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Interactive Prototype Design Using AR and Drag-and-Drop Games to Support Computational Thinking in Children with Mild Autism

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ABSTRACT

This research aims to develop AR applications and drag-and-drop games that can improve computational thinking (CT) abilities in children with mild autism. The method used in this research is Analyze, Design, Development, Implement, Evaluate (ADDIE). In this study, an application was designed that is suitable for children aged 10-12 years who are diagnosed with mild ASD to learn basic programming concepts. Based on the research results, the initial prototype for an application that applies augmented reality technology and drag-and-drop games can be used to help improve the CT abilities of children with ASD. Based on validation results from experts, the average percentage score was 97.64% (category: very good) and many teachers accompanying children with ASD rated this application as very good with an average percentage of 94.80%. It is hoped that the implementation of this application can improve the quality of education and provide better support for children with mild autism in developing their computational thinking skills.

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1. INTRODUCTION

The development of digital technology provides new opportunities in the world of education, especially in efforts to improve computational thinking skills in children, including children with autism spectrum disorder (ASD). Autism Spectrum Disorder (ASD) is an umbrella term that refers to a complex set of neurodevelopmental conditions throughout life (Fernell & Gillberg, 2023). ASD is characterized by qualitative impairments in social interaction, social imagination, speech and nonverbal communication, language function, problem solving, and constructive skills (Skoufou, 2019). Global statistics show that the prevalence of autism is increasing every year at a ratio of between 10% and 17% (Elshahawy et al., 2020). Although there is no known cure, early diagnosis and intervention can improve overall child development and produce positive outcomes in the education and social life of autistic children.

Children with ASD often face challenges in developing computational thinking (CT) abilities, which are important skills in today's digital era, which can greatly impact their interactions with others. The term CT was first defined by Seymour Papert in 1980 as a series of problem-solving processes that include problem recognition, generating several solutions, selecting the optimal solution, and evaluating the effectiveness of the selected solution (Lodi & Martini, 2021). CT is an important method for solving complex problems systematically and effectively (Shute et al., 2017).

Computer-based interventions for children with ASD have been shown to be useful and effective in helping to improve their problem-solving abilities, as most technologies use visual interfaces, which align with the characteristics and preferences of individuals with ASD (Eden & Oran, 2021). Given that social interactions can be highly taxing for children with ASD, they are more interested in computing that is free from social demands. One of the main benefits of software development is that it provides a controlled environment with immediate feedback and no surprises, which is suitable for children with ASD. Additionally, they may be more interested in computer programming because of its consistent and logical nature.

Various technologies have been used to help the development of children with ASD, such as augmented reality (Cunha et al., 2016; Lorenzo et al., 2019), virtual reality (Fridhi et al., 2018; Zhang et al., 2022; Chen et al., 2025; Fallea et al., 2025), and games (Grossard et al., 2017; Khowaja & Salim, 2020; Rezayi et al., 2025; Solórzano Alcívar et al., 2025; de Souza et al., 2025). However, there are still many challenges that must be faced, one of which is the lack of tools specifically designed to improve CT abilities in children with mild ASD. Traditional games are often less effective in attracting the interest and attention of children with ASD, so more innovative and interactive approaches are needed.

Previous research has shown that the use of AR technology and interactive games can increase learning engagement and motivation in children (Lu & Liu, 2015; Topu et al., 2023). However, there is little research that specifically explores the use of AR and drag-and-drop games to improve computational thinking skills in children with mild autism. This research aims to develop AR applications and drag-and-drop games that can improve computational thinking skills in children with mild autism.

The novelty of this research lies in combining AR technology with drag-and-drop games in one Android-based application. This app is designed specifically for children with mild autism, considering their unique needs and characteristics. This approach is expected to provide a more interesting and effective learning experience than conventional methods. Apart from that, it is also hoped that this research can make a positive contribution in the field of special education and become a reference for the development of learning technology in the future. It is hoped that the implementation of this application can improve the quality of education

and provide better support for children with mild autism in developing their computational thinking skills.

2. METHODS

This study employed the Analyze, Design, Development, Implement, Evaluate (ADDIE) model as a systematic framework for developing a technology-based learning product. ADDIE was selected because it provides a structured, iterative workflow in which each phase is explicitly linked to formative evaluation and revision. Consequent, the development process is not only sequential but also cyclical, allowing findings form each stage to inform continuous improvements until the product meets the intended technical and pedagogical quality standards. In Addition, ADDIE is widely applied in educational product development duet o its clarity in defining learning requirements, translating them into design specifications, and testing product feasibility through expert review and field-oriented feedback. **Figure 1** shows the stages of the research procedure.

