Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

Developing moral awareness in children with autism: The use of educational game applications in learning

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ARTICLE INFO

Article history:
Received 18 August 2024
Received in revised form
19 December 2024
Accepted 26 January 2025

Keywords:
Autism spectrum disorder
Moral education
Emotion recognition
Behavioral challenges
Learning applications

ABSTRACT

Children with Autism Spectrum Disorder (CASD) often face challenges in recognizing and understanding emotions, making it difficult for them to interpret their own emotions and those of others. These emotional and behavioral difficulties can lead to behaviors that deviate from social norms and ethical standards. This study evaluates the effectiveness of the previously developed Moral Awareness Game (MAG). An experimental method was used with 19 CASD participants and 14 teachers who provided feedback on their experiences with MAG during the learning process. Data were collected through pre-test and post-test assessments and analyzed using the Kruskal-Wallis test. The findings indicate that the MAG application is effective in terms of ease of use and content quality, although improvements are needed in areas such as command delivery and the clarity of facial expressions. While previous studies have developed tools to support various skills in CASD, this study introduces an innovative focus on moral education. The results suggest that MAG offers a valuable new approach for teachers to support moral development in children with CASD.

1. Introduction

Children with Autism Spectrum Disorder (CASD) often struggle to recognize and interpret the emotions of others, a difficulty closely related to their social cognitive abilities. Social cognition involves the mental processes by which an individual perceives and interprets stimuli, constructing knowledge of emotions and mental states, both of themselves and those around them (Zhang et al., 2021; Morrison et al., 2020). In essence, social cognition enables an individual to process social information and determine appropriate responses using social skills (van Pelt et al., 2022). However, children with CASD frequently have challenges in understanding facial expressions, tone of voice, maintaining eye contact, interpreting smiles, and recognizing other nonverbal cues (Pedregal and Heaton, 2021; Goncalves and Monteiro, 2023). These difficulties arise from underdeveloped cognitive capacities, which impede their ability to comprehend and express emotions accurately (Junaidi et al., 2022).

In summary, deficits in social cognition, such as facial expression recognition, social perception, and Theory of Mind (ToM), may lead to misperceptions and misunderstandings of others' thoughts and behaviors (Lott-Sandkamp et al., 2023; Papoudi et al., 2021). These challenges not only impact interaction and communication (Bejarano-Martin et al., 2020) but also contribute to distinctive repetitive behaviors often observed in individuals with CASD. This phenomenon is hypothesized to stem from limited communication skills that hinder message comprehension (Heath et al., 2021; Craig et al., 2021). Such communication barriers may result in behaviors that deviate from social norms and ethics.

The moral development of children with CASD presents significant challenges, primarily because they struggle to understand others' perspectives (Margari et al., 2020). This difficulty relates to specific developmental issues within their social cognitive capacities (Bamicha and Drigas, 2022), which persist as they grow (Dandil et al., 2020;

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Tseng et al., 2022). The foundation of moral development lies in the ability to comprehend the internal states of others (Dempsey et al., 2020a). The inability to understand others' perspectives and accurately express one's emotions in social interactions often leads to the perception that children with ASD lack empathy (Jozkowski and Cermak, 2020), as they process social information differently (Dempsey et al., 2020b).

The moral issues associated with CASD have sparked a debate: Are children with CASD considered to lack moral responsibility due to psychopathology? (Dempsey et al., 2020a). From an educational perspective, children with CASD should receive tailored interventions to help them develop the capacity to behave in accordance with moral values and societal norms. Research suggests that children with CASD exhibit slower moral development compared to individuals with other neurodevelopmental disorders (Nissinen et al., 2022). In one study, while children with CASD could differentiate behaviors aligned with moral norms from those that were not, their reasoning was often simplistic (Hirt et al., 2024). Another intervention study employed moral dilemmas as a medium, asking children with high-functioning autism to determine right from wrong based on these dilemmas (Peterson and Slaughter, 2024). A different approach involved enhancing moral decision-making skills through utilitarian judgments in the context of moral dilemmas (Okuzumi et al., 2024).

In the educational domain, various learning activities, including games, have been developed for children with CASD. One such application is teaching the Quran, aimed at improving speaking fluency and social communication (Shohieb et al., 2022; Penev et al., 2021) and expanding vocabulary (Urrea et al., 2024). The use of digital games in education is predicated on their effectiveness over traditional learning resources, providing children with immersive experiences through active learning methods (Silva et al., 2021). Games enhance student motivation and engagement, subsequently improving learning outcomes (Rezayi et al., 2023). However, the development of games that incorporate moral learning content specifically for children with CASD remains limited. Prior research has attempted to design such games by adapting to the learning characteristics of children with CASD, emphasizing visual and linear styles and attention to detail. The current study tests the usability of the MAG application in enhancing moral awareness among children with CASD.

