

Development and Validation of Augmented Reality Media for Social and Emotional Learning in Children with Learning Disabilities (SEAKAR)

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ABSTRACT

Learning disabilities (LD) are neurological conditions that affect brain function, often resulting in challenges with reading, writing, and mathematics, despite individuals typically having average or above-average intelligence. Students with LD frequently experience socio-emotional difficulties, such as anxiety and social rejection, which can hinder academic progress and self-esteem. Building resilience is essential to help these students cope with stress and adapt to challenges. This study aimed to develop an educational tool titled *Collaborative Social-Emotional-Academic Augmented Reality (SEAKAR)* to support students with LD in inclusive school settings. The tool was designed using the CASEL (Collaborative for Academic, Social, and Emotional Learning) framework and integrated with augmented reality (AR) technology. A Research and Development (R&D) approach was employed, consisting of a needs assessment, prototype creation, expert validation, and iterative revisions. Ten expert validators—comprising specialists in special education, psychology, language, media, ICT, and inclusive education—assessed the SEAKAR prototype. Feedback from the validation process was positive, indicating the product's relevance, functionality, and potential effectiveness in supporting the social-emotional and academic needs of students with LD. The development of SEAKAR represents a promising step toward innovative, inclusive educational tools that integrate social-emotional learning with technology. Its alignment with the CASEL framework and use of AR enhances its potential to engage and support students with LD. Further implementation and testing in real classroom settings are recommended to evaluate its practical impact.

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1. INTRODUCTION

Learning disabilities (LD) refer to conditions where students face challenges in their academic performance caused by disruptions in brain function or psychological factors, resulting in achievements that fall short of their actual capabilities (Widiastuti, 2020). LD, often termed Specific Learning Disabilities (SLD), encompasses conditions such as dyslexia, dysgraphia, dyscalculia, challenges in visual perception, difficulties with sequencing, right-left discrimination issues, problems with lateralization, and deficits in fine motor skills (Saripinar & Erden, 2010). The prevalence of LD ranges from 5.3% to 11.8% among school-aged children (Katusic et al., 2001), while in DSM-5 (American Psychiatric Association, 2013) stated that the prevalence of LD generally occurs in 5–15% of school-aged children.

Inclusive education provides opportunities for all students with special needs, including those with LD, to attend regular schools alongside peers without disabilities (Yusuf et al., 2018). However, students with learning disabilities (LD) face numerous challenges, including psychological and academic difficulties. They often experience peer rejection, heightened feelings of loneliness, low coherence, elevated levels of anxiety and depression (Al-Yagon, 2011), and low self-esteem resulting from academic difficulties (Antonis, 2022). LD students may sometimes feel discouraged from studying due to insufficient support from their surroundings (Anggraeni et al., 2021). Moreover, negative stereotypes, such as being labeled "lazy" or "stupid," along with instances of bullying, further worsen their condition (Gugoumi & Lau, 2015). Limited social skills also prevent them from building positive relationships with peers, both in school and in social environments (Wiener, 2004), which negatively affects their academic and social outcomes (AL-Qadri et al., 2021). Hence, addressing the social and emotional needs of individuals with learning difficulties is just as crucial as focusing on their academic development (Kayaalp et al., 2022).

To address these issues, LD students need to be encouraged to develop optimal resilience. Resilience is an essential trait that every individual (Borazon & Chuang, 2023), including those with special needs (Azwar et al., 2021) should possess. Resilience is the ability of individuals, organizations, and systems to manage threats resulting from unexpected external events (Weick, 2021). Resilient individuals are not entirely resistant to challenges or exempt from experiencing difficult situations in life. Rather, they still encounter negative emotions because of these circumstances but possess the ability to recover effectively and restore their psychological stability (Hendriani, 2018). Students with high resilience have the strength and character to help them succeed in school, even when facing challenges in their lives. Social Emotional Learning (SEL) is one approach that can be implemented to strengthen the resilience of LD students in the school environment.

SEL is the process by which individuals learn and apply a set of social, emotional, behavioral, and character skills needed to succeed in school, the workplace, relationships, and society. The SEL framework was subsequently combined with academic aspects in schools and became known as the Collaborative for Academic, Social, and Emotional Learning (CASEL). The conceptual framework of CASEL comprises five social and emotional competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making (Taylor et al., 2017a). The illustration of the CASEL conceptual framework can be seen in Figure 1.