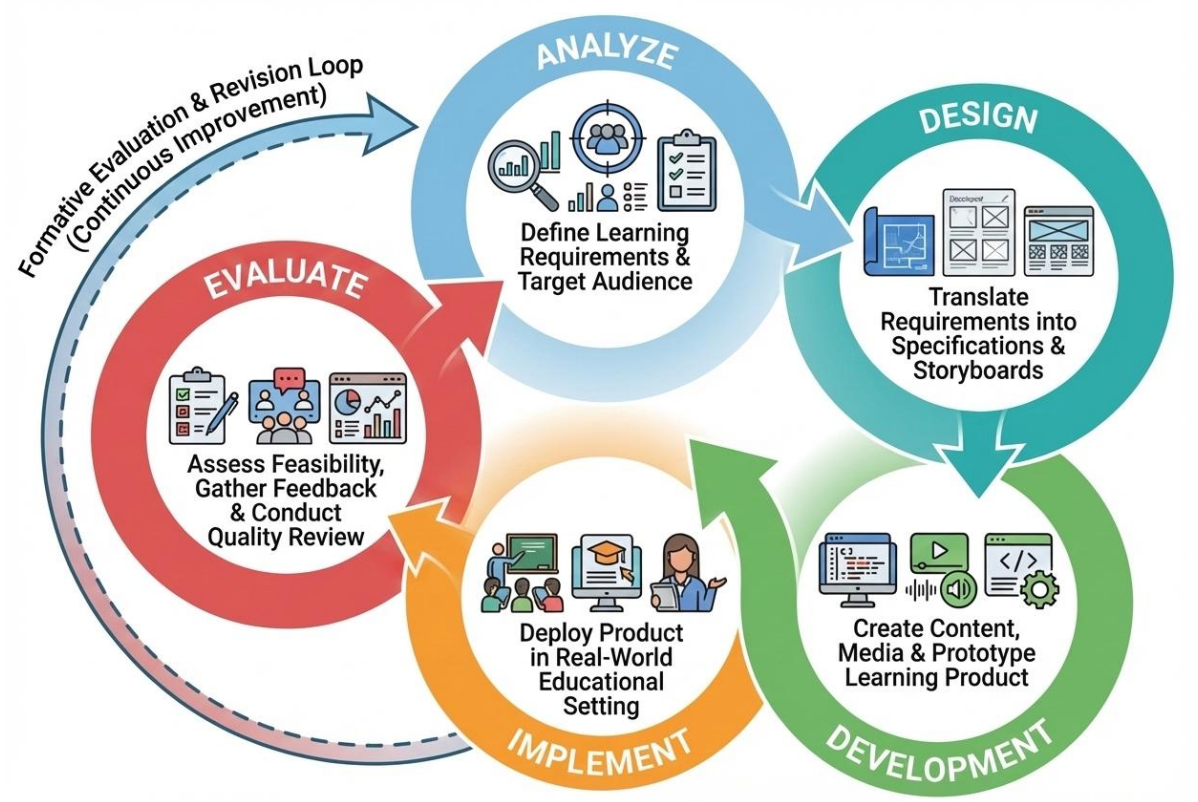


Figure 1. Research Procedure.

2.1. Analysis

The Analysis phase focuses on identifying the core problem, determining development requirements, and establishing the foundation for the learning product. This phase begins with problem identification to clarify the gap between the desired learning conditions and the actual needs in the targeted context. The analysis is conducted through several steps. In the first step, we gather relevant information through a literature review to map the theoretical foundations, learning challenges, and technological opportunities related to the intended learning objectives. This review serves to inform the selection of appropriate learning approaches, content coverage, and features to be embedded in the application.

Afterward, we conducted a user needs analysis to capture the practical expectations of potential users, including constraints, usability expectations, content suitability, and classroom implementation considerations. The needs analysis focused on (i) the learning objectives supported; (ii) user characteristics and readiness; (iii) device and infrastructure availability; and (iv) application functionality. The final step was the formulation of development specifications. These specifications included an initial list of learning materials, required learning activities, user interactions, and technical constraints. A detailed work plan was then prepared, including a development timeline, task distribution, milestones, and a clear workflow to guide subsequent stages.

2.2. Design

The design phase involved developing a plan for the assessment/measurement instrument, including a validation sheet for expert review and a user response questionnaire. Instrument design focused on gathering evidence of product quality across multiple dimensions, such as content suitability, pedagogical suitability, usability, and technical functionality. During this phase, instructional materials were created to be embedded within the application. The application was designed as a learning tool by creating flowcharts and storyboards. Flowcharts were used to define navigation logic, system responses, and user paths. We also created storyboards to define screen-by-screen layouts, learning interactions, visual elements, and user interface components. Collectively, these design outcomes served as a blueprint to ensure that development would be consistent with pedagogical goals and user experience requirements.

2.3. Development

The development phase is the production phase of all application components based on predetermined specifications. During this phase, the developed prototype undergoes expert validation to ensure its feasibility and quality. Expert validation serves as a formative evaluation step, aiming to detect weaknesses early and guide systematic revisions. The experts' comments and ratings are used to revise the prototype, ensuring that the product reaches an acceptable level of readiness before implementation.

