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Leveraging Computer Assisted to Enhance the Effectiveness of Direct Instruction in Supporting Students' Mathematical Reasoning

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Abstrak
Salah satu tantangan yang dihadapi mahasiswa adalah terbatasnya akses ke fasilitas laboratorium komputer, yang menghambat pembelajaran matematika, khususnya dalam metode numerik. Kelemahan ini sebagai penghambat kemampuan berpikir matematis yang krusial untuk keberhasilan memahami algoritma dan membangun program solusi numerik, sehingga pengembangan keterampilan ini perlu diprioritaskan. Pembelajaran direct instruction dianggap kurang efektif, sehingga perlu ditingkatkan dengan penggunaan media interaktif digital, berupa pembelajaran berbantuan komputer, dikenal dengan direct instruction-computer assisted (DI-CA). Penelitian menerapkan langkah research and development (RnD), bertujuan untuk menciptakan dan memvalidasi media instruksional digital guna meningkatkan penalaran matematis mahasiswa. Subjek penelitian pada mahasiswa calon guru matematika, data diperoleh dari validasi ahli, pengalaman pengguna, dan tes kemampuan penalaran matematis melalui pretes dan postes. Web ajar sebagai media dalam pembelajaran DI-CA divalidasi dari aspek yang berfokus pada kejelasan instruksi, kesesuaian materi, dan pengalaman pengguna, yang semuanya dinyatakan valid. Uji coba dengan 33 mahasiswa diperoleh rata-rata hasil tes kemampuan penalaran 61.21, dengan interval antara 56.59 - 65.84, mengindikasikan peningkatan keterampilan penalaran. Penelitian ini menekankan pentingnya integrasi teknologi komputer dalam pembelajaran, yang dapat meningkatkan pengalaman belajar dan kinerja akademis mahasiswa dalam matematika.
Kata Kunci: Media instruksi digital; Pembelajaran matematika; Penalaran matematis

Abstract
One of the challenges faced by students is the limited access to computer laboratory facilities, which hampers mathematics learning, particularly in numerical methods. This limitation impedes the development of critical mathematical thinking skills essential for understanding algorithms and constructing numerical solution programs, highlighting the need to prioritize the development of these skills. Direct instruction is less effective, necessitating an enhancement through the use of interactive digital media, specifically computer-assisted instruction, known as Direct Instruction-Computer Assisted (DI-CA). This research employs a research and development (RnD) approach to create and validate digital instructional media to improve students' mathematical reasoning. The research subjects are mathematics education students, and data are obtained from expert validation, user experience, and mathematical reasoning ability tests through pre-tests and post-tests. The web-based instructional media used in DI-CA was validated based on clarity of instructions, content appropriateness, and user experience, all of which were confirmed to be valid. The trial involving 33 students yielded an average mathematical reasoning test score of 61.21, ranging between 56.59 and 65.84, indicating an improvement in reasoning skills. This study underscores the importance of integrating computer technology into instruction, which can enhance learning experiences and academic performance in mathematics.
Keywords: Digital instruction media; Mathematics learning; Mathematics reasoning

I. INTRODUCTION

Mathematics education is a crucial component of the higher education system, and its ability to develop critical thinking is essential for students (Firdaus, Bakar, M., & Bakry, 2015; Van den Heuvel-Panhuizen & Drijvers, 2020; Sofiani, Nurjamil, & Nurhayati, 2023). However, many students at various educational institutions face challenges due to the lack of access to adequate computer lab facilities, which serve as tools for simulating mathematics learning (Sulasteri, Nur, & Suharti, 2021; Putra, Juandi, & Jufri, 2023). This is especially true in the learning of numerical methods, where complex concepts and mathematical calculations often require better visualization and interaction through technology (Rathour et al., 2022). Thus, limited access to technological aids can hinder students in understanding and mastering the material being taught (Young, 2017; Forde & Obrien, 2020; Yunisca & Nasution, 2023). Therefore, it is important to seek solutions that can enhance students' learning experiences in mathematics, particularly in numerical methods.

Mathematical reasoning skills play a significant role in students' academic success (Iswanto & Faradillah, 2023; Onoshakpokaiye, 2023). Mathematical reasoning is not just about mastering formulas or algorithms, but also the ability to think logically and critically in problem-solving (Arnandi et al., 2023; Khong, Seow, & Lam, 2023). These skills are essential in the professional world, where effective problem-solving can determine an individual's success (Haeruman, 2024). Given the importance of mathematical reasoning, the development of these skills should be a priority in higher education curricula (LeJeune, & Lemons, 2021; Cahyani & Sritresna, 2023). Therefore, innovative approaches are needed to enhance students' mathematical reasoning abilities to meet the demands of the times and industry needs.

