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Kencana Seni: Game Based Inclusive Disaster Mitigation Learning Media

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ABSTRACT

Indonesia, ranks second out of 193 countries with the highest disaster risk in the world. Disaster data from 2024 shows that 3,472 incidents have resulted in 8,136,271 people suffering and being displaced, 540 deaths, and 81,947 units of infrastructure damaged, faces a high risk of natural disasters, making it crucial to protect its people, especially vulnerable groups such as children. One effective approach to improving children's preparedness is through web-based educational games such as Kencana Seni, which uniquely features an inclusive design accessible to all children, including those with visual and hearing disabilities. This study aims to design and develop Kencana Seni, a web-based educational game application that focuses on improving community preparedness, especially children, in facing natural disasters and supporting the post-disaster recovery process. In its development, the researcher used the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The evaluation was conducted using the User Experience Questionnaire (UEQ) administered through web-based media to 3 students with visual and hearing disabilities along with 3 accompanying teachers. The results showed that the system received positive evaluations across all assessed dimensions (interaction, interface, and cognitive skills), with particularly high scores in stimulation and appeal (approaching the maximum value of 3 on the UEQ scale). The interface dimension scored 3.85 (students) and 4.1 (teachers), interaction scored 4.3 (students) and 4.2 (teachers), and cognitive skills scored 4.2 (students) and 4.13 (teachers), demonstrating that Kencana Seni successfully provides an engaging and effective inclusive disaster education experience.

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1. INTRODUCTION

Indonesia's geographical location in the Pacific Ring of Fire area means that the number and intensity of natural disasters have increased over time. According to BNPB's 2024, Of Indonesia's 38 provinces, eight are at high disaster risk, 30 are at medium risk, and none are at low disaster risk. Furthermore, of the 514 regencies/cities, 29.4% (151 regencies/cities) are at high risk, 70.6% (363 regencies/cities) are at medium risk, and none are at low risk (BNPB, 2025). Disaster Risk Index, Disaster mitigation is an important way to increase awareness when facing natural disasters. Therefore, the community must be educated to be able to implement disaster mitigation before, during, and after a disaster. According to Government Regulation of the Republic of Indonesia Number 21 of 2008 concerning the Implementation of Disaster Management, disaster mitigation is one way or action to reduce disaster risks, both through physical development and community awareness and increasing the ability to face the threat of disaster (Mustadi & Atmojo, 2020).

Children are often the most vulnerable group in disaster education. Infants and young children are particularly vulnerable in terms of disaster awareness and response due to their limited self-management capacities and lifecycle characteristics (Lee dkk., 2023). Children have limitations in understanding the risks and responses to disasters, so they need effective and inclusive learning methods. Children with disabilities face even greater challenges, as they are frequently excluded from disaster risk reduction activities and require specialized educational interventions (Rofiah dkk., 2021; Ronoh dkk., 2015). One of the challenges faced is how to convey disaster material to children in an interesting, easy-to-understand way, and involve various groups, including children with special needs. Therefore, a creative and inclusive approach is needed.

With the development of technology today, people more often do various activities, such as working, studying, looking for entertainment can provide stimulus to the three important aspects of learning, namely emotions, psychomotor, and intelligence (Nursyabani dkk., 2020) Serious game-based learning has emerged as a more engaging educational method for disaster prevention education, with research demonstrating significant effects on students' disaster prevention skills, interest in learning, and self-awareness (Tsai dkk., 2020).

The emergence of modern communication and information technology has brought about major changes in the way we learn and teach. The field of education is greatly affected by the expansion of information and communication technology. However, technology has not been fully used by teachers as a learning medium in teaching disaster mitigation, even though technology such as website-based applications can help improve the quality of education, for example disaster mitigation so that it becomes trauma healing for children. Through technology, children can learn about disasters, reduce fear, and prepare themselves to face the risk of disasters in the future (Kukuh Wurdianto dkk., 2022).