2.4. Implementation

The implementation phase involves deploying the developed prototype in a real or semi-real environment to obtain practical feedback and ensure operational readiness. In this study, the prototype was developed using Unity 3D, which allows for the integration of interactive elements and the construction of a functional application environment. During implementation, the application is introduced to potential users (to evaluate its usability and suitability for teaching purposes). This phase emphasizes whether users can operate the application as intended, whether learning materials can be accessed smoothly, and whether the flow of learning activities fits with classroom routines or practical teaching. The implementation results are documented to provide information for further evaluation and refinement.

2.5. Evaluation

The Evaluation phase assesses the overall quality of the product and the learning process, both before and after implementation. The evaluation in this study combines functional testing, expert validation analysis, and user response analysis. We conducted black-box testing to verify the functional correctness of the application from a user perspective without

examining the internal code structure. This testing focused on core functions. Then, we evaluated the expert validation results, and teacher responses were analyzed using a percentage-based approach. Ratings were collected using a rating scale (as summarized in **Table 1**), and percentage scores were calculated using Eq (1) and Eq (2).

$$p = \frac{obtained\ score}{ideal\ score} \times 100\% \quad (1)$$

$$ideal\ score = highest\ score\ for\ each\ item \times number\ of\ respondent \times weight \quad (2)$$

where *p* represents the percentage score. The resulting percentage value is then interpreted using the classification criteria in **Table 1** to determine the product's validation level (Arikunto, 2018; Kemuda & Wulandari, 2023). This classification allows for consistent decision-making regarding whether the product requires major revision, minor revision, or is considered suitable for wider use.

Table 1. Classification of validation results (Arikunto, 2018; Kemuda & Wulandari, 2023).

Percentage Number (*p*)	Validation Level Category
0.00 – 21.00	Very less
20.99 – 40.00	Not enough
39.99 – 60.00	Enough
59.99 – 80.00	Good
79.99 – 100	Very well

3. RESULTS AND DISCUSSION

3.1. Application Requirements

In this research, software needs analysis was carried out to determine user needs (external) and developer needs (internal). External requirements consist of user requirements, hardware requirements, and software requirements. Based on user needs, the application is intended for children with mild ASD aged around 10-12 years. There are two access rights given to users in this application, namely access rights for students and access rights for teachers. Each access right will be described in a use case diagram as shown in **Figure 2**.

Based on **Figure 2**, there are two interacting actors, namely teachers and students. Students have several key interactions with the system, such as viewing information, viewing guides, accessing game baseline, accessing AR camera features, accessing exits, and accessing settings. When students access the “AR Camera” feature, they can advance to other sub-features namely “Materials” and “Practices,” which provide learning content and exercises. Apart from that, students can also take advantage of the marker image scanning feature. After the marker image is scanned, students see a 3D animation corresponding to the moved marker, which provides a three-dimensional visual experience of the scanned object. From here, there are further sub-use cases, namely “Seeing 3D object information” and “Hearing 3D object information,” which provide additional visual and audio information about the three-dimensional object. On the other hand, teachers have different interactions with the system. The teacher starts by logging in via the use case “Login.” After successful login, teachers can expand their interactions by accessing the use case “Accessing student grades,” which allows them to view student grades stored in the system. The <<include>> relationship is used in diagrams to indicate that some sub-use cases are always part of the main use case. For example, after accessing “AR Camera,” students can automatically access “Materials,” “Practice,” and “Scan marker images.” The <<extend>> relationship is used to indicate that

the "Accessing student grades" use case can only be accessed after the teacher has successfully logged in.

