



Investigations into Whiteboard Fox's Use in Mathematics Learning Accommodates 21st Century Skills

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Abstract: 21st century skills should ideally be able to provide a foundation to today's learning. The purpose of this study intends to investigate the use of whiteboard fox in mathematics learning that accommodates 21st century skills. Qualitative research methods with case study types are used to uncover 21st century skills in mathematics learning using whiteboard fox. The research site is located in one of the North Jakarta State High Schools. Purposive sampling techniques were used to answer research questions in which out of 31 students 10 students were selected who were assumed to be able to provide saturated information as well as a primary data source. Data collection techniques use structured interviews with reference to 21st century skill indicators in the context of the use of whiteboard fox in mathematics learning. Data were analyzed using the 2022 version of MAXQDA through coding, sub-coding, in-vivo and MAXMaps visualization processes. The results showed various aspects that emerged in mathematics learning using whiteboard fox related to 21st century skills.

Keywords: whiteboard fox, 21st century skills, math learning

Abstrak: Keterampilan abad ke-21 idealnya mampu memberikan pondasi pada pembelajaran hari ini. Tujuan penelitian ini bermaksud untuk menginvestigasi pemanfaatan whiteboard fox dalam pembelajaran matematika yang mengakomodir keterampilan abad 21. Metode penelitian kualitatif dengan jenis studi kasus digunakan untuk mengungkap keterampilan abad 21 dalam pembelajaran matematika menggunakan whiteboard fox. Tempat penelitian berlokasi di salah satu SMA Negeri Jakarta Utara. Teknik purposive sampling digunakan untuk menjawab pertanyaan penelitian dimana dari 31 siswa dipilih 10 siswa yang diasumsikan mampu memberikan informasi yang jenuh sekaligus sebagai sumber data primer. Teknik pengumpulan data menggunakan wawancara terstruktur dengan merujuk kepada indikator keterampilan abad 21 dalam konteks pemanfaatan whiteboard fox dalam pembelajaran matematika. Data dianalisis menggunakan MAXQDA versi 2022 melalui proses coding, sub-coding, in-vivo dan visualisasi MAXMaps. Hasil penelitian menunjukkan berbagai aspek yang muncul dalam pembelajaran matematika menggunakan whiteboard fox terkait keterampilan abad ke-21.

Kata kunci: whiteboard fox, keterampilan abad ke-21, pembelajaran matematika

▪ INTRODUCTION

The 21st century is known as the age of knowledge where it becomes a topic of conversation (Mukhadis, 2013). This gives rise to various kinds of positive and negative responses (Zubaidah, 2016) because human resources are replaced by current technological developments. With increasingly sophisticated technology, everything becomes easy and practical where the use of technology demands the creation of very important competency changes in the world of education (Falloon, 2020). The 21st century skills are oriented to several skills, namely critical thinking and problem solving, communication and collaboration, as well as creativity and innovation (Trilling & Fadel, 2009).

The results showed that high school, diploma, and college graduates still have very minimal competence in terms of direct or written communication, and the ability to think critically in overcoming problems (Clokie & Fourie, 2016). In addition, other competencies are work ethics and having high professionalism, being able to collaborate in terms of working with a team, working with a team or group that is different from before, utilizing technology, and project management and leadership (Trilling & Fadel, 2009). To be able to provide a meaningful role in the 21st century, every citizen is required to have several abilities that can answer the development of this era (Almarzooq et al., 2020). In fact, education in Indonesia still has many learning problems and moral crises that occur in students today, with increasingly sophisticated technology, making all information in the media social accessible, let alone bad information that can erode student morale (Angga et al., 2022). Therefore, Indonesia really needs qualified, creative, innovative, and highly competitive educators, so that learning in Indonesia becomes more developed, keeping up with the changing times that are getting faster (Aspi & Syahrani, 2022).

Based on the results of an interview with a mathematics teacher in class XI, he said that during online learning, it made learning very less interactive, especially on the subject matter of linear programs. Especially because the teacher cannot supervise whether the student is paying attention to it or not. Therefore, teachers take the initiative to use a more innovative learning media, namely whiteboard fox in learning in the hope that it can help students easily understand linear program materials and be active in learning. With whiteboard fox, it is hoped that teachers can teach as if they were teaching in the classroom.

Whiteboard fox is a free digital whiteboard that can be customized to our liking (Vinson et al., 2019). The following is a page that appears for the first time when a visitor accesses whiteboardfox.com website.



Figure 1. Main view of whiteboard fox

A second page view that contains options that other participants can use, whether other participants can draw and delete anything, draw and delete their own drawings, or can only view the images we create.

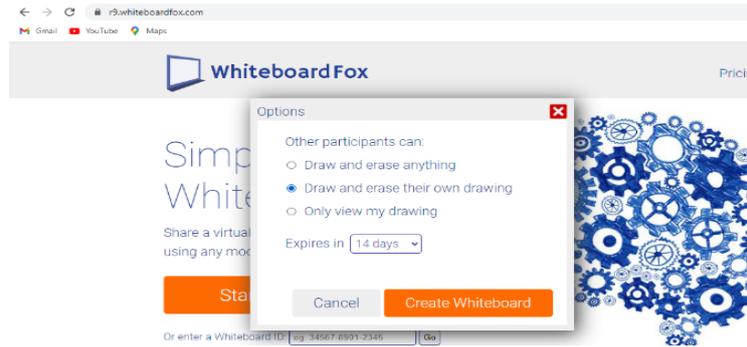


Figure 2. Whiteboard fox second look

Display when you want to write something on whiteboard fox. There are several menus in whiteboard fox such as pencils and different colors, eraser, menus to shift the view, settings that contain several menus in it, undo and redo (Graham, 2020).

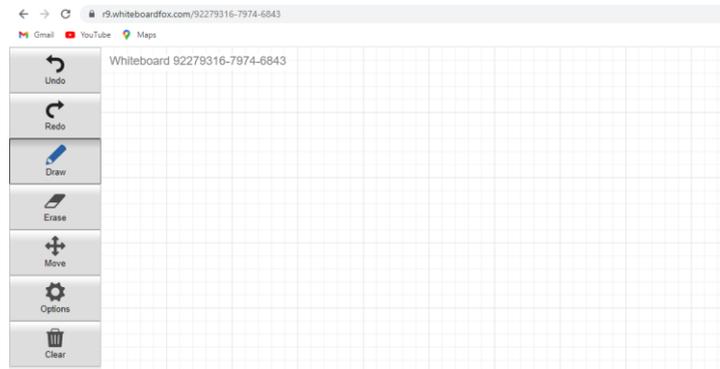


Figure 3. Menu whiteboard fox

Research on the use of interactive mathematics learning media to improve learning outcomes concludes that interactive learning media can be used to motivate and influence learning outcomes. The use of this technology can provide a stimulus to all senses so that they can maximally capture learning messages (Sumilat, 2018). Other research related to android-based mathematics learning media on linear program material concludes that the learning media used in linear program material has been verified by experts and validated by a validator is an android-based mathematics learning media that is easily accessible and adaptable both for learning conducted in the classroom or outside the classroom. Based on trials with an average percentage of students 88.1% that android learning media can involve students in the learning process because learning becomes fun (Apsari & Rizki, 2018).