The purpose of the web-based application Recognize Disasters Early (Kencana Seni) is to improve the elements of inclusive education about miti, and seek information through digital media. Games are another alternative in learning, because games can not only be used as a medium for playing but can also be used as a learning medium. Digital games designed to improve education by helping students learn more and better using interactive multimedia technology or called educational games. With disaster game-based learning media focusing on digital games that help students learn. This application is intended to increase knowledge about disaster risk reduction and help teachers teach disaster mitigation to vulnerable

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groups. Families with children with special healthcare needs require additional information, education, and training to develop disaster preparedness plans, as research shows these families are often poorly prepared and lack awareness of available resources (Hipper dkk., 2018). In addition, Kencana Seni prioritizes psychological aspects, namely giving children a sense of security and functioning as trauma therapy to reduce fear, and accelerate their recovery after a disaster. By incorporating inclusive disaster mitigation education from the early stage, this application aims to benefit children with special needs who are among the most vulnerable groups when disasters occur (Rofiah dkk., 2021). This study aims to design and build a website-based educational game application, namely Kencana Seni, to increase community preparedness, especially children, in facing natural disasters and help the recovery process after natural disasters.

2. METHODS

In this study, the researcher applied the ADDIE model which consists of five stages: analysing, design, development, implementation, and evaluation. In addition, by focusing on literacy and reflection, researchers can continuously improve the system based on user input (Zin dkk., 2009). This model was chosen because it allows researchers to systematically develop an effective Digital Game Based Learning (DGBL) system.

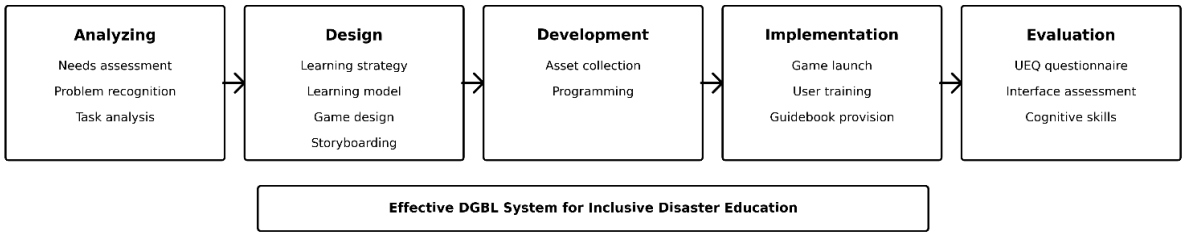

Figure 1. ADDIE Model Development Framework

Analysing is a procedure to determine the content or material that will be studied by prospective users of this system or game later. Needs assessment, problem and needs recognition, and task analysis are all actions taken at this stage (Mahardhika, 2015). Before system development begins, the design stage determines the strategy or learning method to be used and the learning model to be applied to the application. The result of this design stage is a design that can answer the problems from the previous analysis and has a plan about the learning experience that will be obtained by application users (Mahardhika, 2015). The development stage is to realize the design stages that have been made previously in accordance with the rules or principles of software design. In the development stage, the design that has been made in the design stage begins to be implemented including starting to create program codes. Then, all previous designs or plans begin to be implemented. In other words, this stage marks the transformation of the application into a real web-based game. This stage produces a Kencana Seni web-based game that is ready to be played, but there is still a process that must be gone through before the game is available to the public. The final stage is to conduct an evaluation to ensure that the program that has been tested by users receives positive feedback. At this stage, the application is tested to find system and engineering bugs. The result of this stage is a system test report (Lankoski & Bjork, 2015).

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3. RESULTS AND DISCUSSION

The results are organized based on the ADDIE model stages: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation.

3.1. Analysis

The results of initial discussions with partners, BPBD of Pangandaran, revealed gaps in the implementation of disaster mitigation education in schools. Schools in this area have not implemented inclusive disaster mitigation education, especially for children with disabilities. In addition, the lack of use of technology in the learning process hinders the effective dissemination of information and reaches all students. To improve community preparedness and resilience, especially children, innovative and inclusive media are needed for disaster mitigation.

The goal of this program is to improve community resilience through psychological disaster literacy, with a special emphasis on students in Pangandaran Regency. By providing children with child-friendly and disability-friendly mitigation knowledge and skills, it is hoped that risks will be minimized and physical and mental recovery will be faster. This step is also in line with efforts to strengthen disaster risk reduction planning that is responsive to the needs of children and people with disabilities. One method that has proven to be beneficial is through play activities. Games not only help children become happy again, but also help them process traumatic experiences in a more enjoyable way. By playing, children can express their emotions, interact positively, and regain control over their situations, which can gradually reduce the psychological impact of disasters (Amelia & Fitriyani, 2023).