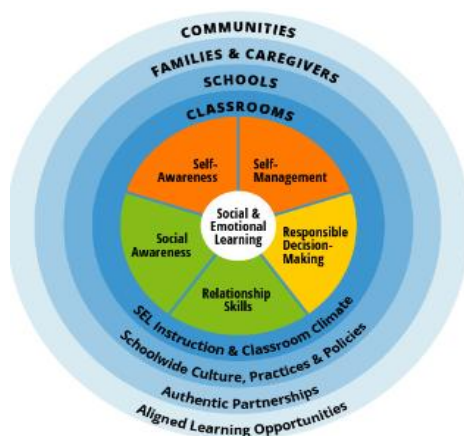


Figure 1. CASEL Conceptual Framework

CASEL is widely recognized and used by researchers, teachers, and policymakers to help systematically, equitably, and evidence-based social and emotional learning from early childhood education to high school (Daley & McCarthy, 2021a). The CASEL framework has also been extensively used to enhance students' psychological and social-emotional aspects, including resilience. A meta-analysis conducted on 213 SEL programs found that SEL can improve social and emotional attitudes, skills, and behaviors (Durlak et al., 2011; Hassani & Schwab, 2021). Armstrong et. al. (2012) reviewed 75 studies on SEL programs in schools and found significant effects in improving students' social-emotional skills, such as social skills, positive self-image, mental health, and prosocial behavior, while also reducing antisocial behavior and substance abuse. SEL also has the potential to enhance students' academic achievement (McMahon et al., 2015a), mental health, and prosocial behavior (Wu et al., 2013). Furthermore, (Hrishikesh & Nair, 2016) have adapted CASEL framework by developing a program called DREAM, which incorporates songs, games, stories, and physical activities designed to suit children's developmental stages, aimed at enhancing resilience.

Considering the challenges faced by LD students and inspired by the positive impacts of the CASEL program, this study aimed to develop an innovative educational media using the CASEL framework integrated with augmented reality (AR) named SEAKAR. The novelty of this research lies in utilizing AR as an intervention to enhance resilience in LD students in inclusive schools to support LD students in building resilience, and empowering them to tackle challenges in academics, emotional well-being, and social relationships. The benefits of AR in increasing student engagement through interactive applications have been well-documented. Research indicates that AR enables students with special needs to grasp concepts more quickly and effectively (Hrishikesh & Nair, 2016) AR are well-suited for LD students as they are equipped with audio, graphics, animations, and videos, which can motivate and engage LD students in the learning process (Rahman et al., 2024). Using AR in learning contexts can positively impact students' emotions, thereby improving cognitive processing and academic performance (Yu et al., 2022).

While SEL provides a proven framework for addressing socio-emotional challenges, integrating it with AR technology offers unique opportunities for interactive and engaging interventions. The growing integration of technology in education underscores the increasing necessity of incorporating SEL into the digital ecosystem (Erstad et al., 2024). This need becomes particularly crucial in inclusive schools, which accommodate students with diverse needs and backgrounds. The lack of accessible and adaptable media often constrains the effectiveness of technology in facilitating SEL within inclusive settings (Signorelli, 2022). Consequently, the development of SEAKAR serves to address these limitations and enhance the implementation of SEL in inclusive educational environments.

SEAKAR represents a pioneering educational tool that integrates the CASEL framework with AR technology, specifically designed to enhance resilience in students with learning disabilities (LD). Although AR has been extensively applied in educational settings, its usage has predominantly focused

on cognitive development and has yet to be tailored to address the social and emotional needs of LD students. SEAKAR incorporates diverse features, including interactive storybooks, AR elements, videos, songs, games, and quizzes. By leveraging illustrated storybooks with AR scanning capabilities, SEAKAR offers an engaging learning experience that combines visual storytelling and advanced technology. Furthermore, the platform includes videos and songs that facilitate social and emotional learning. SEAKAR not only bridges the gap in technology-based social-emotional learning but also introduces an innovative approach to inclusive and student-centred education. This development highlights the potential of AR, when intentionally designed to support SEL for LD students, as a transformative innovation in education and addresses a critical research gap in this domain.