Research on the use of geogebra learning media on student learning outcomes regarding linear programming for class X explained that class action research carried out in class X-Culinary Planning 1 at SMK Negeri 1 Soreang experienced an increase in learning outcomes in terms of completeness in the KKM of 9 students with a percentage (25%) to 26 students (72.22%), the increase was quite large, namely 47.22% due to the help of Geogebra learning media (Sunaryo, 2019). In line with this information, the novelty of this research is to examine the use of whiteboard fox learning media.

Therefore, the purpose of this research is to investigate the use of whiteboard fox in mathematics learning that accommodates 21st century skills.

▪ **METHOD**

Qualitative research methods with the type of case studies and units analyzed by multiple cases were used to find answers to research questions about how to use whiteboard fox in mathematics learning to accommodate 21st century skills. The research was conducted at a public high school in North Jakarta from August to September 2022. The participant population was taken from 31 students of class XI IPS and 10 students were selected as a sample using a purposive sampling technique in the hope of being able to provide saturated answers.

The case study procedure applied uses seven steps, namely identifying a special case in a group of students, selecting several cases to understand the problem, collecting qualitative data in the form of observations, interviews and documentation, analyzing data using MAXQDA, describing cases, and themes that have been revealed, compiling a chronology of cases and themes, and making conclusions (Creswell, 2013). The research instruments used in this study were the researchers themselves, and the interview list was structured in which the interview items referred to 21st century skills. The list of interviews and questions that will be used is validated by a mathematics education lecturer from one of the tertiary institutions in Jakarta.

Table 1. List of interview items

No	Interview Items
1	Does learning mathematics the linear program material using whiteboard fox make it easier for you to understand the material?
2	Can the learning of mathematics linear program material using whiteboard fox make it easier for you to analyze a mathematical problem given by the teacher?
3	Does learning mathematics linear program materials using Whiteboard Fox allow you to opinion/answer teachers' questions confidently or unabashedly?
4	Can you explain to friends the answers you've answered on Whiteboard Fox about the linear program material?
5	How is the interaction between students during the mathematics learning of linear program materials using Whiteboard Fox? For example: by jointly answering each other's questions on the fox whiteboard during learning, or can you correct the wrong friend's answer by deleting the friend's writing?
6	Does the teacher always invite students to play an active role in learning mathematics linear program materials using whiteboard fox?
7	Is it during mathematics learning that linear program material using whiteboard fox you are more actively asking?
8	Can the interaction in mathematics learning linear program materials make learning more exciting and challenging?
9	Do you think it's good if you learn mathematics using whiteboard fox? If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

Interviews were conducted three times to obtain saturated data, in which the participants' answers regarding the use of whiteboard fox in learning mathematics indicated words and sentences that accommodated 21st century skills and their experiences in using whiteboard fox. In the first interview, the expected answer was not found, then continued with the second interview. The third interview confirmed the results of the interview to ensure the answers of each participant. Participants were interviewed using a structured interview list as shown in Table 1 and recorded using a smartphone.

Technical data analysis using MAXQDA Analytic Pro 2022 as shown in Figure 4 with several steps, namely creating transcripts of interview recordings in Word document format, uploading documents into the document system in dark blue, creating codes into the code system in light blue, analyzing participants' answers and categorizing into relevant codes in yellow, creating new sub-codes based on participants' answers (in-vivo) in purple, create sub-code segment model code charts from the analysis results using MAXMaps in green, and create reports using smart publishers in black (Rädiker & Kuckartz, 2020). The main code in the coding system is based on participants' answers to four aspects of 21st century skills, namely critical thinking and problem solving, communication, collaboration, and creativity and innovation. The 21st century skills are the key to lifelong learning and creative work where critical thinking and problem-solving skills, as well as communication and collaboration, are key learning skills and knowledge that address the skills demands of the 21st century workforce. Meanwhile, creativity and innovation, focuses on discovery and exploration where the 21st century global economy requires higher levels of imagination, creativity and innovation to continuously create new and better services and products for the global market (Trilling & Fadel, 2009).

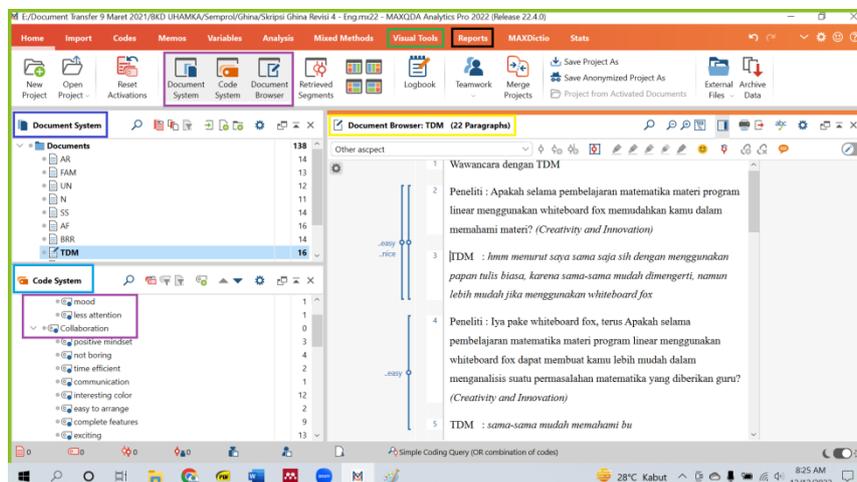


Figure 4. MAXQDA analytic pro 2022 display

▪ RESULT AND DISSCUSSION

The demographics of the 31 participants consisted of 12 men, and 19 women as shown in Figure 5 with an age range that varied between 16 and 18 years of age which is fully shown in Figure 6. Knowledge of the age of the participants in this study

provides an overview of the significance of the final result and conclusions when associated with gender.

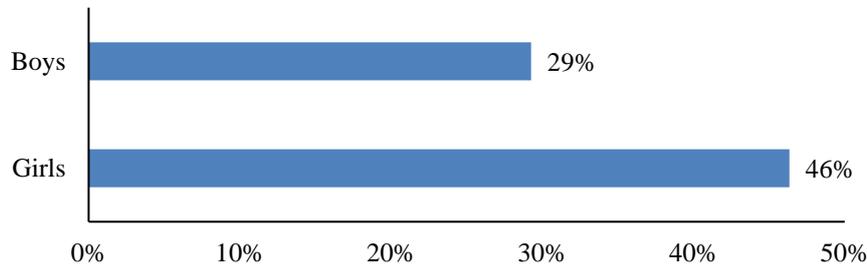


Figure 5. Gender spread

The age distribution of participants in this study as in Figure 8 was dominated by 16 years old as many as 15 people, followed by 17 years old as many as 12 people, and the remaining 18 years old as many as 4 people. This information is included as a consideration of the results of the analysis of participants' answers in terms of readiness and maturity.

