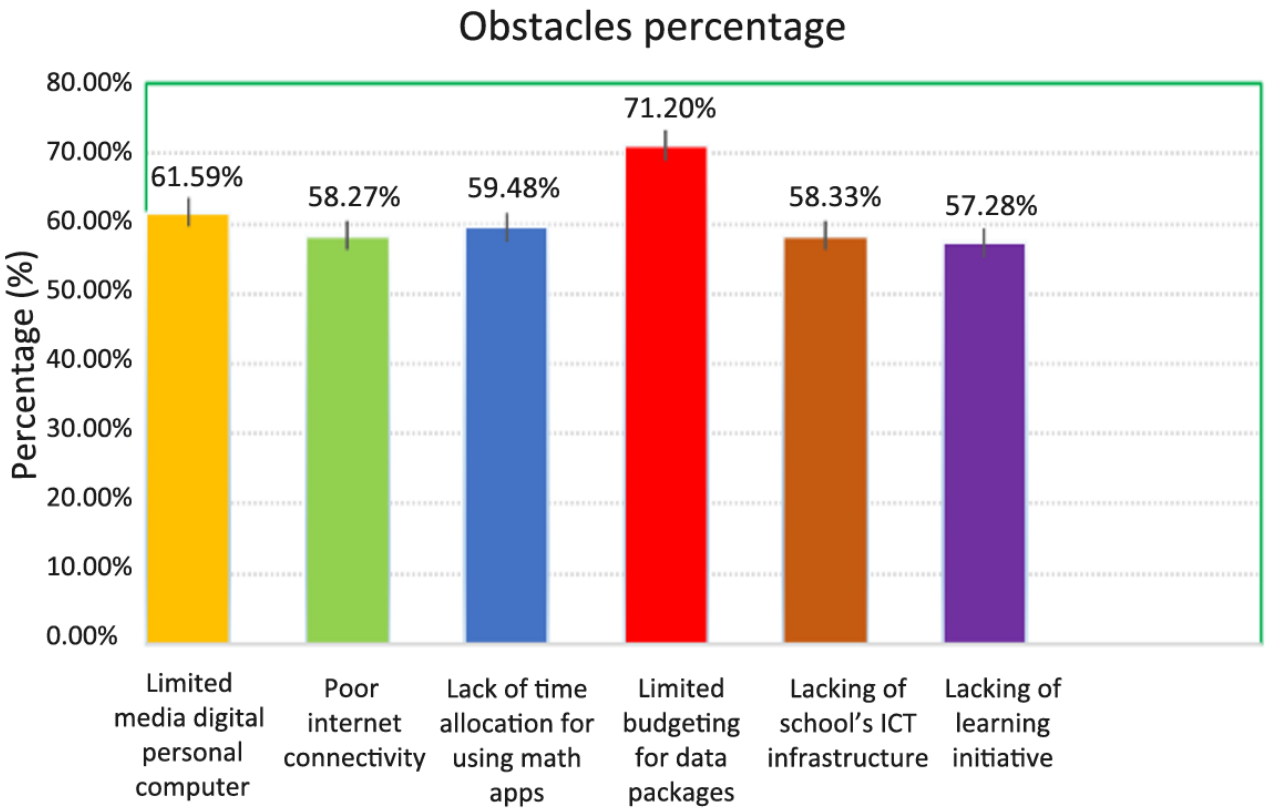

Figure 1.
ICT barriers.

4.2. Discussion

According to Table 2, the respondents had a moderate level of proficiency in information and communication technology. The cost of obtaining data packages on the Internet accounted for 71.20% of the total, making it the most significant contributing factor. In addition, the second issue was limited media, which included digital personal computers, which accounted for 61.59% of the whole. The research findings reveal that some elements hinder learning and restrict the advancement of students' mathematical abilities and their ability to adapt how they learn. This concept makes achieving a reasonable level of information and communication technology literacy more difficult. Consider the possibility that students are proficient in several information and communication technologies. If this is the case, it provides them with the best opportunity to independently investigate and develop mathematical abilities in their best interests [55, 56].