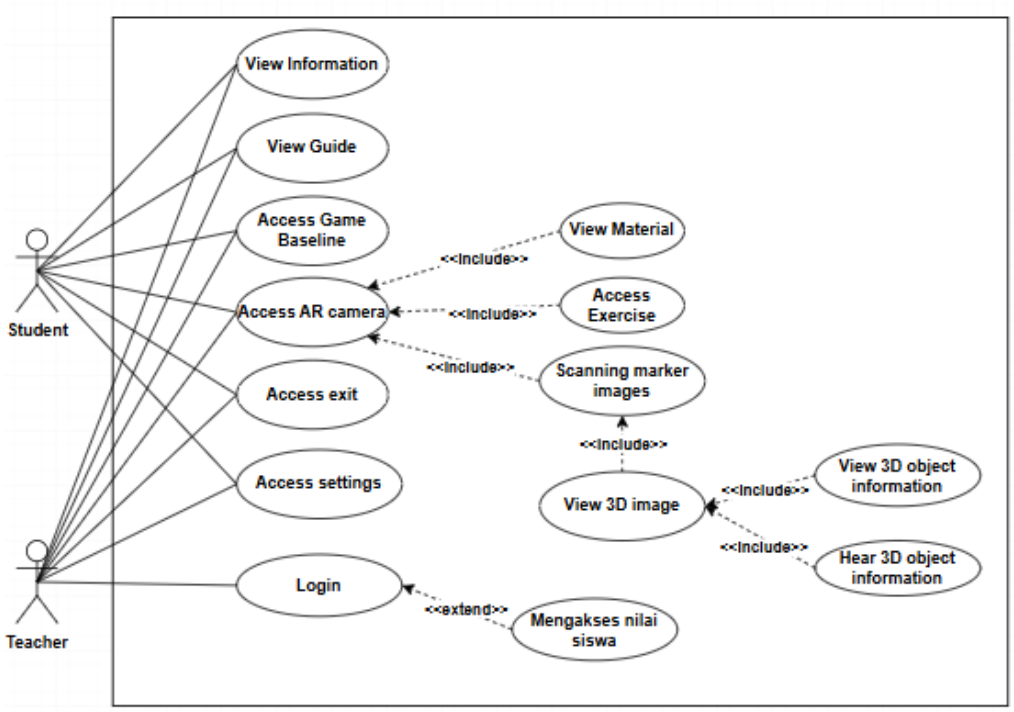


Figure 2. Use case diagram.

Apart from user needs, hardware and software requirements are also analyzed to determine the minimum requirements to run the application. Minimum hardware requirements are shown in **Table 2**, while software requirements are shown in **Table 3**.

Table 2. Minimum user hardware requirements.

No	Hardware	Specification
1.	RAM	4 GB
2.	Internal Storage	2 GB
3.	Processor	Qualcomm® Snapdragon 665™

Table 3. Minimum user software requirements.

No	Software	Specification
Backend – Data Storage		
1.	Name	MySQL® Databases
	Source	Rumahweb.com
	Function	As database management
Admin Operations		
1.	Name	Google Chrome
	Source	Google
	Function	As a web browser
2.	Name	Windows 11
	Source	Windows
	Function	Admin operating system in operating the computer
User Operations		
1.	Name	Android 11
	Source	Google Android
	Function	As the user's smartphone operating system

Apart from external needs, it was previously explained that internal needs were also analyzed in this research. Internal requirements consist of developer hardware requirements and application development software requirements. Development hardware requirements are shown in **Table 4** and development software requirements are shown in **Table 5**.

Table 4. Minimum developer hardware requirements.

No	Hardware	Description
1	Chipset processor	Intel(R) Core(TM) i3-1005G1
2	CPU	Intel(R) Core(TM) i3-1005G1 CPU @ 1.20GHz (4 CPUs), ~1.2GHz
3	GPU	Intel(R) UHD Graphics
4	RAM	16384 MB (16GB)
5	Internal Storage	464 GB

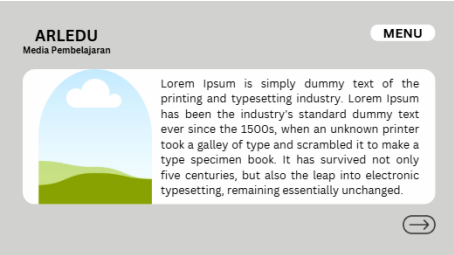
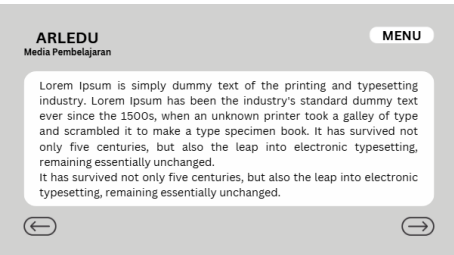
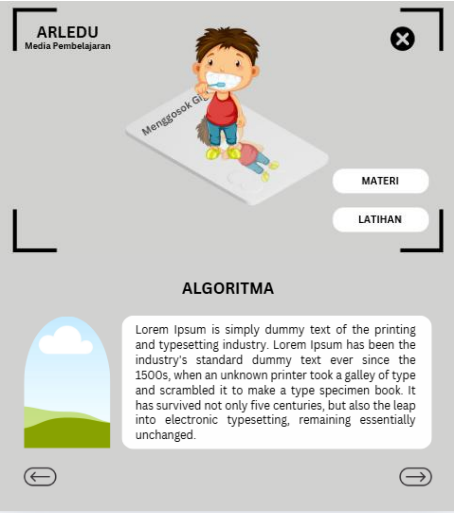
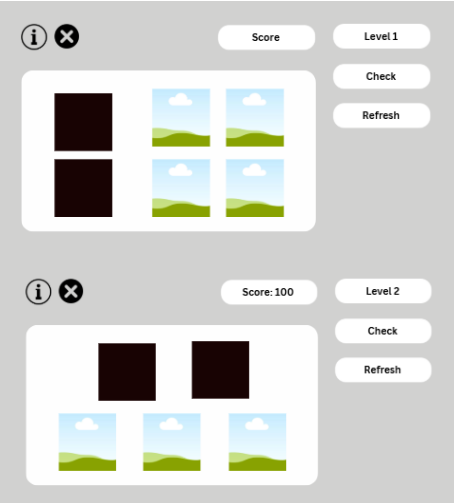
Table 5. Minimum developer software requirements.