Direct instruction methods have been proven effective in teaching various mathematical concepts (Mangundu, Intja, & Moyo, 2023). However, the effectiveness of this method can be improved when combined with appropriate media, especially computer-based digital media (Gan, Menkhoff, & Smith, 2015; Kalyani, 2024). The use of digital tools can enrich students' learning experiences, providing them with opportunities to engage with the material more deeply (Husniah & Azka, 2022; Ní Shé, Ní Fhloinn, & Mac an Bhaird, 2023). Digital media also allows students to learn at their own pace and provides instant feedback that can enhance their understanding (Pinheiro, Barbosa, Carvalho, & Freitas, 2021). Thus, the integration of computer technology in direct instruction has the potential to increase student engagement in the learning process.

This research employs a Research and Development (RnD) methodology to create and validate digital instructional media specifically designed to enhance students' mathematical reasoning (Suciati, Munadi, Sugiman, & Dwi, 2020; Hudiria & Haji, 2022). The validation process involves assessment from various aspects, including the clarity of direct instruction syntax, material relevance, and user experience (Amadi, Anireh, & Aruchi, 2019; Laurent et al., 2020). Each of these aspects is crucial to ensure that the developed media can be effectively used in learning. Through an RnD approach, this research aims to provide concrete solutions that can be implemented in higher education settings (Kamaliya, Tukiran, & Indana, 2022). With the development of valid media, it is hoped that students will find it easier to understand complex mathematical concepts.

Many studies focus on traditional direct instruction methods without considering the integration of digital technology that could enhance the learning experience (Bereczki & Kárpáti, 2021). Additionally, although mathematical reasoning is crucial, there is a lack of research exploring how computer-assisted tools can improve these skills. Existing interactive media have also not been thoroughly evaluated in the context of direct instruction, which hinders understanding of the impact of technology. Many previous studies have not involved comprehensive validation or empirical assessment to measure the effectiveness of digital tools (Burnett & Lisk, 2021, Marion & Fixson, 2021). The lack of focus on applying technology in higher education is also a gap that needs to be addressed. This research aims to address these shortcomings by integrating technology with direct instruction and employing Research and Development (RnD) methods for comprehensive validation and assessment.

From this background, this research initiates the development and evaluation of the impact of computer media applied to direct instruction learning on students' mathematical reasoning abilities. In the testing phase, this research will measure the effectiveness of the media through assessments of mathematical reasoning abilities (Montague, 2010; Suherman & Vidakovich, 2022). The results of this assessment are expected to show significant improvements in students' reasoning skills and provide insights into how computer technology can be integrated into mathematics learning (Nurjanah, Dahlan, & Wibisono, 2021).

II. METHOD

This study is a research and development (RnD) project using the ADDIE method (Analysis, Design, Development, Implementation, and Evaluation) as a framework to develop computer-assisted learning (CAL) media based on direct instruction aimed at enhancing students' mathematical reasoning (Smith & Johnson, 2020). The selection of subjects, consisting of students of mathematics education at a university in Langsa, who are enrolled in the numerical methods course, involved 33 individuals chosen as a sample using purposive sampling (Creswell, 2014). They were observed and treated from September to December 2023. The research aims to develop discovery learning with the computers assisted, specifically by providing a learning website that meets assessment aspects based on the following instruments:

The questionnaire consists of 12 questions developed to describe the aspects of Computer Access Availability, Difficulties in Learning, Interactive Media Needs, Learning Preferences, Feedback on

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Learning, and Suggestions for Media Development.