3.2. Design

The design begins by formulating rules, challenges, or player interactions in each type of game with competencies that refer to the construct of psychological disaster literacy, establishing characters, and determining how player success is measured through levels or achievements in each type of game.

i. This or That

In This or That mode, players must choose the right option according to the questions given to be able to continue the game to the next stage or round. In This or That mode, there are right and wrong choices. Players must determine the right choice based on the questions. This game is designed so that players can make quick decisions regarding fun activities during the emergency response phase.

ii. Sorting Activities

In the sorting activities mode, players must sort various activities in the list that are still random into the correct order according to the given situation. In the sorting activities mode, there is a wrong order of activities. Players must sort the list of activities so that they become a series of correct activities. This sorting activities mode is designed to simulate the process of rearranging daily activities after a disaster, which is an important step in trauma recovery.

iii. Collecting Items

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In the collecting items mode, players must collect items that are needed when a disaster occurs. In the collecting items mode, there are necessary and unnecessary items. Players must collect all the necessary items based on the current situation. This mode is designed to direct players to prepare the items needed in the event of a disaster. In the system design, the character is also set to be limited to being moved only in two dimensions in the display provided. The character can be moved by touching and holding, then moving it to the desired location. If the character is given the wrong choice or decision by the player, then the character's life will be reduced by one. Conversely, if given the right choice or decision, then the character's life will increase by one.

Player success is measured through levels, namely when the player successfully completes the game from a material, then the player can proceed to the next disaster material with full character lives. Players have been tested for their ability to provide psychological support during disaster situations through a certain level.

The design of Kencana Seni use storyboard methodology. Storyboarding is a crucial technique in game development, serving as a visual tool to plan and communicate the narrative and interactive elements of a game. (Knauf dkk., 2010) emphasize that storyboarding is highly effective for anticipating learning experiences. In general, the main work flow of the game can be seen in the following image.

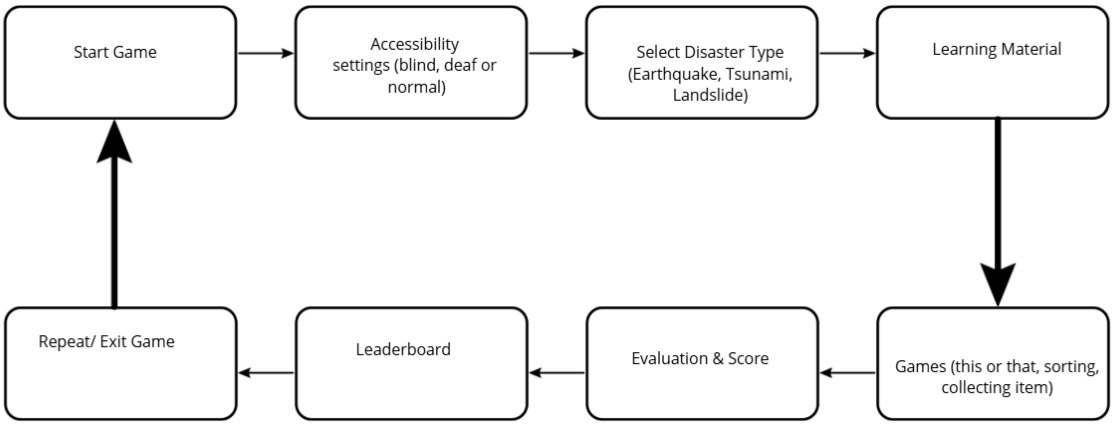

Figure 2. Design work flow of the game

3.3. Developing Kencana Seni

Kencana Seni development begins with asset creation. The asset creation process generated comprehensive multimedia resources designed specifically for inclusive disaster education. This phase was critical in establishing the visual and auditory foundation that supports diverse learning needs. Background assets included pre-disaster and post-disaster scenarios for three disaster types (earthquake, tsunami, and landslide), creating visual narratives that demonstrate the tangible impacts of natural disasters. Each disaster scenario was illustrated with attention to Indonesian cultural context, featuring architectural styles and environmental elements familiar to children in Pangandaran and similar regions. Illustration of conditions before a disaster is used to state the initial situation before the player knows what happened in the related disaster, while Illustration of conditions after a

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disaster is used to state the final situation so that the player knows what happened in the related disaster.