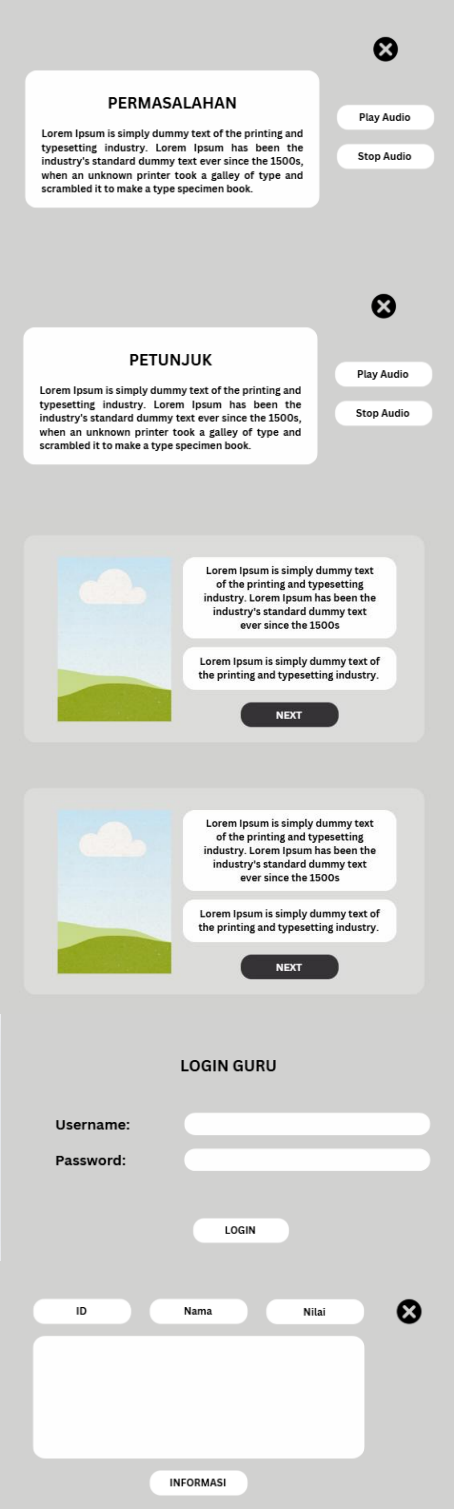
No	Software	Description
Web Server		
1.	Name	XAMPP 8.2.12
	Source	XAMPP Server
	Function	As a stand-alone server (localhost)
Integrated Development Environment (IDE)		
1.	Name	Visual Studio Code 64 Bit Version 1.96
	Source	Microsoft Visual Studio Code
	Function	As an IDE (Coding Editing Tool)

Apart from that, storyboards were also made in this research to describe the storyline from the beginning to the end of the application being developed. The application storyboard is shown in **Table 6**.

Table 6. Storyboard AR apps and drag-and-drop games.

Scheme	Description
	**Page Loading** The loading page that will appear when students open the application for the first time. This page is used for students to enter the application. On this page there is the name of the application created in the middle of the page. **Homepage** The initial page that will appear when students successfully enter the application. On this home page there are five shortcut menus, namely: • Information: to view developer information • Settings: to change application settings • Exit: to close the application • Camera AR: to access material, quizzes and camera AR during learning • Guide: to view instructions for using the application • Game baseline: to access the initial and final baseline questions

Scheme	Description
	**Information Page** The information page is used to view information related to the developer. On this page there are 2 main sections, namely: • Menu: button to return to the home page • Next: button to continue to the next page Apart from that, on this page there will also be a photo of the developer, the name of the developer, the identity of the developer, and anyone involved in developing this media will be presented on the information page.
	**Guide Page** The guide page is used to see how to use the application and see the functions of the buttons in the application. On this page there are 3 main sections, namely: • Menu: button to return to the home page • Next: button to continue to the next page • Back: button to return to the previous page Apart from that, the application logo will also be on this guide page.
	**Camera AR page** The AR camera page is used to scan the marker image so that a 3D object appears. On this page there are 3 main sections, namely: • Exit: button to return to the home page • Materials: button to access learning materials • Practice: button to access practice questions **Materials Page** The material page is used to access and view learning material regarding basic algorithm concepts. On this page there are several sub-materials that will be displayed starting from the concept of algorithms (understanding algorithms), how to write algorithms in narrative form, examples of using algorithms in everyday life, and conditionals. On this page there are 2 main sections, namely; • Menu: button to return to the start page • Next: button to continue to the next page • Back: button to return to the previous page
	**Baseline Game Page** The baseline game page is used to work on Computational Thinking ability test questions. On this page students are given four types of questions consisting of: • Sequencing the steps of a random problem • Identify conditions • Create a sequence of steps in the form of a narrative algorithm • Guess the sequence of steps in a puzzle On this page there are 5 main sections that can be accessed, namely: • Refresh: button to refresh the answer to return to the beginning. • Check: button to submit answers and continue to the next question. • Information: button to view work instructions and questions.