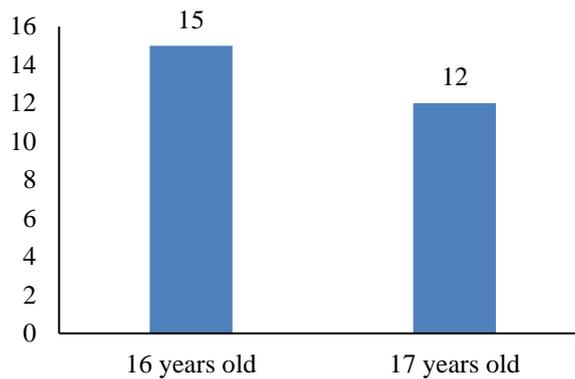


Figure 6. Age spread

The results in the first step of the case study showed that social studies class XI was chosen as a research participant because the observations showed that the ability to ask questions, collaborate, be creative, and the ability of some participants to solve linear programming problems was still lacking. This is a special case which is the focus of research on social studies class XI. Meanwhile, class XI social studies was chosen as a research participant because the observation results showed that mathematical ability in linear program materials was still not optimal and the lack of participants' ability to solve linear program problems (Soebagyo et al., 2021). In the second step, the results of identifying cases from 31 participants, 10 participants were selected based on the distribution of test scores on Linear Programming material with the lowest score of 60 and the highest 100, and the results of observations showed their ability to express opinions in depth and be able to provide information related to 21st century skills using whiteboard fox in learning mathematics.

In the third step of the case study, data collection was carried out through interviews and documentation, but beforehand, mathematics learning is carried out using a whiteboard fox where the subject matter has been prepared as shown in Figure 7. Participants can access the material via whiteboard fox using the shared link as shown in Figure 8. Participants can access the material from the link provided using a laptop or smartphone that looks like in Figure 9.

The screenshot shows a web browser window with the URL r7.whiteboardfox.com/72455768-4292-5844. The whiteboard content includes:

PROGRAM LINEAR

Tujuan Pembelajaran

1. Menentukan daerah himpunan penyelesaian
2. Menentukan pertidaksamaan linear 2 variabel jika diketahui daerah himpunan penyelesaiannya

Tentukan Daerah Himpunan Penyelesaian Sistem Pertidaksamaan Linear berikut

$$\begin{cases} 2x + y = 4 \\ 2x + 3y = 6 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

Penyelesaian: 1. Tali potong sumbu x dan y pada persamaan

$$\begin{aligned} 2x + y &= 4 & \Rightarrow & \begin{cases} x = 0 & y = 4 \\ y = 0 & x = 2 \end{cases} \\ 2x + 3y &= 6 & \Rightarrow & \begin{cases} x = 0 & y = 2 \\ y = 0 & x = 3 \end{cases} \end{aligned}$$

A red banner at the bottom of the board reads: "This board will expire on 8/27/2022".

Figure 7. Materi's display on whiteboard fox

The display in Figure 7 gives participants the opportunity to read, understand, and correct answers directly, if there is a misdescription or incorrect. The activity can also be done through the fox whiteboard by asking for permission in advance.

The screenshot shows a web browser window with the URL r9.whiteboardfox.com/92279316-7974-6843. A sharing dialog box is open, displaying the following text:

r9.whiteboardfox.com says

To let someone else view this whiteboard in real-time, copy the link below and send it to them. To share a static picture of your whiteboard, select 'Snapshot' from the 'Options' menu

<https://r9.whiteboardfox.com/92279316-7974-6843>

Buttons: OK, Cancel

Figure 8. Whiteboard fox access link

The access link whiteboard fox in Figure 8 is the key to seeing the material that has been prepared in it. Participants get an access link from the WA group that has been shared by the teacher. The majority of participants accessed it via smartphone because of its ease, effectiveness and efficiency in carrying or using it.



Figure 9. Whiteboard fox display on student mobile phone

In this third step, 10 participants namely AR, FAM, UN, N, SS, AF, TDL, LKD, DM, and BRR were interviewed regarding the use of whiteboard fox in mathematics learning which accommodates 21st century skills, and the results are continued with the fourth step using MAXQDA Analytic Pro 2022 assisted text analysis as shown in Figure 10. We do not present all of the interview results from the 10 participants as well as the results of the analysis in this section.

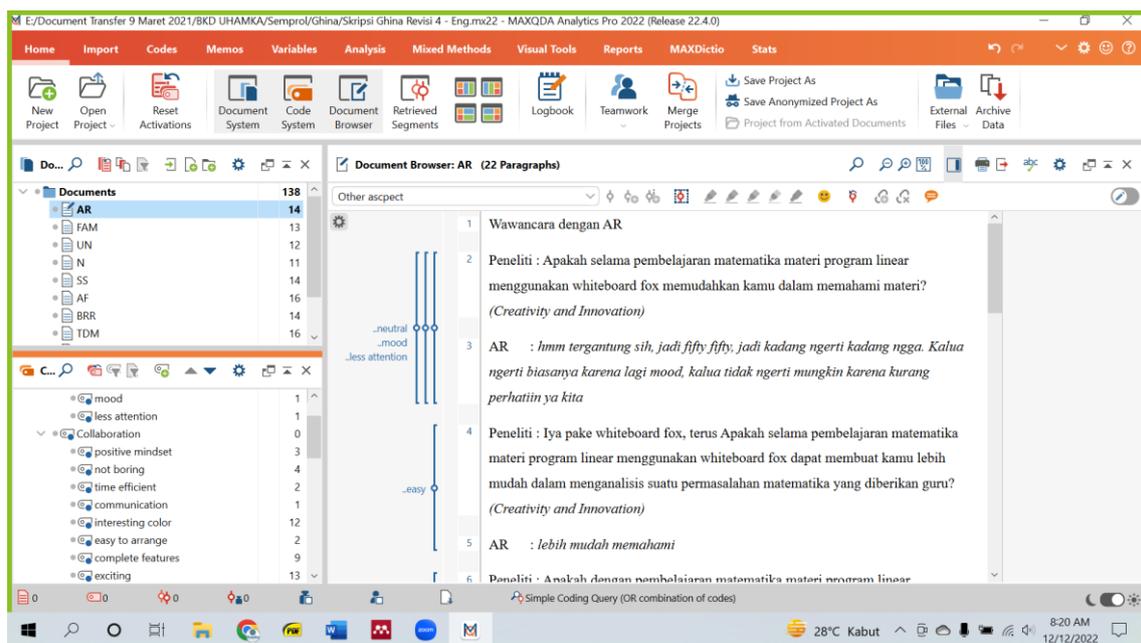


Figure 10. Process of text analysis of one of the participants at MAXQDA

The text analysis step using MAXQDA first enters the transcript files from 10 participants into the document system then creates a code for each indicator of 21st century skills. The third step is to analyze the participants' answers by grouping according to the code that has been made, and creating a new code or sub-code if there is a unique answer that has not been accommodated in the main code. The analysis step of the participant's answers was repeated until all the answers were analyzed. Examples of text analysis such as AR's answer in Figure 10 which states that understanding the

material he feels using whiteboard fox sometimes makes him understand, sometimes it is not included in the neutral code in the main code of creativity and innovation. The following is a description of the cases and themes that were revealed, the compilation of cases and themes using MAXMaps from the results of text analysis using MAXQDA.