Figure 3. House Area Assets Before and After the Earthquake

Figure 4. Wrong Asset Choice During an Earthquake

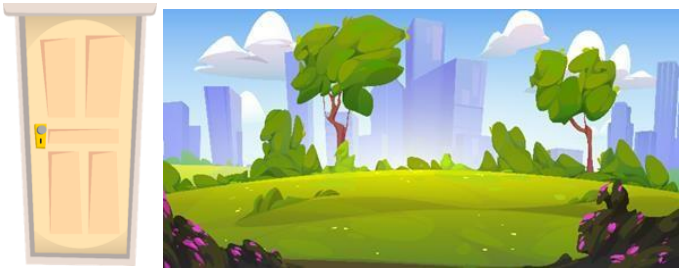

Figure 5. The Right Asset Choices When an Earthquake Occurs

Figure 6. Disabled Mode Accessibility Display

With features that support an inclusive gaming experience, this game is made to be accessible to various disability groups, including the blind and deaf. As seen in Figure 6, for navigation, users with visual disabilities can activate "Visual Disability Mode" and use a gamepad or controller. This mode has voice navigation and audio descriptions for images. Each menu option is explained with clear voice narration and each illustration has a detailed audio description to help the blind understand the content displayed. Meanwhile, users with hearing disabilities can deactivate Visual Disability Mode and the audio narration can be

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turned off to make this game more flexible. Children can follow instructions and understand the context of the game without sound.

Figure 7. Disaster Recognition Page View

In this display, there are three sub-menu options that can be played, namely "Earthquake", "Tsunami", and "Landslide". To select the desired sub-menu, you can do it by clicking on the menu you want to play, so that the playing experience becomes more interactive and easily accessible.

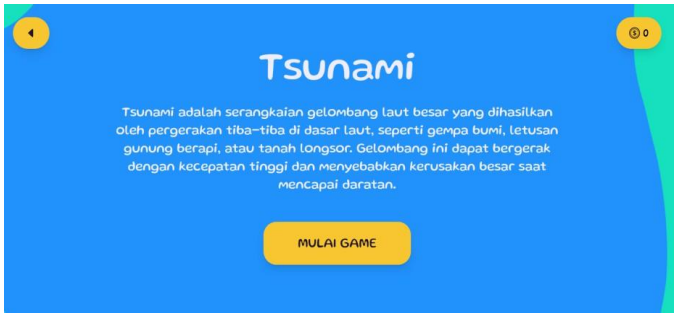

Figure 8. Display of the Tsunami Disaster Recognition Submenu

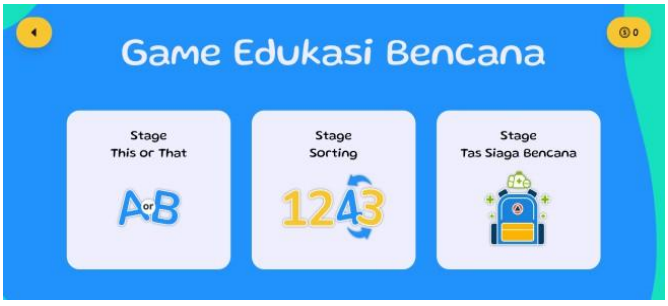

Figure 9. Disaster Education Game Menu Display

On the disaster education game menu display, there are three game stages that can be selected, namely "This or That", "Sorting", and "Disaster Preparedness Bag". To select the game stage to be played, you can do so by clicking on the stage box you want to select or pressing the (A) button if using a gamepad.

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Figure 10. This or That Stage Display

Based on figure 10, players must choose one correct answer between two options. Players can choose by clicking the selected box. Players will be given 10 pairs of choices related to activities or actions that can be taken after a disaster. Players can choose the most appropriate one. If using a gamepad, click the left/right button to change options and (A) to select. If the player's answer is correct, they will get 10 points! But if the answer is wrong, the points will be reduced by 5. The total points will be displayed after the player completes this game.

Figure 11. Stage Sorting Display

Figure 11 shows the stage sorting and in it, five activities will be given that must be sorted correctly from morning to night. To sort them, by moving the activity image to the position that the player thinks is appropriate. Sort all activities correctly to get +100 points.