Scheme	Description
	**Question Page** The question page contained in the Baseline Game is to see the questions that students have to work on. There are two features that can be used, namely • Play audio to play the explanation in voice form. • Stop audio to stop the explanation in voice form. **Instructions Page** Instructions page contained in the exercise to see instructions on how to do the questions. There are two features that can be used, namely • Play audio to play the explanation in voice form. • Stop audio to stop the explanation in voice form. **Page If Answer is True** The correct answer page will appear if students successfully solve the quiz questions. On this page there will be a next or submit button to continue to the next question and send the answer. **Page If Answer is Wrong** A page with incorrect answers will appear if students fail or have not succeeded in solving the quiz questions. On this page there will be a next or submit button to continue to the next question and send the answer. **Teacher Login Page** This page contains columns for filling in the password and username. Through this page the teacher will be able to enter the database page where student grades are stored.

3.2. Prototype Application

Next, a prototype of this application is created, making the prototype display referring to the flowchart and storyboard that have been created. The appearance of the Drag-and-Drop based AR Game learning media interface is as follows:

a. Main page. The main page is the initial display when the user opens the Drag-and-Drop based AR Game Application. Through this page, users can access several available features, such as game baseline, AR camera, and guides.

b. Developer information page. This page displays information about the Drag-and-Drop based AR Game application developer, starting from the developer's name and application development background. On this page, credit information for the assets used in the Drag-and-Drop based AR Game application is also presented.
c. Settings page. This page allows users to set background music. Through this page, users can turn off the music, turn on the music, reduce and increase the music volume.
d. Teacher login page. This page is used by teachers to enter the grades page, so that teachers can see the final grades from the results of the baseline questions that students have worked on.
e. Student grades database page. This page displays student grades that have been collected while using the application. Teachers can access and manage this data to monitor student learning progress.
f. Exit page. This page provides options for users to exit the application or remain within the application.
g. Baseline game page. This page displays baseline games designed to test students' abilities before and after they begin the learning material.
h. Baseline game issue information page. This page provides an explanation of the problems in the baseline game, helping students understand the purpose and how to complete the game.
i. AR camera page. This page allows students to use the Augmented Reality (AR) feature in the application, which can help them understand the material through interactive visualization.
j. Material page. This page presents learning material that has been compiled in the application. Students can access and study the material.
k. Practice page. This page provides exercises designed to test students' understanding of the material they have studied and to explain the CT abilities being studied.
l. Practice problem information page. This page provides an explanation of the problem or task in the exercise, helping students understand how to complete the exercise.
m. Guide page. This page provides a guide to using the application, including an explanation of the menus in the Drag-and-Drop based AR Game Application.

Figure 3 shows one of the implementation results of the application design that was developed.

Figure 3. Design Drag-and-Drop based AR Game Application.

3.3. Application Testing

The testing phase was carried out using the black-box testing method. Black-box testing is carried out by testing input and output as expected or not (Supriyono, 2020). Black-box testing ensures that all features in the application run well according to user expectations and that there are no problems in the application's basic functions. The results of black-box testing can be seen in **Table 7**. Based on **Table 7**, all the features in the application can function well. All results obtained are in accordance with the expected results. This shows that the application has been successfully tested and functions according to the specified specifications, which indicates that functional testing has been carried out well. Black-box testing ensures that all features in the application run well according to user expectations and that there are no problems in the application's basic functions.

Table 7. Black-box testing results.

No.	Testing Scenarios	Expected results	Results Obtained	Test Results
1.	Press the teacher button	Go to the page for filling in the password and username, after that the student score database appears	Go to the page for filling in the password and username, after that the student score database appears	Succeed
2.	Press the exit button	A pop up appears asking “are you sure you want to leave”. Then there is a Yes or No option. If the user clicks Yes then the application will close, if the user clicks no it will return to the main page.	A pop up appears asking “are you sure you want to leave”. Then there is a Yes or No option. If the user clicks Yes then the application will close, if the user clicks no it will return to the main page.	Succeed
3.	Press the settings button	Enter the settings page which contains 3 features., namely: - Music mute button. If the user presses this button, the background music will turn off. - Button turns on music. If the user presses this button then the background music will turn on. - Music volume button	Enter the settings page which contains 3 features., namely: - Music mute button. If the user presses this button, the background music will turn off. - Button turns on music. If the user presses this button then the background music will turn on. - Music volume button	Succeed
4.	Pressing the information button marked with an exclamation mark (!)	Go to the developer information page	Go to the developer information page	Succeed
5.	Pressing the next button	Go to the next page	Go to the next page	Succeed
6.	Pressing the back button	Return to previous page	Return to previous page	Succeed
7.	Press the menu button	Return to main page	Return to main page	Succeed
8.	Pressing the guide button	Enter the guide page	Enter the guide page	Succeed
9.	Pressing the game baseline button	Go to the main page of the baseline game, fill in your personal identity (name)	Go to the main page of the baseline game, fill in your personal identity (name)	Succeed