Critical Thinking and Problem Solving

An analysis of interviews from 10 participants related to critical thinking and problem-solving aspects showed that 80% of participants expressed their approval of the activeness of critical thinking and problem-solving in mathematics learning using whiteboard fox as shown in Figure 10. This is shown by the problem solving indicator of the test scores of 10 participants where 3 people got a score of 100, 1 person got a score of 95, 2 people got a score of 80, 2 people got a score of 70, and 2 people got a score of 60. Meanwhile, the critical thinking indicator seen from the ability to ask students and check answers between participants with other participants. These results are in line with the results of research on the use of the internet in mathematics learning which provides better critical thinking than conventional learning (Muali et al., 2018). Research on mobile-based learning shows similar results in which learning attention increases, and critical thinking is better (Ismail et al., 2018).

However, the research results showed a unique answer from one of the participants. The results of the interview of 1 participant showed their inactivity due to embarrassment as seen in the following interview snippet.

Researcher : Is it during mathematics learning that linear program material using whiteboard fox you are more actively asking?

AR : less actively asking, out of shame.

Unfortunately, the question does not proceed with finding out why he is embarrassed. However, the observations show that AR belongs to the category with low replay scores. Between the results of the interview and the test score may be directly proportional where the shyness of giving a low test score (Ameliah et al., 2016). These findings are contrary to those that state that students are able to provide information and have confidence in problem solving (Leonisa & Soebagyo, 2022).

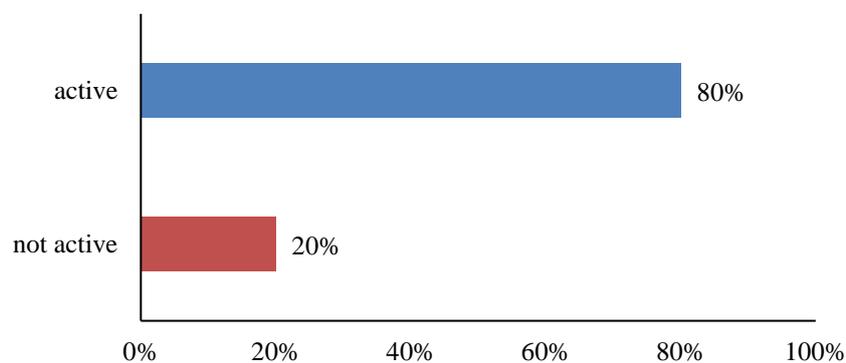


Figure 11. Level of activity of critical thinking and problem solving aspects

On the other hand, one of the participants showed independence in learning mathematics in critical thinking and problem solving aspects when learning mathematics using whiteboard fox. Here's a snippet of the interview.

Researcher : Is it during mathematics learning that linear program material using whiteboard fox you are more actively asking?

AF : If you use whiteboard fox I'd rather find out for yourself first from mom's notes, and if I've been really tired, I'm just asking for it.

The AF statement indicates that when he will answer the problem, he will only ask, but is preceded by working independently through the notes. If he is unable to answer, then he will ask. These results are similar to research on flipped classroom learning that can improve student performance in learning (Wei et al., 2020). The AF situation demonstrates a fairly good critical thinking and problem-solving ability in mathematics learning using whiteboard fox because it does not depend entirely on the teacher (Sulistyani et al., 2020). This is also shown by a replay score of 88 which is in the excellent category.

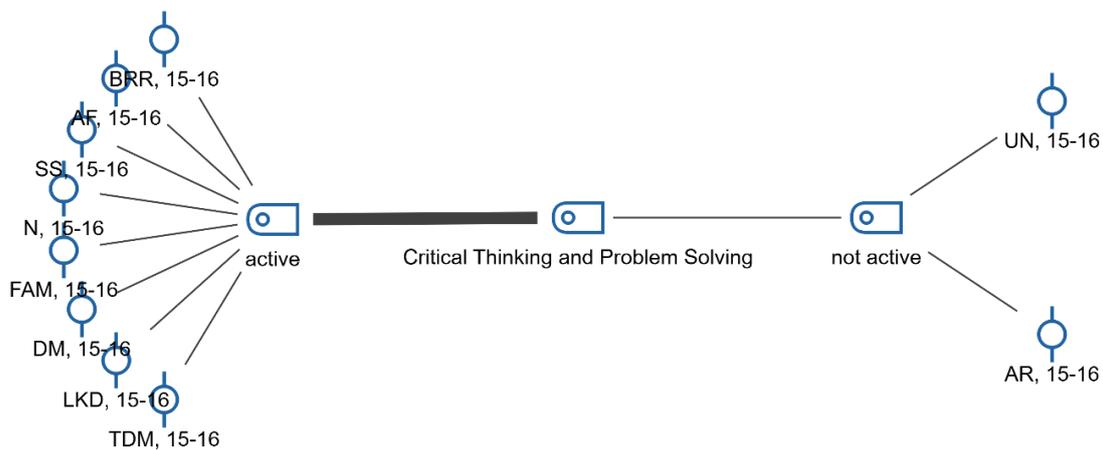


Figure 12. MAXMaps critical thinking and problem solving

From the case of 10 participants related to critical thinking and problem-solving aspects, it can be seen that the size of the connecting rod with the active code is quite large as shown in Figure 11. These results show that the use of whiteboard fox in mathematics learning provides a significant level of activeness to 21st century skills, namely critical thinking and problem solving. Mathematics teachers are advised to use an advocacy learning as an alternative in teaching mathematics to improve students' critical thinking skills. Any mathematics learning requires comprehensive material exploration activities by relating several concepts to support critical thinking and problem-solving skills (Ibrahim et al., 2021).

Communication

The results of the analysis with MAXQDA showed that the majority of participants agreed that the use of whiteboard fox in mathematics learning provided an

opportunity to check each other's answers. However, in the activity of checking each other's answers, there were 1 participant interview results that showed ethical aspects when learning to use whiteboard fox as seen in the following interview snippet.

Researcher : How is the interaction between students during the mathematics learning of linear program materials using whiteboard fox? For example: by jointly answering each other's questions on the fox whiteboard during learning, or can you correct the wrong friend's answer by deleting the friend's writing?

AF : yes, the important thing is to say first, mom, if you want to correct the wrong answer.

AF feels uncomfortable if there is a friend who wants to correct the wrong answer from someone else but without confirmation. During the learning using the whiteboard fox, AF felt that the teacher had invited all students to play an active role during the learning. According to AF, whiteboard fox is an application that has many advantages, especially it can save learning time because in whiteboard fox there is already material today, so it does not take much time to write (Peters-burton & Stehle, 2019).