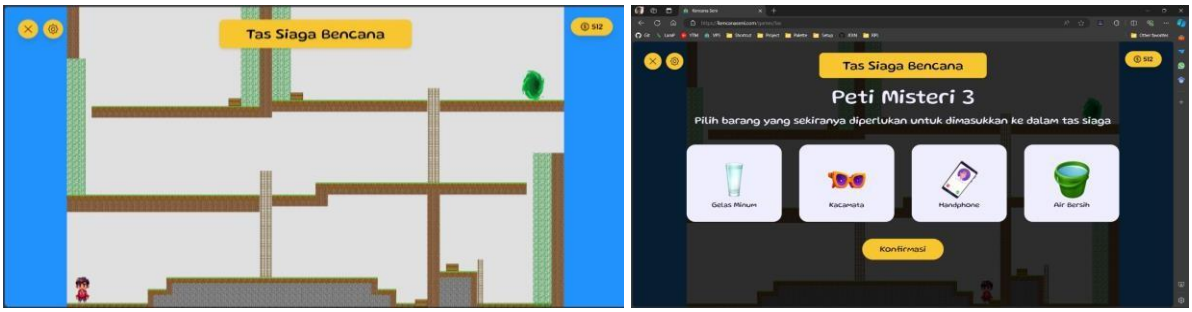

Figure 12. Disaster Preparedness Bag Stage View

Based on figure 12, Keni must find several mystery chests scattered around the game area in this stage. Inside the chests are various items. Keni must choose which items are a priority

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to be put into the disaster preparedness bag. Click “confirm” to select items in each mystery chest and click “Sure” if all items are in accordance with your choice.

Figure 13. Leaderboard Display

The Leaderboard menu display in Figure 13 above will display the results of all games that have been played. The leaderboard will show the player's ranking based on the points obtained from all games that have been played. The leaderboard components consist of name, agency, region, and points. The top three rankings with the highest points will be displayed on the top of the leaderboard. To enter data, players can click the "Save Score" button.

3.3. Implementation

The game launch and user training are aimed at accompanying teachers and children with special needs, such as blind and deaf. At this stage, users are given a guidebook and tutorial by the research team to help them understand how to play the game. This training aims to enable users to use the game as an effective learning tool, while ensuring that the game's features are well accessible to all users, including those with special needs.

3.4. Evaluation

The evaluation was conducted by filling out the Indonesian version of the UEQ Questionnaire by 3 students with visual and hearing disabilities along with 3 accompanying teachers (N=6) to assess game performance and analyse feedback in order to improve and enhance the quality of user experience. The User Experience Questionnaire (UEQ) is a standard questionnaire used to measure user experience with digital/interactive products quantitatively (Laugwitz dkk., 2008), assesses Perspicuity: How easy the system is to understand and use, Efficiency: How quickly users can achieve their goals using the system. Dependability: How reliable the system is and to what extent users feel they have control while interacting with the system. Stimulation: How interesting and exciting the system is for users, and finally Originality: Creativity and novelty possessed by the system. The results of the student evaluation showed that the six aspects above had positive or high scores, this indicates that overall users feel that this system provides a good and enjoyable experience, especially in terms of stimulation and appeal (approaching a maximum value of 3).

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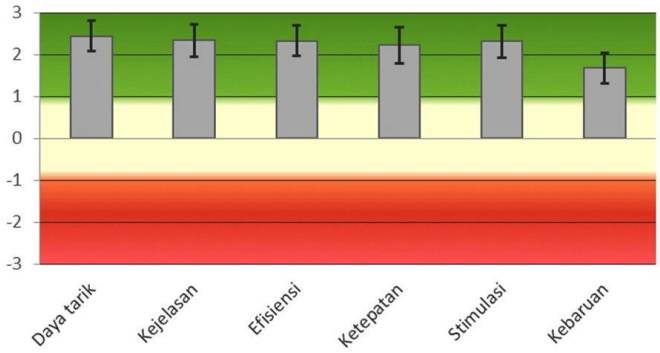

Figure 14. UEQ Scale (Mean and variance in children with visual and hearing impairments as users)

Meanwhile, the evaluation of the accompanying teachers showed that this system is very interesting and innovative, the very low variance in the novelty aspect indicates almost universal agreement among users regarding this novelty aspect. Meanwhile, Accuracy and Efficiency have lower mean scores with higher variances, indicating differences of opinion among teachers regarding the reliability and efficiency of this system.

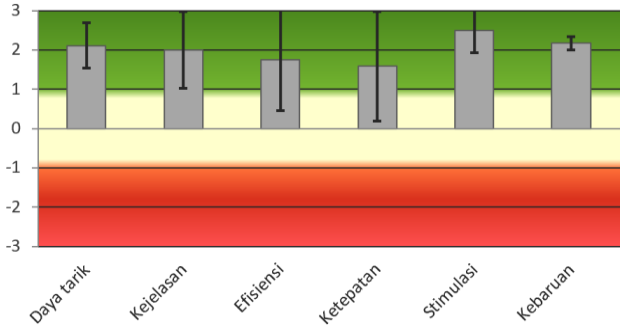

Figure 15. UEQ Scale (Average and variance on accompanying teachers as users)