No.	Testing Scenarios	Expected results	Results Obtained	Test Results
10.	Pressing the start button on the baseline game	Enter the drag and drop game page	Enter the drag and drop game page	Succeed
11.	Pressing the information button in the baseline game	Go to the question page	Go to the question page	Succeed
12.	Pressing the check button on the baseline game	Go to the next question page	Go to the next question page	Succeed
13.	Pressing the refresh button on the baseline game	Delete all answers to the question being worked on	Delete all answers to the question being worked on	Succeed
14.	Pressing the finish button on the baseline game	Return to the main page and the value data is saved into the database	Return to the main page and the value data is saved into the database	Succeed
15.	Pressing the AR camera	Enter the AR camera page	Enter the AR camera page	Succeed
16.	Pressing the material button on the AR camera	Go to the learning materials page	Go to the learning materials page	Succeed
17.	Press the exercise button	Enter the practice page in the form of a drag and drop game	Enter the practice page in the form of a drag and drop game	Succeed
18.	Press the check button on the AR camera	If the answer is correct, go to the next question. If the answer is wrong, return to the question being worked on.	If the answer is correct, go to the next question. If the answer is wrong, return to the question being worked on.	Succeed
19.	Pressing the refresh button on the AR camera	Delete all answers to the question being worked on	Delete all answers to the question being worked on	Succeed
20.	Press the finish button on the AR camera	Return to the AR camera page. Value data is not saved into the database.	Return to the AR camera page. Value data is not saved into the database.	Succeed
21.	Scan markers using AR camera	A 3D animation appears according to the marker image	A 3D animation appears according to the marker image	Succeed
22.	Pressing the information button on the exercise in the AR camera	Problems arise that must be resolved	Problems arise that must be resolved	Succeed
23.	Press the play audio button	Audio sound comes out	Audio sound comes out	Succeed
24.	Press the audio stop button	The sound audio stops	The sound audio stops	Succeed
25.	Press the (X) button on the AR camera	Return to main page	Return to main page	Succeed

3.4. Application Feasibility Test

At the feasibility test stage, experts provide an assessment through an expert judgment process to assess the feasibility of Android-based augmented reality (AR) media. This assessment involved learning media experts (AS) and autism experts (RM) using a multimedia product validation instrument adapted from research conducted by Nisrina et al. (2022). The main aspects in this assessment are interface components (multimedia displays such as text, graphics, animation, audio and video), navigation (how users move between pages in multimedia), and robustness (product knowledge that minimizes multimedia errors). After the scores from each expert were collected, the researcher made an average for each aspect

of the assessment. The results of this assessment are then used as material for improvement before Android-based AR media is tested. The results of the media assessment by experts are presented in **Table 8**.

Table 8. Results of expert judgment.

No	Assessment criteria	Number of Experts	Number of items	Ideal Score	Result	Percentages (%)
1.	interface (multimedia displays such as text, graphics, animation, audio and video)	2	13	130	123	94.61
2.	navigation (how users move around pages in multimedia)	2	5	50	50	100
3.	robustness (knowing products that minimize multimedia errors)	2	6	60	59	98.33
	Average					**97.64**

Data analysis in this expert judgment activity uses a rating scale. The rating scale calculation is determined using the Arikunto (2018) formula. After the percentage data is obtained, the data is translated using an interpretation scale. The scale can be seen as in **Figure 4**.

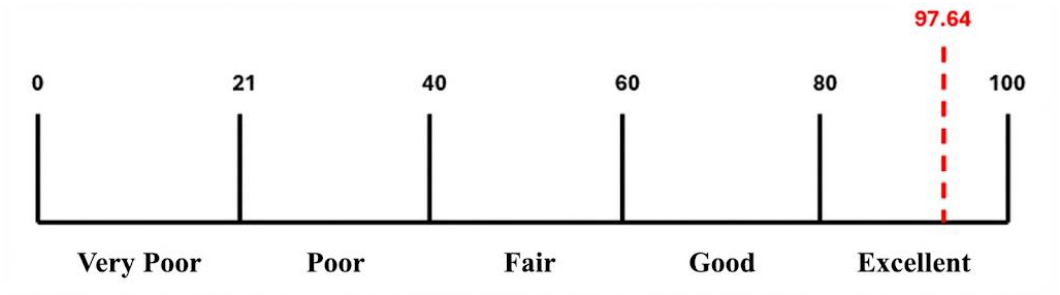


Figure 4. Expert judgment categorization results.

Based on **Figure 4**, the results of the Android-based AR media assessment analysis by experts are as follows:

a. Interface aspects (multimedia displays such as text, graphics, animation, audio and video). In this aspect, from a total of two experts who assessed, the resulting score was 94.61%. This aspect includes cover illustrations that can describe the contents of the module, the color combination in the module cover is harmonious, the shape and size of the letters on the module cover are proportional, the type of letters used are easy to read, the placement of consistent elements is based on the writing pattern, the placement of chapter titles or equivalent is consistent, the illustrations are able to expresses the meaning/meaning of the object clearly, the distance between text and illustrations is appropriate, the choice of type and size of letters is clear and legible, the sound in video and audio is heard clearly, the space between text and illustrations is appropriate, the color combination in the module content is harmonious, and consistent use of symbols.
b. Navigation aspect (how users move around pages in multimedia). In this aspect, from a total of two experts who assessed, the resulting score was 100%. This aspect includes links in the content table that make it easier for readers to access the contents of the module, page numbering according to the table of contents, instructions for using the module that are easy to understand, instructions for working on questions that are easy to understand, instructions for self-assessment that are easy to understand.

c. Robustness aspect (knowing a product that minimizes multimedia errors). In this aspect, the score obtained was 98.33%. This aspect includes easy teaching materials, the content table functions well, the AR camera link functions well, the audio button functions well, the practice question link functions well, the practice questions on the media function well.