Another participant, admitted that he could analyze the questions given by the researchers because they saw them on their respective cellphones, making it easier to enlarge or reduce the writing.

Researcher : How is the interaction between students during the mathematics learning of linear program materials using whiteboard fox? For example: by jointly answering each other's questions on the fox whiteboard during learning, or can you correct the wrong friend's answer by deleting the friend's writing?

BRR : there is interaction, especially since this fox whiteboard uses a projector so that we can more easily show it, easily scroll down, so it's not necessary to delete it richly on a regular whiteboard.

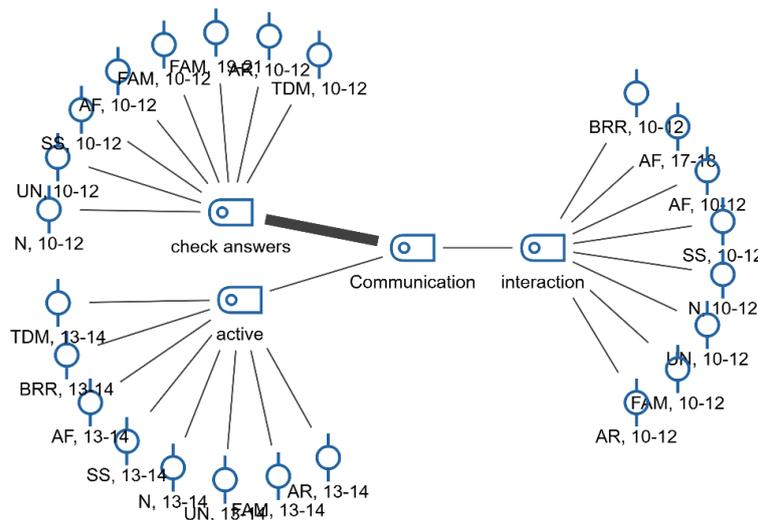


Figure 13. MAXMaps communication

During learning using whiteboard fox there is interaction between students and students, and students with teachers. Then because the teacher displays his whiteboard fox using a projector makes it easier to point the material, and the most important thing is that there is no need to remove it like a regular whiteboard. By utilizing whiteboard fox during learning, BRR becomes more active in asking questions, and can explain to his friends the answers he has answered. The results of this study are in line with the results of research which states that the use of audio-visual media increases activeness in learning (Naibaho, 2019).

An analysis of interviews from 10 participants related to communication aspects showed that 100% of participants expressed their approval of interactive and active communication in mathematics learning using whiteboard fox. The aspects that arise related to communication in mathematics learning using whiteboard fox are checking each other's answers, interaction, and being active as shown in Figure 12. These results show that the use of whiteboard fox in mathematics learning provides an opportunity to check each other's answers to 21st century skills, namely communication. The use of language structure in good mathematics teaching and learning activities allows the communication process to run smoothly so that participants can understand the material well (Alfirahmadita & Maarif, 2020).

Collaboration

Analysis results of interviews from 10 participants related to the collaboration aspect showed that 100% of participants expressed their approval of the excitement aspect in mathematics learning using whiteboard fox. Other aspects that emerged from the results of the collaboration-related interview in Figure 13, 90% of participants stated that whiteboard fox has attractive colors, 40% stated that it is not boring and comfortable, 30% stated that it builds a positive mindset, 20% stated that it is easy to manage and efficient, and 10% stated that it can build communication.

The collaboration aspect in Figure 13 of 21st century skills in mathematics learning using whiteboard fox provides a wealth of information describing variations in participants' answers. These results show that the use of whiteboard fox in mathematics learning provides many advantages and benefits for collaborating in a fun way. This result is similar to the use of other learning media in mathematics learning which states the same thing (Sulistiyawati et al., 2021), and increase interest in learning.

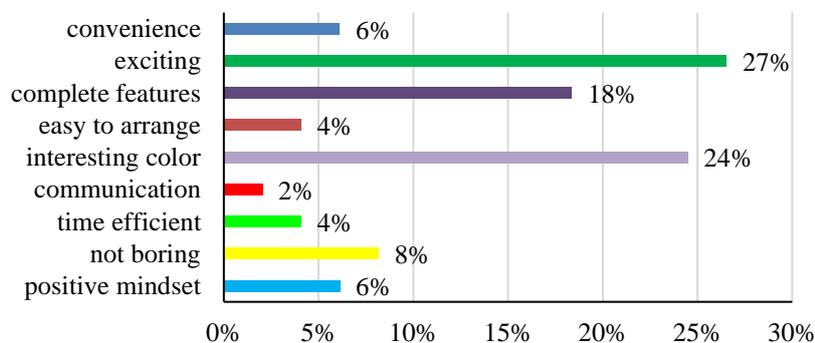


Figure 14. Sub-code presentation collaboration

In fact, one of the participants' answers stated that it can give passion in learning mathematics using whiteboard fox to the 21st century skill aspect, namely collaboration. Here's a snippet of the interview.

Researcher : Can interaction in mathematics learning linear program material make learning more exciting and challenging?

AF : yes, because there must be a discussion, mom, there is a thought, so you can do it more passionately. Sometimes we can't be lazy, mom, if you can do it so excited.

Based on the answers given, AF and BRR showed that they felt that using a whiteboard fox made learning more exciting because he could brainstorm with his friends.

Researcher : Do you think it's good to learn mathematics using whiteboard fox? If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

AF : it's just delicious, mom, if there are many colors on the fox whiteboard, the advantages are very much saving learning time, so we don't change it just a little bit, mom, so you can continue to the next material because you have already been moved, you can find out for yourself first the material that will be explained later.

Researcher : Do you think it's good to learn mathematics using whiteboard fox? If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

BRR : it's delicious, it builds a more exciting atmosphere, because it works directly on the cellphone, and the colors are attractive to make you not bored, the advantages make the first easier, the second helps change people's mindset that mathematics is boring.

BRR participants stated that learning mathematics using whiteboard fox makes classroom learning more exciting because it has various color features, making it easier to use, so that it can change the mindset of students who think that mathematics is boring.

Researcher : Can the interaction in mathematics learning of linear program materials make learning more exciting and challenging?

BRR : it's more exciting, because we don't want to just look at the blackboard, we can delete.

With a wide variety of features, BRR states that it makes learning easier because it can be enlarged and reduced as needed. The convenience obtained from the use of learning media has an impact on performance in learning (Sumantri & Pratiwi, 2015). Here's a snippet of the interview.

Researcher : Yes, using whiteboard fox, then Can during mathematics learning linear program material using whiteboard fox can make it easier for you to analyze a mathematical problem given by the teacher?

BRR : easier, because we see it on our respective cellphones so it's easier to zoom in or out of the writing.

DM participants stated that the use of whiteboard fox during learning makes learning more exciting because they can interact with each other by finding the information needed by themselves. Here's a snippet of the interview.

Researcher : Can the interaction in mathematics learning linear program material make learning more exciting and challenging?