2. METHODS

This study employed a Research and Development (R&D) methodology based on the Borg & Gall model (Sugiyono, 2011). The study focused on designing and refining SEAKAR, an educational tool that integrated illustrated storybooks with Android-based Augmented Reality (AR) technology to support social and emotional learning (CASEL). The procedural steps included: (1) developing a needs assessment instrument, (2) conducting a needs assessment, (3) analyzing the needs assessment data, (4) creating a prototype and a user manual for the SEAKAR educational media, (5) validating the product with experts and end users, and (6) revising the product. This article focused on refining the existing product and validating it through expert and practitioner reviews. Following the validation process, the researchers intended to conduct field testing; however, this phase was beyond the scope of the present study.

The SEAKAR educational media was designed using the CASEL framework, which encompasses five core competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. This media was developed as a combination of three illustrated storybooks and an Android-based application, requiring a minimum operating system of Android version 11. Each competency is supported by specific activities incorporated into both the storybooks and the SEAKAR application, with the aim of facilitating the achievement of social and emotional learning objectives.

The validation stages of SEAKAR were conducted using both qualitative and quantitative approaches through Focus Group Discussions (FGDs) and structured assessments. The validation process involved 10 experts, including 2 specialists in special education, 2 psychologists, 2 linguists, 2 experts in technology and educational media, and 2 inclusive school practitioners with experience supporting LD students. The process began by providing the SEAKAR educational media along with a quantitative evaluation instrument in the form of a questionnaire. Subsequently, an FGD was conducted through structured discussions. Each validator was given two types of questionnaires: (1) an overall content evaluation, distributed to all validators, and (2) an assessment focused on specific aspects aligned with each validator's area of expertise.

The specialized evaluation included the following aspects: (1) the relevance of the product to LD characteristics (special education experts), (2) the alignment of the media with the CASEL framework (psychologists), (3) language suitability (linguists), (4) interface design and interaction tools within the SEAKAR application (technology and media experts), and (5) ease of use of the media (practitioners). The FGD results were analyzed thematically to identify the strengths, weaknesses, and recommendations for product improvement. Meanwhile, the quantitative assessment instrument was analyzed descriptively by calculating the average validation score provided by each validator.

3. FINDINGS AND DISCUSSION

3.1. Development of SEAKAR Media

Based on the results of the need assessment, it was found that there are social and emotional challenges faced by students with LD. Therefore, it is necessary to develop learning media to address these challenges. The researchers developed SEAKAR media with the aim of improving the social and emotional aspects of LD students, including their academic resilience. The development of SEAKAR media began with the preparation of a blueprint using the CASEL conceptual framework (Taylor et al., 2017b). The SEAKAR blueprint can be seen in Table 1.

Table 1. Blueprint of SEAKAR

No	Aspect	Indicator	Activity
1	Self awareness	Recognizing emotions	Emotion Recognition Song
		Recognizing thoughts	My Emotions Journal
		The impact of emotions and thoughts on behavior	Guess the Emotion
2	Self management	The ability to manage emotions, thoughts, and behavior in various situations	Emotion Management Exercise
		Striving to achieve goals	"Let's Adventure" Game
3	Social awareness	The ability to understand others' perspectives	Role-Playing "Be Me"
		Empathizing with others	Identifying Good and Bad Behavior
4	Relationship skill	The ability to build and maintain healthy relationships	Praise Network
		Communicating effectively with others	Emotion Riddle
		Seeking and offering help when needed	Kindness Bingo
5	Responsible decision-making	The ability to make constructive choices regarding personal behavior and social interactions	Number Puzzle Game
		Evaluating the consequences of actions	
		Considering the well-being of oneself and others	"It's Not Just Me" Game

The researchers then developed the blueprint into three series of illustrated storybooks and the SEAKAR application, which comes with a SEAKAR user guidebook. The SEAKAR application can be installed on smartphones with a minimum specification of Android version 11 and requires an internet connection. The creation of the AR component was carried out with the assistance of professional expertise, ensuring it was tailored to the CASEL framework, aligned with the SEAKAR book storyline, and adapted to meet the needs of LD students.