Factors that determine the outcome include the student's mathematics education level and capacity to use and comprehend information and communication technology efficiently. In light of the current educational system, it is anticipated that students will immediately be literate in digital information and communication technology to acquire mathematics literacy skills [57, 58]. It is considered reasonable to anticipate that students will have an understanding of how various learning apps operate on their current computer hardware. For learners to understand the numerous facets and possibilities offered by contemporary information and communication technology devices, they need to have an excellent grasp of the different mathematics applications. For students to be able to efficiently handle the information and communication technology instruments they use daily, it becomes essential for them to have a working knowledge of

mathematics [10, 28]. Accordingly, the level of technology literacy has a direct influence on people's math skills. Students with a limited understanding of information and communication technology require assistance in comprehending the mathematical concepts presented to them.

The extent of the pupil's competence in information and communication technology, as well as the skills that are required to operate it, has a direct impact on the student's capacity to comprehend and make use of fundamental aspects of mathematics, such as fundamental operations, critical thinking, logical reasoning, and mathematical communication [18, 19]. Learners of mathematics who are proficient in information and communication technologies can effectively evaluate their capabilities and deficiencies in a wide range of mathematical skills, including fundamental operations, critical thinking, logical reasoning, and mathematical communication. This further motivates learners to evaluate their progress in mathematics literacy skills.

Enhancing proficiency in ICT influences various dimensions, including the capacity for autonomous study and self-assessment and the cultivation of creativity and innovative skills, enabling students to attain essential competencies swiftly. The rationale behind this concept is that students' attitudes toward learning are changing due to this improvement. It is possible that making consistent adjustments to learning patterns could assist in overcoming various obstacles in acquiring adequate information and communication technology literacy. In light of the growing demand for more complex applications of information and communication technology in the classroom, students can rapidly demonstrate creative solutions to a variety of challenges that they face when learning mathematics [9, 23]. Students can study, analyze, and enhance their knowledge through the Internet—provided that they demonstrate passion and take the initiative [12]. That is why the capacity to study on one's own is an essential component in accomplishing goals associated with information and communication technology literacy. By enabling students to autonomously determine their own pace of learning and transform their learning strategies according to their preferences, autonomous learning makes it easier for students to achieve their educational goals [59].

When students can make decisions based on their awareness, excitement, and involvement in the learning process, they have attained autonomy Zimmerman [53]. Zimmerman [53] clearly illustrates the necessity of planning, organizing, managing, monitoring, and evaluating oneself at different phases of independent learning. Students receive structured techniques to facilitate academic achievement and discern their strengths and areas for improvement. Consequently, the instructional process in academic disciplines, such as Mathematics, can be improved by integrating autonomy into learning.

Moreover, it is essential to recognize that the growing importance of acquiring information and communication technology literacy abilities must be distinguished from the evolution of how students learn. The process of acquiring knowledge Children's mastery of mathematics marks differs in ICT-based classrooms from those without ICT to support their learning [42, 55]. Those who stand to gain from this should familiarise themselves with this concept and conduct an in-depth investigation into it. The rate at which individuals can gain competency in information and communication technologies is greatly accelerated by several aspects. Under being within the scope of this study, six distinct qualities provide students with challenges in achieving proficiency in information and communication technology. An evaluation of these six limiting factors was carried out through a questionnaire sent to the respondents.

In-depth interviews with sixty-five students and ten representatives from each of the six educational institutions that were a part of our research were conducted to go along with administering the questionnaire. Several factors contribute to this, including the number of students who have access to computers, the availability of information and communication technology infrastructure across the entire institution, the dependability of internet connections, the absence of regulations regarding the utilization of particular programs for math instruction, the financial resources that are allocated for data packets, and, lastly, the interest and commitment of students towards integrating of technology into math instruction. The requirement for a greater presence of computers in the classroom is one factor contributing to the low proportion of students who can achieve competency in information and communication technology. The stakeholders are urged to identify and address the many factors that may hamper the progression of students' information and communication technology literacy skills and to design solutions to address these difficulties.