DM : it's more exciting, mom, it's like there are rules so you don't scribble on the whiteboard fox, so the class atmosphere becomes more active, right if you write it down, then we will continue to look at it, if that's the book isa see for yourself, scroll yourself.

According to DM, the use of whiteboard fox during learning makes learning more exciting because it can interact with each other, and can streamline time because in the fox whiteboard there is already material that will be discussed today, without having to wait for researchers to write down questions such as the usual use of fox whiteboards. The results of this study are similar to learning research using e-modules which states that e-module learning can facilitate students in the learning process and make it easier for teachers to teach (Hamid et al., 2020).

Researcher : Do you think it's good to learn mathematics using whiteboard fox? If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

DM : there's a good thing about it, mom, the advantage is that it's not a waste of time, if it's on the blackboard, we mostly wait for the writing to be finished, if it's on the whiteboard fox, we just have to look and mom explains. Then also the features are complete, the colors can be changed.

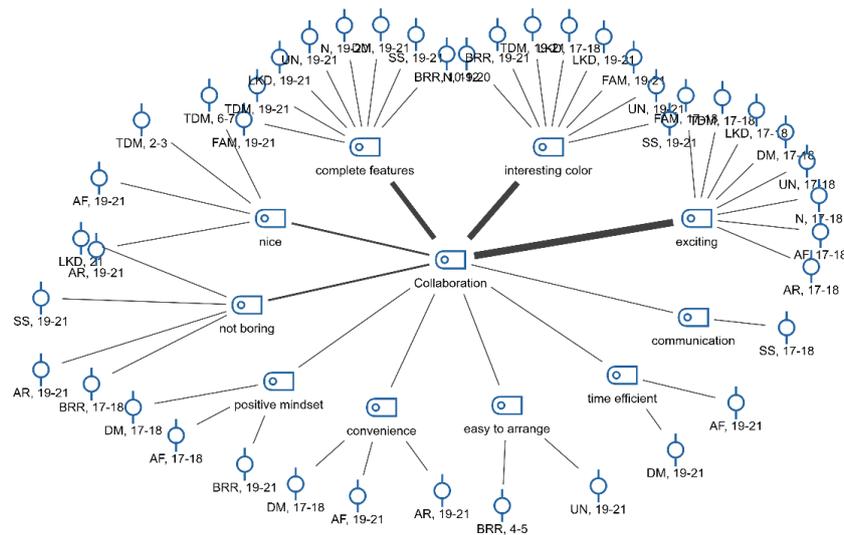


Figure 15. MAXMaps collaboration

From the case of 10 participants related to the collaboration aspect, it can be seen that 4 thick lines are connected with fun codes, attractive colors, complete features, and delicious. as shown in Figure 14. These results show that the use of whiteboard fox in mathematics learning provides a significant collaboration aspect to 21st century skills.

Creativity and Innovation

The analysis of interviews from 10 participants related to the creativity and innovation aspect showed a variation in the percentage of sub-codes that appeared as seen in Figure 15. There are 4 sub-codes of code creativity and innovation where 3 out of 4 sub-codes have the same percentage of 24.4%. However, in other sub-codes, it shows a figure of 26.8%, meaning that the use of whiteboard fox in mathematics learning can provide high confidence to participants.

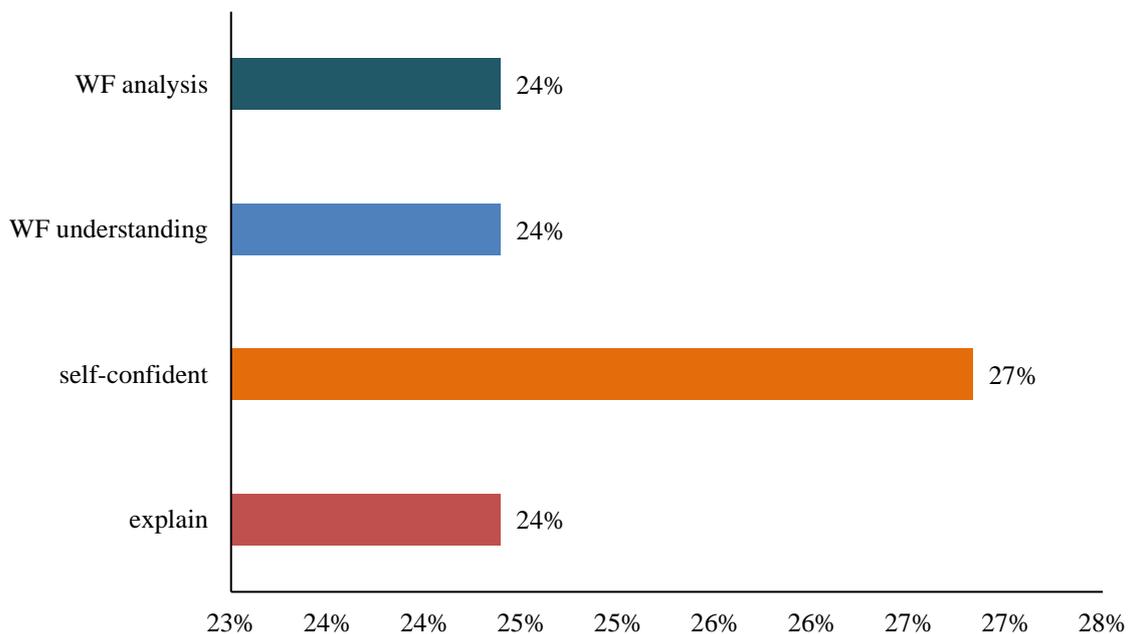


Figure 16. Presentation sub-codes of creativity and innovation

One participant stated that the use of whiteboard fox gave her confidence even though she was actually shy. Here's a snippet of the interview.

Researcher : Does learning mathematics linear program material using Whiteboard Fox allow you to confidently or unabashedly argue/answer teachers' questions?

AF : I'm shy, I'm not sure and afraid of being wrong, but if you use whiteboard fox, it can help me as a shy person, mom.

However, AF is a shy child so using a whiteboard fox during math learning really helps AF to be more confident because he doesn't have to come forward to answer his friends' questions.

Researcher : Does learning mathematics linear program material using whiteboard fox make it easier for you to understand the material?

AF : yes, mom, it helps me to just feel uncomfortable if someone is dragging, just like the buttons are afraid of pressing it wrong, but if you use it, it's good because you can immediately record the material.

AF feels that whiteboard fox is a learning medium that is good to use because the material in it can be directly recorded, but the problem is that AF feels uncomfortable if a friend scribbles on the whiteboard fox, and he is also afraid that he will be wrong in clicking on one of the features on the whiteboard fox.

Researcher : then Can during mathematics learning linear program material using whiteboard fox make it easier for you to analyze a mathematical problem given by the teacher?

AF : yes, before you teach, I can think first of all this is how the formula goes.

AF can analyze the questions given by the researcher, because before being taught, he first finds out how to formula and how to solve the problem. From the results of the AF interview, it shows that the use of whiteboard fox during learning makes AF more confident and whiteboard fox is a fun medium because of its many features. Whiteboard fox makes BRR more confident because it can answer the teacher's questions without having to come in front of his friends.