3.2. SEAKAR Book Series 1: "Understanding 6 Types of Emotions Within Ourselves"

SEAKAR Book Series 1 covers the aspects of "Self-Awareness" and "Self-Management," which include the recognition of emotions and behaviors, the impact of emotions and thoughts on behavior, the ability to manage emotions, thoughts, and behaviors in various situations, and striving to achieve set goals. Additionally, this book is enhanced with the use of AR, which can be accessed through the SEAKAR application. The aim is to make the content more interactive and to increase the interest of students with LD. The SEAKAR application also includes videos, such as songs and quizzes, covering the aspects presented in SEAKAR Book Series 1. SEAKAR Book Series 1 and the SEAKAR application are illustrated in Figure 2.



Figure 2. SEAKAR Book Series 1. (a) shows the book cover of book series 1 with the theme of recognizing 6 types of emotions within, (b) shows the front cover of the SEAKAR application, (c) shows the SEAKAR application when displaying augmented reality.

3.3. SEAKAR Book Series 2 : "Keeping Friendships Strong"

SEAKAR Book Series 2 covers the aspects of "Social Awareness" and "Relationship Skills," focusing on the ability to understand others' perspectives, empathize with others, comprehend social norms and ethical behavior, build and maintain healthy relationships, communicate effectively with others, and seek and offer help when needed. SEAKAR Book Series 2 is also implemented within the SEAKAR application, which includes songs and quizzes that support the aspects of "Social Awareness" and "Relationship Skills." SEAKAR Book Series 2 is illustrated in Figure 3.

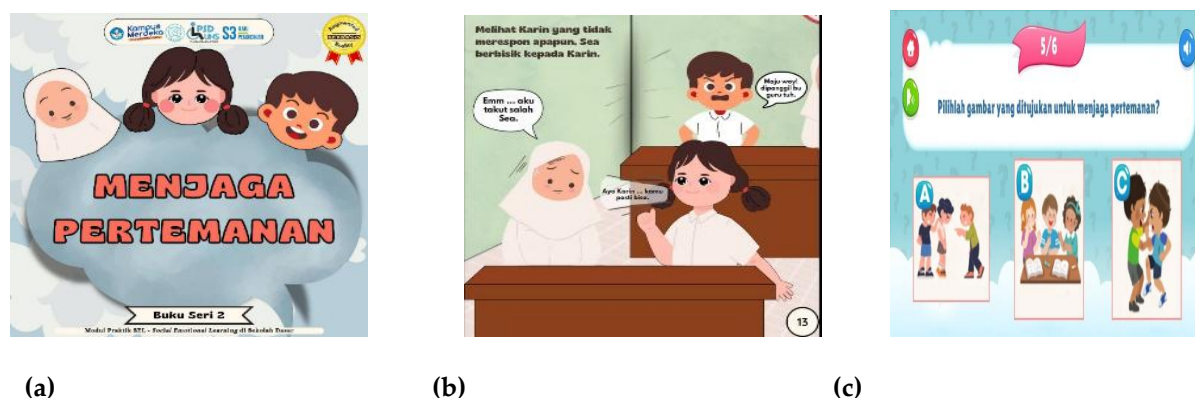


Figure 3. SEAKAR Book Series 2. (a) shows the book cover of book series 2 with the theme of maintaining friendship, (b) shows an overview of the contents of the book on how to maintain friendship in a classroom situation, (c) shows the quiz contained in the SEAKAR application.

3.4. SEAKAR Book Series 3 : "Learning to Make Decisions Together"

In Book Series 3, the focus is on the aspect of "Responsible Decision-Making," which includes the ability to make constructive choices regarding personal behavior and social interactions, evaluate the consequences of actions, and consider the well-being of oneself and others. Similar to Book Series 2, Book Series 3 is also integrated into the SEAKAR application, which contains songs and quizzes. SEAKAR Book Series 3 is illustrated in Figure 4.



Figure 4. SEAKAR Book Series 3. (a) shows the book cover of book series 3 with the theme of learning to make decisions together, (b) shows an illustration of the content of the book that shows about mutual agreement, (c) shows the quiz contained in the SEAKAR application.