No	Aspect	Question	Agreement Score (1-4)	Notes
1	Computer Access Availability	I have adequate access to a personal computer to support my learning.		
2		The computer lab facilities at the university are sufficient for my		
3	Difficulties in Learning	I find it difficult to understand concepts in numerical methods.		
4		The current numerical methods instruction is effective in helping me		
5	Interactive Media Needs	I believe that interactive learning media would enhance my understanding of numerical		
6		Visual aids in learning are very helpful for me in understanding difficult mathematical concepts.		
7	Learning Preferences	I prefer using technology in learning compared to traditional methods.		
8		I would like to use computer simulations in learning numerical		
9	Feedback on Learning	The numerical methods instruction I am currently undergoing feels less		
10		The instructions provided in the numerical methods learning are easy		
11	Suggestions for Media Development	I recommend the development of computer-assisted learning media for the numerical methods course.		
12		I would like to receive training on using digital media before starting		

Figure 1. Survey of student needed analysis

The applied media is validated for its suitability concerning direct instruction and the material. Both aspects are validated by two validators: an expert in mathematics education and an expert in web media development. The suitability of the media is assessed from three aspects:

1) The appropriateness of the appearance,

No	Assessment Aspects	Agreement Score (1-4)	Notes
A	Graphic Display		
1	The front page display is related to learning		
2	Graphic display of each web page		
3	Complete material according to the table of contents		
4	The font size is appropriate and the color is clearly legible		
B	Multimedia		
5	The media used is appropriate to explain the material		
6	The illustrations presented are interesting		
7	The media used is varied		
	Practicality of operation		
8	There are instructions for using the website		
9	Ease of access		

Figure 2. Quesioneire of Interface

2) The relevance of the material,

Evaluation of material suitability			
No	Assessment Aspects	Agreement Score (1-4)	Notes
A	Appropriateness of material/content		
1	Material conformity with CPL		
2	Suitability of material to learning objectives		
3	Material accuracy		
4	The material uses appropriate examples		
5	Short, concise and clear material		
B	Feasibility of presentation		
6	Presentation of coherent/ coherent concepts		
7	Availability of exercises		

Figure 3. Quesioneire of Material Suitable

3) The suitable to direct instruction learning.

Suitable of Direct Instruction model			
No	Assessment Aspects	Agreement Score (1-4)	Notes
1	Accommodate students' learning preparations		
2	Deliver the material accurately and comprehensively		
3	Conduct appropriate demonstrations for each material		
4	Guided practice in accordance with the material		
5	Independent practice that aligns with the material		

Figure 4. Quesioneire of DI Suitable

Information is provided by 20 students who have undergone computer-assisted direct instruction, as well as reviewing the effectiveness of the media used.

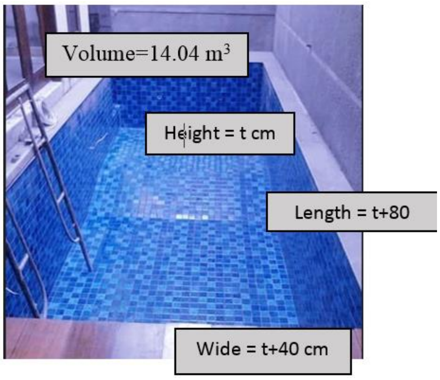
No	Questions	Agree	Disagree	Notes
1	The learning web is easy to use in learning			
2	Web learning can shorten time			
3	Easy to access anytime and anywhere			
4	The description of the material and exercises is easy to understand			
5	Attractive web appearance			
6	The content on the website is related to images, tables and diagrams in accordance with the material			
7	The language used is easy to understand			
8	The color combinations used are appropriate and attractive			
9	The web helps independent learning			
10	Feel helped after using web media			
11	The web is useful for increasing insight			

Figure 5. Quesioneire Student Experience

The reasoning ability test consists of 3 questions to measure learning success after implementing computer-assisted direct instruction.

Table 1.
Problem and its Reasoning Aspect

No	Problem: Sub-Problem	Reasoning Aspect
1	A non-linear equation $x^2 - 3x - 5 = 0$ Determine solutions to the equation using two approaches: analytical method and numerical method, specifically employing the bisection method with the selection of bounds that contain the solution	
1.1	Using analytical method	Memorize reasoning
1.2	Find the bounds and prove it that contain a solution	Plausible reasoning
1.3	Using bisection method to find a solution	Algorithmic reasoning
1.4	Find other solution	Novelty reasoning
2	Given an equation $x^{0,3} + x^2 - 1 = 0$ Find the solution to the equation using the bisection method by determining the initial bounds, constructing the algorithm, and computing each bound until obtaining the solution	
2.1	Find the bounds and prove it that contain a solution	Plausible reasoning
2.2	Build the algorithm	Memorize reasoning
2.3	Calculate each iteration	Algorithmic reasoning
3	A pool with a volume of 14.04 m³, its height, length, and width are unknown. Find the surface area of the pool to be covered with tiles.	