Whiteboard fox makes DM more active in asking because of the confusion he experiences. According to DM, whiteboard fox makes DMs interact with other friends, for example When a DM answers a researcher's question, then the answer is not quite right. His friend can fix the DM answer. The DM can explain to his friends the answers he has answered.

Researcher : How is the interaction between students during the mathematics learning of linear program materials using Whiteboard Fox? For example: by jointly answering each other's questions on the fox whiteboard during learning, or can you correct the wrong friend's answer by deleting the friend's writing?

DM : yes, it can help to correct a friend's wrong answer, so if you are in front of me if you are afraid of being afraid of being bullied, and if you use a whiteboard fox, they are embarrassed not to be very sorry, they help remove the wrong answer.

The use of whiteboard fox in mathematics learning does not always provide convenience to participants. One DM participant was of the view that he still needed an explanation even though the material had been provided through a whiteboard fox. Here's a snippet of an interview with the DM.

Researcher : Yes, using whiteboard fox, then Can during mathematics learning linear program material using whiteboard fox can make it easier for you to analyze a mathematical problem given by the teacher?

DM : that's not the case, mom, it's easier to one-on-one, right if it's whiteboard fox, mom has already written the material first on the fox whiteboard, so it's like we were confused at the beginning before it was explained.

Unfortunately, DM is not observed in depth because there is an aspect of dependence even though the material has been provided in the fox whiteboard. This finding is contrary to the results of research on the use of crossword puzzle media which is able to increase student learning independence (Setiadi, 2021). We cannot generalize the DM case, but the fact is that there are participants who are still dependent on learning mathematics. On the other hand, TDM stated that fox whiteboard provides convenience in correcting the answers of his friends, and interest when using fox whiteboard.

Researcher : Do you think it's good to learn mathematics using whiteboard fox? (Collaboration). If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

TDM : it's delicious, the advantage is hmm we can correct our friend's wrong answer, there is a ruler feature, the color is the most influential, especially when learning linear program material.

According to TDM, whiteboard fox is very useful because it has many advantages such as complete features, and varied colors because color variations are very influential, especially on linear program materials.

Researcher : Do you think it's good to learn mathematics using whiteboard fox? If so, what are the advantages of whiteboard fox that you feel during mathematics learning linear program materials?

TDM : it's delicious, mom, so there is a ruler feature, so we don't have to worry about the ruler, it's easier to choose the color according to your needs. 1) easy to set up, 2) there are quite a lot of features"

With the ruler feature, it makes it very easy for students, especially in this linear program material, the whiteboard fox is a digital whiteboard that is easy to set up and has many features.

Researcher : Can the interaction in mathematics learning of linear program materials make learning more exciting and challenging? (Collaboration)

TDM : it's more exciting, mom, because she has more tools, than the colors, so it's easier for us to distinguish what line this line is, and then the line.

From the case of 10 participants related to aspects of creativity and innovation, Figure 16 shows the ease, confidence, ability, and ability to analyze mathematical problems. These results show that the use of whiteboard fox in mathematics learning provides knowledge that the use of technologies such as whiteboard fox in mathematics learning has a positive advantage, although there are other sides that have not been fully accommodated, especially towards 21st century skills.

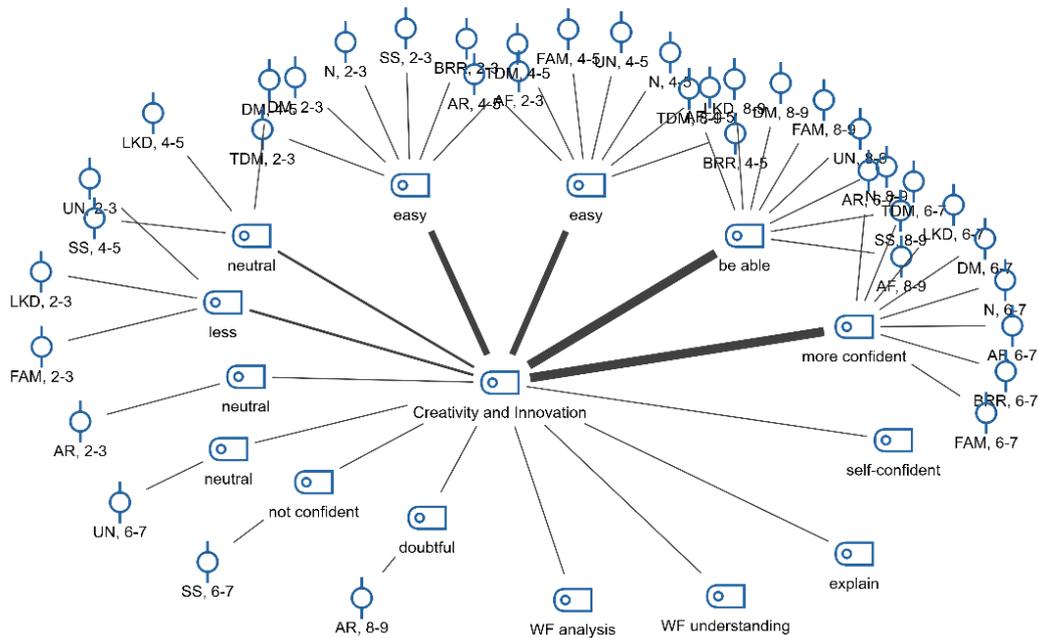


Figure 17. MAXMaps creativity and innovation

▪ **CONCLUSION**

The use of whiteboard fox in mathematics learning to accommodate 21st century skills has been investigated. Many words emerged from the participants' interviews both positive and negative from the 9 questions representing 21st century skills. The results of research from the aspects of critical thinking and problem solving show that the ease of checking each other's answers is the dominant advantage of the use of whiteboard fox in mathematics learning. The use of whiteboard fox in mathematics learning related to the collaboration aspect shows the excitement factor, interesting and complete features so as to provide more value in learning. In the aspect of creativity and innovation, it provides knowledge that the use of whiteboard fox in mathematics learning provides convenience, confidence and the ability to be creative and innovative.

This study had limitations on the number of participants and the characteristics of the schools that were the location of the study. Research with different participant characteristics may produce different studies. Research on investigating learning independence in mathematics learning has the opportunity to become the next research topic because there are participants who are independent and not independent in learning. Future research on 21st century skills in mathematics learning using other learning media is possible.