The MAG application is used as an intervention tool for children with autism to help them recognize emotional expressions through facial expression training. Facial expressions serve as primary indicators of emotions, and children with autism often face challenges in identifying emotions from facial cues, such as the eyes, mouth, or forehead. The intervention for recognizing emotional expressions involves several phases, starting with identifying basic emotions, interpreting their meanings, applying this information in appropriate contexts, generalizing emotional recognition, and ultimately demonstrating suitable behaviors corresponding to emotional expressions in their environment (Scuotto et al., 2024).

2. Methodology

This study utilized a quantitative pre-test and post-test design to assess the effectiveness of a game-based mobile application in enhancing moral awareness among children with autism spectrum disorder (Fig. 1). The intervention was conducted over a three-week period in three special schools in East Java Province, selected based on the characteristics and needs of their students. The sample consisted of 19 CASD students aged 7-18 with a minimum intellectual functioning level of 60, as measured by the Wechsler Intelligence Scale for Children, and demonstrated proficiency in using smartphones. Additionally, 14 teachers from the participating schools were involved in the implementation of the application, providing feedback for further refinement. Teacher assessments of student interactions were collected using a structured observation method facilitated by the game-based application. The collected data were then analyzed using the Kruskal-Wallis test to evaluate changes in moral awareness.

3. Results

The scale for assessing students' independent behavior in operating the application is divided into three categories: (1) requires significant assistance, (2) requires minimal assistance, and (3) operates independently. Table 1 presents data on the participants' levels of independence in using the MAG application. Notably, the age group of 7-10 years displayed the lowest level of independence in operating the application.

Table 1: Subject independence score in operating the app

	Age group	N	Mean rank
Ability to operate the App	7 – 10 years old	8	6.13
	11 – 14 years old	6	12.50
	15 – 18 years old	5	13.20
	Total	19	

Table 2 presents the results of the Kruskal-Wallis test, indicating a significant difference in the levels of independence among children with autism spectrum disorder in using the MAG application. The age groups 11-14 and 15-18 demonstrated moderate to high levels of independence in operating the application.

Table 2: Statistics test result

	Ability to operate the app
Kruskal-Wallis H	8.189
df	2
Asymptotic significance	.017

Grouping variable: Age group

The usability test of the MAG application for developing moral awareness among CASD was conducted based on teachers' assessments. Teachers evaluated the usability of the application after integrating it into the teaching and learning process. It is important to note that the impact of the learning process, particularly in terms of behavioral change, is gradual and long-term rather than immediate. Therefore, teachers' assessments serve to evaluate the application's effectiveness in fostering moral awareness among CASD. The usability of the MAG app was assessed using four indicators, as shown in Table 3, which presents the percentages of teachers' evaluations for each indicator. The results suggest that, while the application provides examples of appropriate behavior based on ethical standards, it has not yet demonstrated a direct impact on behavioral changes in the daily lives of CASD.