The quiz and augmented reality (AR) features within the SEAKAR application are specifically designed to integrate seamlessly with illustrated storybooks, fostering social and emotional learning (CASEL). Users can engage with these features through the following steps: (1) While reading the storybook, certain illustrations are intended for scanning. Users can access the AR feature from the SEAKAR application menu to display AR content, such as various emotional states. (2) Upon completing the storybook, users can access a quiz at the end of the session via the quiz feature in the SEAKAR application. The quiz content is directly aligned with the themes and narratives of the storybook previously read.

By leveraging AR technology, the application facilitates active user engagement in story-based activities, including answering multiple-choice questions and matching images relevant to the story's context. The features are purposefully designed to enhance and extend the narrative elements of the storybooks. For instance, if a story explores the concept of emotions, the application's quizzes incorporate scenarios, questions, or simulations that relate to the emotional lessons conveyed within the story.

3.5. Validation of SEAKAR

After completing the development stage, the researchers conducted validation of the SEAKAR media with several experts, including:

1. **Special Education Experts (SEE):** Two special education experts assessed the alignment of the SEAKAR media with the characteristics of students with learning disabilities (LD). Overall, both experts found that the SEAKAR content is relevant to the characteristics of LD, the media is interactive, and it has an appealing design that engages LD students in learning.
2. **Psychology Experts (PsyE):** The assessment by two psychology experts focused on the content and materials related to emotional and social learning in the SEAKAR media, as well as the relevance of the activities to the topics presented. Both psychology experts concluded that the SEAKAR content and materials effectively represent emotional and social learning. They found the design to be engaging, and the activities in SEAKAR are relevant to emotional and social learning for students in grades 4 to 6 of elementary school.
3. **Linguistic Experts (LE):** Two linguistics experts evaluated the language aspects of the SEAKAR media, including writing style, spelling, punctuation usage, sentence structure, and the appropriateness of the language used for the target age group. Both language experts found that the language used is generally suitable, the sentence structure is adequate, and the presentation is engaging. However, they noted that some writing, punctuation usage, and sentence structure still require revisions.

4. **Media and Instructional Technology Experts (MITE):** The media and instructional technology experts evaluated the user interface, interaction tools, and content aspects of the SEAKAR application. Both experts concluded that the application functions well, is easy to use, has a good interface, and the AR features are relatively easy to access. However, they provided feedback suggesting that AR objects should include supporting movements and audio to better convey the displayed emotions. Additionally, the assets in the media need to be enlarged, as they are currently too small, making them unclear to view and increasing the likelihood of errors when interacting. It was also noted that the letters in the AR content were reversed, and a zoom in-out feature for AR should be added. They further recommended conducting additional reviews.
5. **Inclusive Education Practitioners (IEP):** The inclusive education practitioners involved in assessing the SEAKAR media were two inclusive education teachers who work with students with learning disabilities (LD). These practitioners evaluated the ease of use of the SEAKAR media, its content, and the appropriateness of the language used. Furthermore, they highlighted the need to include tangible media alongside AR to support LD students and recommended incorporating audio into the quiz feature to aid those who struggle with reading.

A summary of the expert validation results can be seen in Table 2 below.

Table 2. Expert Validation Results

Aspects	Validator Judgment (%)					Criteria
	SEE	PsyE	LE	MITE	IEP	
Content	90	90	88	87	92	Valid
Relevant with LD	89	-	-	-	90	Valid
Relevant with CASEL	-	87.5	-	-	-	Valid
Language eligibility	-	-	87	-	90	Valid
Interface	-	-	-	90	-	Valid
Interaction Tools	-	-	-	86	-	Valid
Ease of use	-	-	-	-	89.5	Valid

Discussions

The development of SEAKAR aims to support students with learning disabilities (LD) in enhancing their social and emotional aspects, including academic resilience. After the validation stage with experts and practitioners, it was found that the SEAKAR media content is appropriate for LD students. LD students particularly need support in overcoming challenges in social interaction and emotion management. Through SEL, LD students gain adequate information on how to tackle the challenges arising from social interactions and managing their emotions. Daley & McCarthy (2021b) explained that SEL interventions have been proven to support emotional and social learning in students with special needs. These findings are also supported by Hassani's systematic literature review (Hassani & Schwab, 2021), which explains that SEL interventions for students with special needs conducted in the United States have a positive impact on their emotional and social development.