In addition, this study also evaluated the dimensions of the interface and interaction in multimodal games for people with visual and hearing disabilities along with cognitive aspects that include:

a. interface: the size of visual elements that attract attention and facilitate readability, color create atmosphere, convey meaning, or distinguish one element from another, evoke certain emotions, give important signs (such as red for warnings), or enhance the overall visual aesthetics, good contrast makes it easy for users to distinguish one element from another, especially in the context of readability and accessibility. 2D graphics are developed with good color accuracy, composition, proportion, and readability. 3D graphics are developed with perspective effects and create the illusion that objects "exist" in real space.
b. interaction: tactical or tactile feedback felt through physical touch, voice-based feedback in the form of tones, alarms, or other sounds notifying the user of certain actions or conditions and visual feedback in the form of color changes, animations, or visual symbols on the screen are well developed, use of spoken language, Specific Devices (game controllers, voice assistants) help user interaction with the developed game.

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c. cognitive skills: the ability to understand game rules and gameplay, the ability to map and understand the environment in the game, the ability to use the structure of space in the game to their advantage, such as seeking shelter or placing themselves in a more strategic position, the ability to move from one point to another such as avoiding obstacles, and the ability to solve problems or puzzles in the game efficiently.

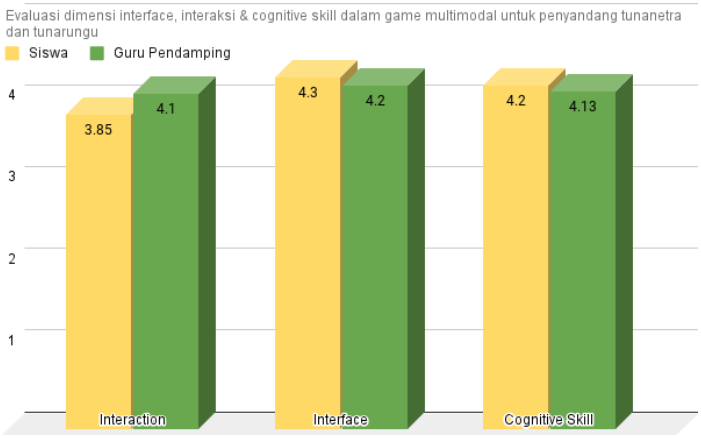

Figure 16. Comparison of teacher and student assessments on the dimensions of interface, interaction, and cognitive skills in the Kencana Seni multimodal game for the blind and deaf

From the graph above, it can be concluded that in general, both students and accompanying teachers gave positive evaluations of the multimodal game that was developed. This can be seen from the average value which tends to be high in all dimensions assessed, namely interaction, interface, and cognitive skills. All dimensions received high ratings, demonstrating that the inclusive design successfully accommodated users with visual and hearing disabilities. Multimodal games have proven to be effective in increasing the engagement and learning motivation of deaf and blind students. The development and utilization of this game need to be continuously supported to improve the quality of education for students with special needs.

Suggestions for further development for this game include increasing its accessibility by providing options for the game to be played both online and offline. This aims to ensure that the game remains accessible to users in various conditions, including in areas with limited internet access. Thus, the game will be more inclusive and able to reach more users, especially those in areas with inadequate digital infrastructure.

4. CONCLUSION

In conclusion, Kencana Seni demonstrates significant potential as an innovative and inclusive educational tool for disaster preparedness among children, especially vulnerable groups such as children with disabilities. This game delivers disaster material in an interesting and inclusive way, and uses an interactive multimedia approach that allows children to better understand how to deal with disasters and get psychological support during post-disaster trauma recovery. Kencana Seni, as an educational innovation to reduce disasters, has been shown to build positive attitudes towards preparedness, especially for children with special needs. The multimodal interface received high ratings from both students (M=3.85/5.0) and teachers (M=4.1/5.0). Interaction design scored highest among all dimensions (students:

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M=4.3/5.0; teachers: M=4.2/5.0), demonstrating that the combination of visual, auditory, and tactile feedback effectively accommodates diverse learning needs. This game not only improves learning but also increases children's psychological resilience through gamification elements and multimodal designs that support various learning styles. Despite the promising results, there is still room for further development. Future research can focus on adding more diverse disaster scenarios and more sophisticated evaluation tools to measure the long-term impact on children's behavior. Kencana Seni has great potential to be used as an innovative and inclusive educational tool to raise awareness of disaster preparedness from an early age.

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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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