Construct a model so that we can find the value of "t" using the bisection method

No	Sub-Problem	Reasoning Aspect
3.1	Construct the model	Mathematics foundation
3.2	Count the solution of "t" using bisection method	Algorithmic reasoning
3.3	Using the proper bound	Plausible reasoning
3.4	Find the surface inside area	Mathematics foundation

This instrument has undergone validity and reliability testing to ensure its accuracy and consistency. Additionally, the learning media used has also gone through a development and validation process before implementation. The data obtained were validated using triangulation stages to enhance the accuracy and credibility of the collected data (Creswell, 2014).

III. Result and Discussion

In this section, the research findings will be discussed to evaluate the effectiveness of computer-assisted learning media based on direct instruction in enhancing students' mathematical reasoning.

A. Result

The presentation of results at each step of ADDIE is as follows:

1) Analysis

An analysis was conducted on students at a university in Langsa regarding the learning of numerical methods. At this stage, the students' needs were identified, and it was found that they faced difficulties in learning numerical methods due to a lack of access to computer lab facilities. The survey results are shown in the following summary Table 2:

Table 2.
Average Score of Students Learning Access

No	Aspect	Question	Mean Score
1	Computer Access Availability	I have adequate access to a personal computer to support my learning.	3.75
2		The computer lab facilities at the university are sufficient for my learning needs.	1.9
3	Difficulties in Learning	I find it difficult to understand concepts in numerical methods.	3.5
4		The current numerical methods instruction is effective in helping me understand the material.	1.8
5	Interactive Media Needs	I believe that interactive learning media would enhance my understanding of numerical methods.	3.75
6		Visual aids in learning are very helpful for me in understanding difficult mathematical concepts.	3.45
7	Learning Preferences	I prefer using technology in learning compared to traditional methods.	3.5
8		I would like to use computer simulations in learning numerical methods.	3.6
9	Feedback on Learning	The numerical methods instruction I am currently undergoing feels less engaging.	3.4
10		The instructions provided in the numerical methods learning are easy to understand.	1.9
11	Suggestions for Media Development	I recommend the development of computer-assisted learning media for the numerical methods course.	3.7
12		I would like to receive training on using digital media before starting the learning process.	3.45

The results of the survey indicate that students have good access to personal computers (average 3.75), but access to computer labs is very low (average 1.9), indicating limited facilities that hinder the learning of numerical methods. Students find it difficult to understand the concepts of numerical methods (average 3.5) and consider the current learning to be ineffective (average 1.8). They strongly desire interactive learning media (average 3.75) and believe that visual aids can enhance understanding (average 3.45). Additionally, students support the development of computer-assisted learning media (average 3.7) and want to receive training on using digital media before the learning process (average 3.45). This analysis indicates the need for improved access to computer lab facilities and the development of more innovative teaching methods to address students' difficulties in understanding numerical methods concepts. The high demand for interactive learning media and support for the use of technology reflect students' readiness to adapt to more modern and engaging learning approaches.

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2) Design

The computer-assisted learning media is designed with a learning website that can be accessed via laptops or smartphones, as well as incorporating freely available online applications. This media takes into account the suitability of the direct instruction learning steps, the availability of digital devices (laptops or smartphones), and the material (Bisection Method). The computer-assisted learning based on direct instruction is designed as follows:

- Preparation

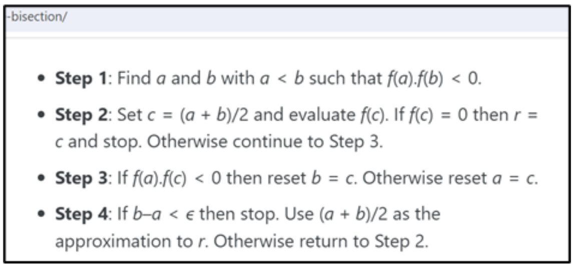
Students are asked to access the web page, create an account, and log in using their preferred digital media (laptop or smartphone).

Figure 5. Begining of Homepage

On the homepage, information about the learning objectives and expected learning outcomes is provided.

- Delivering Information

The teaching material presented by the lecturer is displayed on the web and can be accessed through digital devices.