Based on these studies, researchers have developed innovative and effective learning media to support SEL development in LD students through AR-based activities. AR has emerged as a technology that can make a significant contribution to education, including in developing SEL in LD students. AR allows the integration of virtual elements into the real world, creating an immersive and interactive learning environment that can enhance student engagement (Bacca et al., 2014). Research has shown that the use of AR in education can improve conceptual understanding and deepen students' engagement with learning materials (McMahon et al., 2015b). The development of AR media focused on SEL is designed to help LD students develop the skills needed to manage emotions, interact effectively with others, and make responsible decisions.

In the development of SEAKAR media, various activities supporting SEL development, such as emotion recognition, emotion management exercises, and interactive games, are integrated into an application accessible to LD students. These activities not only support social and emotional learning but also help LD students better understand and control their learning environment. For example, Parsons & Cobb's research (Parsons & Cobb, 2011) shows that AR-based interventions can improve social and emotional skills in students with special needs, indicating the great potential of AR media in inclusive education. For instance, emotional management exercises in the illustrated storybook feature narratives depicting various social or emotional scenarios, such as joy, sadness, anger, fear, disgust, and surprise, enhanced with AR capabilities. Scanning the AR elements displays visual representations of these emotions. The storybook also incorporates a "kindness bingo," which includes examples of simple acts of kindness, such as assisting a teacher, expressing gratitude, or saying goodbye to parents. The bingo activity further lists other positive actions, prompting LD students to mark the ones they have performed. Through this process, LD students reflect on their actions and identify behaviors they should adopt, promoting the development of positive relationships and encouraging a more optimistic outlook.

The validation results of the AR media development for SEL indicate that the developed content is relevant to the characteristics of LD students and has an engaging and interactive design. Special education, psychology, and instructional technology experts assessed that this media meets the eligibility criteria for use in LD student learning. However, there are still some technical challenges in using this media that need to be addressed before wider implementation. The challenges faced include user device limitations, as not all users possess Android devices with specifications capable of supporting Augmented Reality (AR) technology. This can lead to slow performance, application crashes, or incompatibility issues. To mitigate these challenges, it is essential to provide information about the minimum Android specifications required, while ensuring the SEAKAR application is designed with a lightweight file size and broad compatibility.

Moreover, limited technological literacy and overly complex user interface designs may pose difficulties for users, particularly teachers, children, and parents who are less experienced with technology. To address this, the SEAKAR application should feature a simplified layout with enlarged elements for improved visibility. Conducting usability testing with target groups (such as students and teachers) can help identify problematic areas, allowing for improvements based on their feedback. Additionally, offering training sessions for teachers or practitioners using SEAKAR to support learning, along with providing clear user guides and step-by-step tutorials, can further enhance the application's accessibility and usability. After completing the validation phase, the researchers will move on to field testing to assess the product's effectiveness with its intended users, namely LD students.

4. CONCLUSION

The validation results from experts and practitioners indicate that the development of SEAKAR media followed a systematic process comprising six key stages: (1) designing a needs assessment instrument, (2) conducting a needs assessment, (3) analyzing the collected data, (4) developing a prototype and user guide for SEAKAR media, (5) validating the product with experts and target users, and (6) revising the product based on feedback. The findings from the FGD confirmed that SEAKAR media met the required feasibility standards, with adjustments made in response to expert recommendations. These improvements included harmonizing font usage, refining punctuation, incorporating audio into the AR features, enlarging media assets for improved clarity, correcting reversed text within AR elements, and adding a zoom-in-out functionality for AR components.

The application of SEAKAR media is anticipated to enhance social-emotional competencies, including academic resilience, among LD students in inclusive educational settings. SEAKAR presents significant potential to advance inclusive education by exemplifying the integration of AR technology with the SEL framework. By utilizing AR technology, SEAKAR offers immersive and interactive

learning experiences, enabling students with diverse abilities and learning preferences to engage actively. This approach underscores the principles of inclusivity by facilitating equitable access to educational resources.

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