Overall, AS and RM consider that Augmented Reality media to improve the computational thinking skills of students with mild ASD is suitable for use. The average validation result of two media experts for Drag-and-Drop based AR Game Application was 97.64%. So, this Android-based AR media falls into the "Very Good" category as shown in **Figure 4**. These results also show that Drag-and-Drop based AR Game Application can be used in schools as a learning media.

3.5. Responses from Teachers Supporting Children with ASD

In this research, apart from a feasibility test from experts, teachers' responses to the application being developed were also examined. This response involved five teachers. The five teachers consist of homeroom teachers and teachers accompanying children with ASD. The teacher response instrument uses LORI version 1.5 with a rating scale of 1-5. Teacher responses are carried out to see effectiveness, improve quality, and see suitability to student needs and the curriculum with a different view from experts. There are five components that are asked about, starting from presentation design, ease of interaction, accessibility, reusability, and compliance standards. After the scores from each teacher were collected, the researcher made an average for each aspect of the assessment. The results of teacher responses to Drag-and-Drop based AR Game Application are presented in **Table 8**.

Table 8. Results of teacher responses.

No	Assessment criteria	Number of teachers	Number of Items	Ideal Score	Result	Percentages (%)
1.	Presentation design	5	3	75	68	90.67
2.	Ease of interaction	5	3	75	70	93.34
3.	Accessibility	5	2	50	47	94.00
4.	Reuse	5	1	25	25	100
5.	Compliance standars	5	1	25	24	96.00
	Average					**94.80**

Data analysis on the results of teacher responses used a rating scale. The rating scale calculation is determined using the Arikunto (2018) formula. After the percentage data is obtained, the data is translated using an interpretation scale. The scale can be seen as in **Figure 5**.

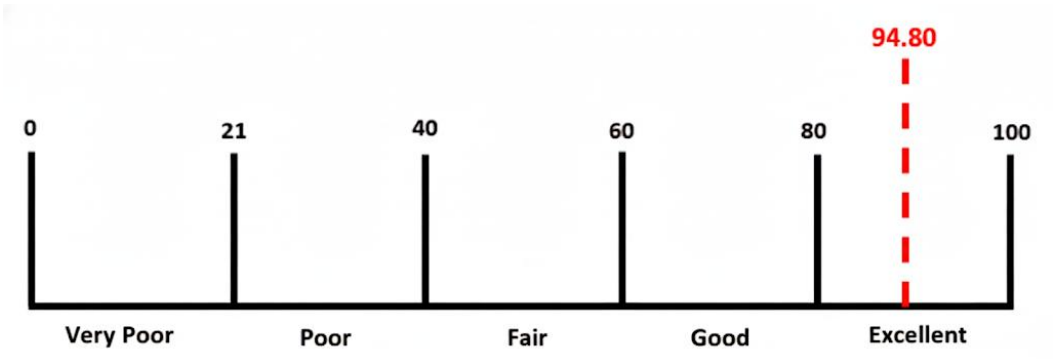


Figure 5. Results of categorization of teacher responses.

Based on **Figure 5**, the results of the analysis of teacher responses to Android-based AR media as a whole show that this AR media is effective for improving the CT skills of students with mild ASD. This media not only makes it easier to convey material but is also easy for anyone to use. This learning media is very suitable for use by teachers, especially in teaching children with ASD. The average response from five teachers to Drag-and-Drop based AR Game Application was 94.80%. Therefore, Drag-and-Drop based AR Game Application is included in the "Very Good" category.

4. CONCLUSION

The conclusion of this research shows that the development of Augmented Reality (AR) applications and drag-and-drop games can be used to improve computational thinking (CT) abilities in children with mild autism. The application development process is carried out through steps which include analysis, design, development, implementation and evaluation. At the design stage, flowcharts and storyboards are produced which become the basis for developing learning media. Application coding is carried out using the C# programming language. Based on the evaluation results, it shows that the application developed is suitable for use with several recommended improvements, namely simplifying instructions. Expert validation showed very good results, with an average percentage score of 97.64% and many accompanying teachers rated this application as very good with an average percentage of 94.80%. Based on these findings, the developed AR application and drag-and-drop game can be considered very feasible and effective to help improve computational thinking abilities in children with mild autism. However, further research is needed to clearly determine the effectiveness of this application, if tested directly on children with mild ASD.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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