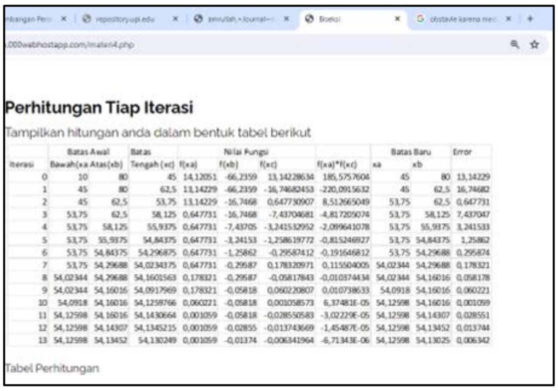

-bisection/

- **Step 1**: Find *a* and *b* with $a < b$ such that $f(a).f(b) < 0$.
- **Step 2**: Set $c = (a + b)/2$ and evaluate $f(c)$. If $f(c) = 0$ then $r = c$ and stop. Otherwise continue to Step 3.
- **Step 3**: If $f(a).f(c) < 0$ then reset $b = c$. Otherwise reset $a = c$.
- **Step 4**: If $b–a < \epsilon$ then stop. Use $(a + b)/2$ as the approximation to *r*. Otherwise return to Step 2.

Figure 6. Algorithm Biseksi on web

- Demonstration

The application of the learning material is demonstrated through the solution of a non-linear equation using a table shown in the following illustration:


Perhitungan Tiap Iterasi

Tampilkan hitungan anda dalam bentuk tabel berikut

	Batas Awal		Batas	Nilai Fungsi				Batas Baru		Error
Iterasi	Bawah(xa	Atas(xb)	Tengah (xc)	f(xa)	f(xb)	f(xc)	f(xa)*f(xc)	xa	xb	
0	10	80	45	14,12051	-66,2359	13,14228634	185,5757604	45	80	13,14229
1	45	80	62,5	13,14229	-66,2359	-16,74682453	-220,0915632	45	62,5	16,74682
2	45	62,5	53,75	13,14229	-16,7468	0,647730907	8,512665049	53,75	62,5	0,647731
3	53,75	62,5	58,125	0,647731	-16,7468	-7,43704681	-4,817205074	53,75	58,125	7,437047
4	53,75	58,125	55,9375	0,647731	-7,43705	-3,241532952	-2,099641078	53,75	55,9375	3,241533
5	53,75	55,9375	54,84375	0,647731	-3,24153	-1,258619772	-0,815246927	53,75	54,84375	1,25862
6	53,75	54,84375	54,296875	0,647731	-1,25862	-0,29587412	-0,191646812	53,75	54,29688	0,295874
7	53,75	54,29688	54,0234375	0,647731	-0,29587	0,178320971	0,115504005	54,02344	54,29688	0,178321
8	54,02344	54,29688	54,1601563	0,178321	-0,29587	-0,05817843	-0,010374434	54,02344	54,16016	0,058178
9	54,02344	54,16016	54,0917969	0,178321	-0,05818	0,060220807	0,010738633	54,0918	54,16016	0,060221
10	54,0918	54,16016	54,1259766	0,060221	-0,05818	0,001058573	6,37481E-05	54,12598	54,16016	0,001059
11	54,12598	54,16016	54,1430664	0,001059	-0,05818	-0,028550583	-3,02229E-05	54,12598	54,14307	0,028551
12	54,12598	54,14307	54,1345215	0,001059	-0,02855	-0,013743669	-1,45487E-05	54,12598	54,13452	0,013744
13	54,12598	54,13452	54,130249	0,001059	-0,01374	-0,006341964	-6,71343E-06	54,12598	54,13025	0,006342

Tabel Perhitungan

Figure 7. Calculating result in tabel

Displays the results of the calculations using MS Excel to explain each step of the algorithm.

- Guided Practice

Students are given the opportunity to practice through realistic problems.

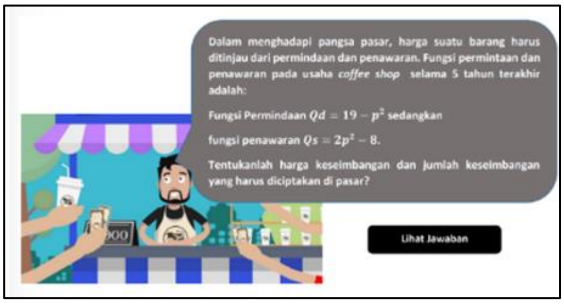


Figure 8. Problems to solve with guidence

The lecturer observes the students' work and provides direct guidance or instructions.

- Independent Practice

Students are assigned 3 non-linear equation problems to work on independently. The lecturer observes the students' work and collects their answers once completed.