It was determined through the data that out of the total number of participants, precisely 560 persons who were anticipated to have knowledge and proficiency in digital technology, the average rating for their information and communication technology ability was 3.4. An assessment of this significance is more than the minimum required to be categorized as having skills of an intermediate level. The high cost of internet data packages, which comprise 71.20% of the whole, was the biggest obstacle preventing individuals from developing ICT skills. The survey results are currently being actively considered by educators, particularly those working in mathematics courses. Mathematics teachers have successfully addressed the substantial challenges associated with information and communication technologies. Since such, the students have been able to improve their abilities to make use of these tools and have been allowed to engage in self-directed learning. The result of this is that these difficulties have been changed into opportunities that are extremely beneficial for the acquisition of mathematical skills in the era of artificial intelligence.

Additionally, it is essential to provide pupils with a method of evaluation to enhance their mathematics knowledge level. Firstly, by providing students with guidance and support in the process of conducting these assessments; secondly, by encouraging and supporting students to engage other people (Mathematics teachers) in the process of establishing performance criteria related to their duties; and thirdly, by providing guidance and support to students in the process of evaluating their performance, we can improve students' ability to evaluate their mathematical proficiency to fulfill their tasks. The investigators concluded that it is necessary to combine both criteria for students in secondary schools in Indonesia to gain competency in the utilization of information and communication technology for autonomous mathematics learning.

5. Conclusion

ICT literacy is directly linked to the problems people have learned to use information and communication technologies well. Students' ICT skills help them understand how different digital parts of their learning work better, which in turn helps them learn maths literacy skills and become more independent in their learning. Using information and communication technology is demonstrated by twenty questions in the survey. It was found that most of the 560 secondary school pupils surveyed from six different schools had scores that fell within the intermediate range (3,4) on the competency scale for information and communication technology competence ratings. The findings of this moderate category are consistent with the six barriers that prevent students from becoming literate in information and communication technologies. These problems include the interests and efforts of students, the cost of internet data packages, the fact that there are no rules about using particular apps to teach maths, the instability of internet links, and the fact that schools don't have many computers. Educators and learners are required to enable the acquisition of information and communication technology skills among students and to foster their advancement in this domain; thus, all stakeholders must collaborate and help significantly. Such actions can convert met barriers into significant possibilities for enhancing mathematical literacy and fostering learning autonomy.

5.1. Implications

In what ways do the results of this study have any implications? There is a firm connection between AI and students' need to change how they use technology. AI is only a tool that helps people improve their higher-order thinking skills assessment. As instructors, we must acknowledge that AI-powered apps can help students learn HOTS and maths faster. This idea leads to the question: Is AI a friend or a threat? The correct answer is as a friend and stimulator, as long as everyone is willing to work together to get past the six things stopping students from becoming more ICT-literate and following the HOTS process correctly. Without artificial intelligence (AI), teachers should still emphasize critical thinking and incorporate mathematics into their lessons to make sensible changes to information and communication technology (ICT). Improved proficiency with information and communication technologies will allow pupils to learn autonomously and subconsciously grasp mathematical concepts.

5.2. Limitation

In the context of this research, several limitations were discovered. This study has several limitations, one of which is that it is entirely dependent on survey research to assess the ICT literacy abilities of respondents through questionnaires. ICT literacy, a theory established by Trilling and Fadel [1] is relevant to the statements included in the ICT questionnaire for evaluation. In addition to this, the questionnaire was utilized to ascertain the proportion of various issues that impeded the participants' ability to achieve ICT literacy. The data from the two questionnaires were enhanced by insights obtained from dialogue with representatives of the respondents. The representatives emphasized the necessity of incorporating ICT literacy into cutting-edge Mathematics instruction in the context of artificial intelligence (AI). Due to the restricted resources available to the researchers, they conducted interviews only with sixty-five participants online in strengthening questionnaire findings.

5.3. Suggestion for Future Research

Future studies are suggested to focus on expediting the acquisition of mathematical skills, prospective investigators should prioritize investigating the usefulness of specific apps mediated by artificial intelligence. Including a greater number of participants throughout a wide range of study programs at various institutions in several different places in Indonesia is one way to achieve this premise.

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