▪ **REFERENCES**

Alfirahmadita, J., & Maarif, S. (2020). Peran bahasa dalam komunikasi pembelajaran matematika secara online pada masa pandemi covid-19. *Jurnal Pendidikan Matematika Universitas Lampung*, 8(3), 153–167. <https://doi.org/10.23960/mtk/v8i2.pp153-167>

- Almarzooq, Z. I., Lopes, M., & Kochar, A. (2020). virtual learning during the covid-19 pandemic: a disruptive technology in graduate medical education. *Journal of the American College of Cardiology*, 75(20), 2635–2638. <https://doi.org/10.1016/j.jacc.2020.04.015>
- Ameliah, I. H., Munawaroh, M., & Muchyidin, A. (2016). Pengaruh keingintahuan dan rasa percaya diri siswa terhadap hasil belajar matematika kelas vii mts negeri i kota cirebon. *Eduma : Mathematics Education Learning and Teaching*, 5(1), 9–21. <https://doi.org/10.24235/eduma.v5i1.598>
- Angga, A., Abidin, Y., & Iskandar, S. (2022). Penerapan pendidikan karakter dengan model pembelajaran berbasis keterampilan abad 21. *Jurnal Basicedu*, 6(1), 1046–1054. <https://doi.org/10.31004/basicedu.v6i1.2084>
- Apsari, P. N., & Rizki, S. (2018). Media pembelajaran matematika berbasis android pada materi program linear. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 7(1), 161–170.
- Aspi, M., & Syahrani, S. (2022). Profesional guru dalam menghadapi tantangan perkembangan teknologi pendidikan. *ADIBA: Journal of Education*, 2(1), 64–73. <https://doi.org/10.54443/injoe.v3i2.35>
- Clokie, T. L., & Fourie, E. (2016). Graduate employability and communication competence: are undergraduates taught relevant skills? *Business and Professional Communication Quarterly*, 79(4), 442–463. <https://doi.org/10.1177/2329490616657635>
- Creswell, J. W. (2013). Qualitative inquiry & research design choosing among five approach. In *SAGE (Third Edit)*. SAGE Publications. Inc.
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (tdc) framework. *Educational Technology Research and Development*, 68(5), 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Graham, K. (2020). TechMatters : visualize this and annotate that : whiteboards for online teaching and presentations. *LOEX Quarterly*, 47, 4–7.
- Hamid, M. A., Yuliawati, L., & Aribowo, D. (2020). Feasibility of electromechanical basic work e-module as a new learning media for vocational students. *Journal of Education and Learning (EduLearn)*, 14(2), 199–211. <https://doi.org/10.11591/edulearn.v14i2.15923>
- Ibrahim, I., Sujadi, I., Maarif, S., & Widodo, S. A. (2021). Increasing mathematical critical thinking skills using advocacy learning with mathematical problem solving. *Jurnal Didaktik Matematika*, 8(1), 1–14. <https://doi.org/10.24815/jdm.v8i1.19200>
- Ismail, N. S., Harun, J., Zakaria, M. A. Z. M., & Salleh, S. M. (2018). The effect of Mobile problem-based learning application DicScience PBL on students' critical thinking. *Thinking Skills and Creativity*, 28, 177–195. <https://doi.org/10.1016/j.tsc.2018.04.002>

- Leonisa, I., & Soebagyo, J. (2022). Strategi siswa dan langkah polya dalam penyelesaian masalah matematis berbasis hots. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, 5(2), 77–86.
- Muali, C., Islam, S., Bali, M. E. I., Hefniy, H., Baharun, H., Mundiri, A., Jasri, M., & Fauzi, A. (2018). Free online learning based on rich internet applications; the experimentation of critical thinking about student learning style. *Journal of Physics: Conference Series*, 1114(1). <https://doi.org/10.1088/1742-6596/1114/1/012024>
- Mukhadis, A. (2013). Sosok manusia indonesia unggul dan berkarakter dalam bidang teknologi sebagai tuntutan hidup di era globalisasi. *Jurnal Pendidikan Karakter*, 4(2).
- Naibaho, L. (2019). The integration of group discussion method using audio visual learning media toward students' learning achievement on listening. *International Journal of Research -GRANTHAALAYAH*, 7(8), 438–445. <https://doi.org/10.29121/granthaalayah.v7.i8.2019.697>
- Peters-burton, E. E., & Stehle, S. M. (2019). Developing student 21 st Century skills in selected exemplary inclusive STEM high schools. *International Journal of STEM Education*, 6(1), 1–15.
- Rädiker, S., & Kuckartz, U. (2020). Focused analysis of qualitative interviews with MAXQDA: Step by Step. In *Maxqda Press*.
- Setiadi, I. (2021). Peningkatan keaktifan dan kemandirian belajar matematika siswa dalam jaringan synchronous menggunakan media crossword puzzle. *Journal of Mathematics Education*, 7(1), 1–12.
- Soebagyo, J., Habibie, H., & Gunawan, I. (2021). Polya's four phases exploration in solving linear program story questions based on student beliefs. *Proceedings of the 1st Annual International Conference on Natural and Social Science Education (ICNSSE 2020)*, 547(Icnsse 2020), 260–267. <https://doi.org/10.2991/assehr.k.210430.040>
- Sulistiyawati, W., Sholikhin, R., Afifah, D. S. N., & Listiawan, T. (2021). Peranan game edukasi kahoot! dalam menunjang pembelajaran matematika. *Wahana Matematika Dan Sains: Jurnal Matematika, Sains, Dan Pembelajarannya*, 15(1), 46–57. <https://ejournal.undiksha.ac.id/index.php/JPM/article/view/29851>
- Sulistiyani, D., Roza, Y., & Maimunah, M. (2020). Hubungan kemandirian belajar dengan kemampuan pemecahan masalah matematis. *Jurnal Pendidikan Matematika*, 11(1), 67–76. <http://ojs.uho.ac.id/index.php/jpm>
- Sumantri, M. S., & Pratiwi, N. (2015). The effect of learning media and types of personality on elementary student's mathematic performance. *American Journal of Educational Research*, 3(3), 276–281. <https://doi.org/10.12691/education-3-3-4>
- Sumilat, J. M. (2018). Pemanfaatan media pembelajaran matematika interaktif untuk meningkatkan hasil belajar siswa di sd negeri 2 tataan. *INVENTA: Jurnal*

Pendidikan Guru Sekolah Dasar, 2(1), 40–46.

- Sunaryo, A. (2019). Penggunaan media pembelajaran geogebra terhadap hasil belajar siswa tentang materi program linier kelas X. *Journal on Education*, 02(01), 96–103.
- Trilling, B., & Fadel, C. (2009). *21st Century Skills, Enhanced Edition: Learning for Life in Our Times*. 45–86.
- Vinson, N. G., Molyneaux, H., & Martin, J. D. (2019). *Explanations in artificial intelligence decision making*. <https://doi.org/10.4018/978-1-5225-9069-9.ch006>
- Wei, X., Cheng, I. L., Chen, N. S., Yang, X., Liu, Y., Dong, Y., Zhai, X., & Kinshuk. (2020). Effect of the flipped classroom on the mathematics performance of middle school students. *Educational Technology Research and Development*, 68(3), 1461–1484. <https://doi.org/10.1007/s11423-020-09752-x>
- Zubaidah, S. (2016). Keterampilan abad ke-21: keterampilan yang diajarkan melalui pembelajaran. *Isu-Isu Strategis Pembelajaran MIPA Abad 21*, 2(2), 1–17.