Here are three non-linear equations that cannot be easily solved using analytical methods:

1. **Transcendental Equation:**
   $e^x + x^2 - 4 = 0$
2. **Trigonometric Equation:**
   $\sin(x) + x - 2 = 0$
3. **Logarithmic Equation:**
   $x \ln(x) - 1 = 0$

Figure 9. Non-linear equation

- Understanding Feedback

The instructor evaluates the students' answers from the independent practice and provides feedback in the form of corrections for any errors, as well as offering an opportunity for students to ask questions.

3) Development

The computer media in the form of a learning website is developed based on validation surveys that indicate alignment with direct instruction and the learning material. Validation is conducted twice: once for the media draft and again after revisions:

- Suitability of Appearance

Table 3.
Average Score of Appearance Suitable

No	Assessment Aspects	Score			
		Initial		Revised	
A	Graphic Display	V1	V2	V1	V2
1	The front-page display is related to learning	3	3	4	4
2	Graphic display of each web page	3	2	4	4
3	Complete material according to the table of contents	2	2	3	3
4	The font size is appropriate and the color is clearly legible	2	3	4	4
B	Multimedia				
5	The media used is appropriate to explain the material	2	3	3	4
6	The illustrations presented are interesting	3	2	3	3
7	The media used is varied	2	2	4	3
	Practicality of operation				
8	There are instructions for using the website	1	1	4	3
9	Ease of access	2	1	4	4
		2.2	**2.1**	**3.7**	**3.6**

Improvements are needed in the design and delivery of learning materials to enhance learning effectiveness. First, it is important to clearly present the learning objectives and learning outcomes so that students can understand the focus of the material to be studied. Additionally, the use of relevant and non-distracting images, as well as illustrations related to everyday life, can help reinforce students' understanding. To support the learning process, providing a help menu and summaries of previous material is highly recommended, along with adjusting color contrast to make the text easier to read. Finally, integrating other media such as videos or Geogebra applications, along with clear usage instructions, will ensure that the material can be optimally accessed through both PCs and mobile devices.

- Suitable for direct instruction

Table 4.
Score of Direct Instruction Suitable

No	Assessment Aspects	Score			
		Initial		Revised	
		V1	V2	V1	V2

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No	Assessment Aspects	Score			
		Initial		Revised	
		V1	V2	V1	V2
1	Accommodate students' learning preparations	3	3	4	4
2	Deliver the material accurately and comprehen-sively	2	3	4	4
3	Conduct appropriate demonstrations for each material delivery process	3	3	4	4
4	Guided practice in accordance with the material	3	3	4	4
5	Independent practice that aligns with the material	2	2	3	4

From the validator's comments, it can be concluded that in the learning process, it is important to use examples from everyday life or research journals to enhance student interest. The problems presented should be based on real cases with simple calculations, so they are not too difficult for students. Demonstrations should be conducted using interactive media that clearly illustrate the bisection process. Additionally, verification can be done through Google Forms to allow students to provide feedback directly. Finally, the use of problems relevant to everyday life should have varying levels of difficulty to match the students' abilities.

- Suitability of the Bisection Material

Table 5.
Evaluation of material suitability

No	Assessment Aspects	Score			
		Beginning		Repaired	
		V1	V2	V1	V2
A	Appropriateness of material/content				
1	Material conformity with CPL	4	3	4	4
2	Suitability of material to learning objectives	2	3	4	4
3	Material accuracy	1	3	3	4
4	The material uses appropriate examples	3	2	4	4
5	Short, concise and clear material	3	3	4	4
B	Feasibility of presentation				
6	Presentation of coherent/coherent concepts	2	3	3	4
7	Availability of exercises	2	2	4	3

The validator's statement emphasizes the importance of aligning the material with the Program Learning Outcomes (CPL) of the study program at the research location. The presented material should not only focus on the bisection topic but also include prerequisite topics, such as limits, to help students understand solutions and approximate values before discussing bisection. Furthermore, the examples provided should be accompanied by illustrations to clarify understanding, rather than relying solely on text narratives. The use of clear and precise language is crucial for effectively conveying information. Lastly, the presentation of the material should include guided practice and independent practice, featuring relevant examples from everyday problems so that students can apply the concepts learned.

Based on the assessment and comments provided by the validator, each step of the direct instruction has been revised as follows:

- Preparation

In the preparation stage, students are conditioned and mentally prepared to begin learning. They are provided with case examples of the application of non-linear problems across various fields of study.

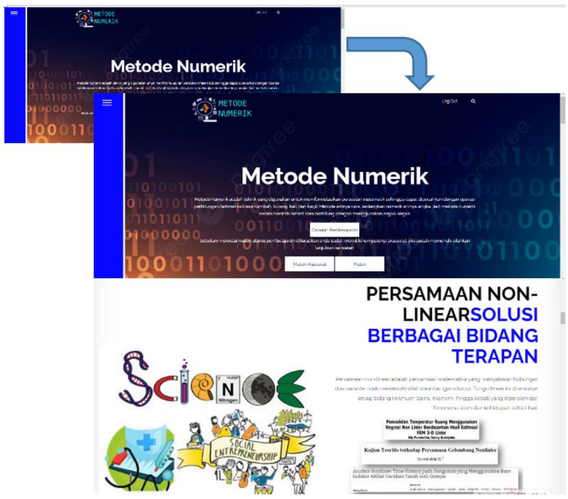

Figure 10. Revised of study preparation

- Information Delivery

In the information delivery stage, each step of the bisection method is demonstrated by building a programming language (MATLAB) using Octave Online. The Octave application is a free online tool that requires no installation and is processed in the cloud, so it does not limit the processing capability of the students' laptops or smartphones.

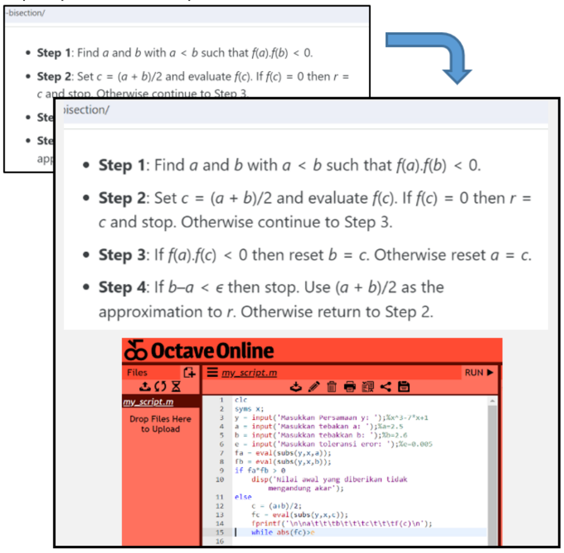

Figure 11. Revised of Information Delivery

- Demonstrating

Demonstrating the bisection method using a GeoGebra applet, rather than just an iteration calculation table, allows students to visually illustrate the process of narrowing the bounds by dividing them in half until approaching the desired solution.

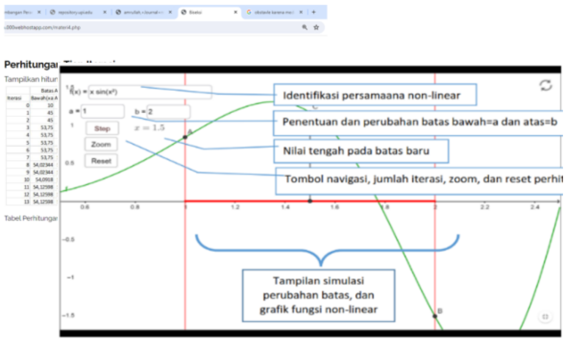

Figure 12. Revised of Demonstrating

- Guided Practice

In this guided practice, students will work with the same problem (Figure 8) but will demonstrate their results through a simulation using a GeoGebra applet (Figure 11).

- Independent Practice

In this independent practice session, students will work on problems that can be visualized with images from real-world cases. One of the problems will involve a non-linear equation related to volcanic material explosion.

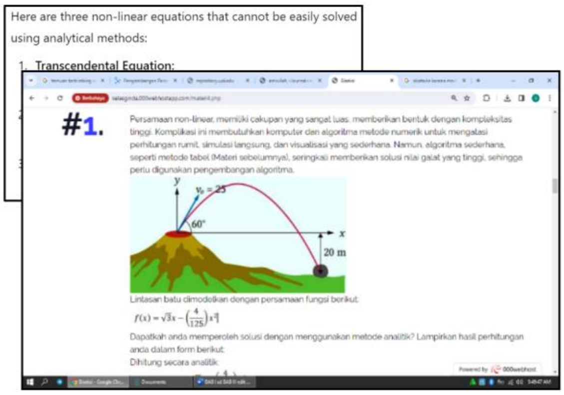

Figure 13. Revised of Independent Practice

- Understanding Feedback

The instructor will evaluate the students' answers from the independent practice and provide feedback in the following manner: Assessment of Answers, Constructive Feedback, Question and Answer, encouraging students to ask about any difficulties they encountered during the practice. This will create an open dialogue where students can seek clarification on concepts, they find challenging.

4) Implementation

The media trial was conducted with 33 students, and the results of the mathematical reasoning ability test show the following descriptive statistics:

Table 6.
Analysis of Statistic Descriptive

Aspek Statistik		Statistic
Mean		61,2124
95% Confidence Interval for Mean	Lower Bound	56,5868
	Upper Bound	65,8381
Median		63,6400
Variance		170,180
Std. Deviation		13,04529
Minimum		30,91
Maximum		96,36
Range		65,45
Interquartile Range		16,36
Skewness		-,222
Kurtosis		1,024

The results of the statistical analysis show a mean score of 61.21, with a 95% confidence interval between 56.59 and 65.84. The median is 63.64, which means half of the data falls below this value. The variance is 170.18 and the standard deviation is 13.05, indicating significant variation in the data. With a range of scores from 30.91 to 96.36, the data distribution is quite wide. The negative skewness (-0.222) and kurtosis of 1.024 indicate a slight leftward tilt and a tendency toward flatness in the distribution. Overall, these scores can be considered good, but attention should be given to the considerable variation in the data.

5) Evaluation

Data from the questionnaire on the suitability of the media for direct instruction, teaching materials, and its presentation have been accommodated as revisions for the development of the web media. The analysis of the mathematical reasoning ability test shows that the learning media is effective in enhancing students' reasoning skills and is deemed suitable for use in future learning.

B. Discussion

Computer-assisted Direct Instruction (DI-CA) has been shown to significantly enhance students' mathematical reasoning abilities. By using computer media, this method aids in the visual and interactive presentation of information, making it easier to understand abstract concepts. The application of computer media in the Direct Instruction method can increase student engagement and motivation in learning (Young, 2017). The interaction generated from clear and appealing visualizations contributes to better understanding, making students more confident in tackling complex mathematical material.

The DI-CA method not only focuses on information delivery but also creates a dynamic learning environment through interaction between the instructor and students (Kauffman et al., 2022). The instructor's presence as the primary source of learning, combined with computer media, strengthens the learning process. Students are given opportunities to ask questions, engage in discussions, and practice, all of which contribute to a deeper understanding of mathematical concepts. With this approach, students become active participants in the learning process rather than passive recipients of information, aiding in their knowledge construction (Alonzo & Sweeney, 2022).

The use of computer media in DI-CA allows students to access relevant information and exercises directly. This facilitates a better understanding of difficult concepts and enhances their ability to apply knowledge in real-world situations. Students can see the practical applications of the theories they learn, thus increasing the relevance of the material being taught (Suciati, Munadi, Sugiman, & Dwi, 2020). Consequently, DI-CA provides a more meaningful and applicable learning experience for students (Mangundu, Intja, & Moyo, 2023).

Moreover, the strength of DI-CA lies in its ability to offer diverse and interactive exercises. Through well-designed practice problems, students can work on a variety of tasks that help them understand different aspects of mathematical concepts (Nurjanah, Dahlan, & Wibisono, 2021). This method not only supports theoretical learning but also provides opportunities to develop problem-solving skills necessary in mathematics. This approach is crucial in equipping students with the analytical skills needed in the real world (Young, 2017).

Overall, the application of computer-assisted Direct Instruction positively impacts students' mathematical reasoning abilities (Warsono & Candra, 2014). With a focus on interactive and visual presentations, DI-CA creates a more engaging and effective learning experience. The active involvement of students, along with support from instructors and technology, makes this method very promising for improving academic outcomes in mathematics (LeJeune, & Lemons, 2021). Further research can be conducted to explore additional ways to integrate technology into mathematics education to maximize student potential.

IV. CONCLUSION

Computer-assisted Direct Instruction (DI-CA) significantly enhances students' mathematical reasoning abilities through the interactive and visual presentation of information. By engaging students and allowing them to practice with relevant problems, DI-CA creates a more meaningful learning experience. Therefore, the integration of technology into this teaching method is highly effective in facilitating the understanding of complex mathematical concepts. The implications of this research are to implement computer-based learning that enables direct interaction and visualization of concepts.

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