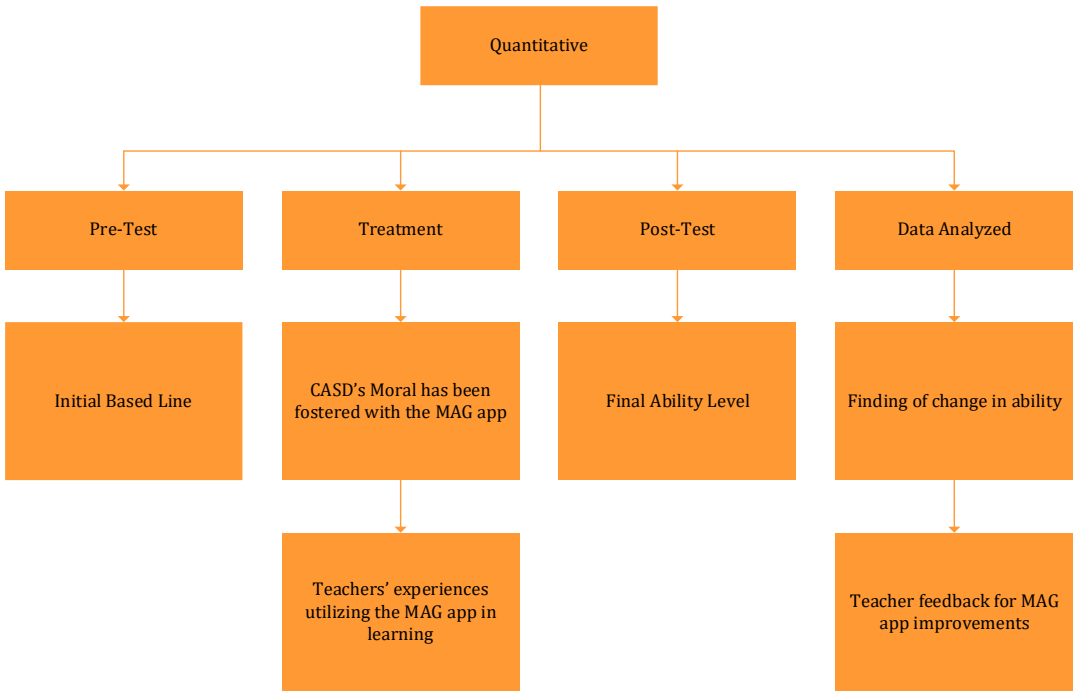

Fig. 1: Research flow

Table 3: Indicators of the app's usability

No.	Indicator	Percentage
1	Through playing in the MAG app, CASD can differentiate appropriate and inappropriate behavior	92.9%
2	Through playing in the MAG app, CASD can decide on appropriate behavior according to the context	71.43%
3	Through playing in the MAG app, CASD can show facial expressions according to the context	57.14%
4	Through playing in the MAG app, CASD can behave appropriately according to the context	42.86%

The teachers' assessments of the MAG application were further analyzed using the Intraclass Correlation Coefficient (ICC) to determine the consistency and correlation among the 14 teachers who evaluated the application's usability. Table 4 shows the ICC results, indicating that teachers agree the application is effective in fostering moral awareness among CASD.

Table 4: Intraclass correlation coefficient

	Intraclass correlation	95% confidence interval		F-test with true value 0			
		Lower bound	Upper bound	Value	df1	df2	Sig.
Single measures	.101	-.019	.715	2.577	3	39	.068
Average measures	.612	-.348	.972	2.577	3	39	.068

Another analysis involved Kendall's Tau Correlation test to explore the relationships between the following variables: (1) independence in using the MAG application, (2) ability to remain calm and focused on tasks, (3) ability to understand commands or instructions, (4) speaking skills (ability to convey a message), and (5) age group. Based on Table 5, the following observations can be made: (1) there is a significant correlation between the variable "ability to use the app" and the variable "age group"; (2) there is a correlation between the variable "ability to sit calmly" and the variable "understanding commands." These findings indicate that only the variable "age group" shows a significant correlation with the "ability to use the app."

4. Discussion

The MAG prototype was developed for game-based moral learning, incorporating elements such as identifying moral values and making moral judgments. The MAG architecture is outlined as follows: (1) Frontend using Flutter—chosen to develop an interactive and appealing user interface, supporting integration with the backend system through an API (Application Programming Interface)

provided by Laravel and implementing game logic, control, and state management. (2) Backend using Laravel and MySQL designed for API configuration and management to communicate with the frontend, manage the database through Laravel's ORM, Eloquent, for efficient interaction with MySQL, and handle other functions such as authentication, authorization, and security.

Table 5: Kendall's tau correlation test result

			Ability to use the app	Ability to sit calmly	Understanding command	Speaking	Age group
Kendall's Tau_b	Ability to use the app	Correlation Coefficient	1.000	.422	.269	.089	.614**
		Sig. (2-tailed)	.	.063	.237	.688	.004
		N	19	19	19	19	19
	Ability to sit calmly	Correlation Coefficient	.422	1.000	.637**	.275	.281
		Sig. (2-tailed)	.063	.	.007	.234	.206
		N	19	19	19	19	19
	Understanding command	Correlation Coefficient	.269	.637**	1.000	.306	.106
		Sig. (2-tailed)	.237	.007	.	.184	.633
		N	19	19	19	19	19
	Speaking	Correlation Coefficient	.089	.275	.306	1.000	-.009
		Sig. (2-tailed)	.688	.234	.184	.	.966
		N	19	19	19	19	19
	Age group	Correlation Coefficient	.614**	.281	.106	-.009	1.000
		Sig. (2-tailed)	.004	.206	.633	.966	.
		N	19	19	19	19	19

Following the concepts proposed by Gilligan (2023), moral learning for children with autism is designed to be more inclusive, relational, and contextual. This approach aims to help children grasp moral values more profoundly while enhancing their social and emotional skills, which are crucial for their daily lives. The initial content integrated into MAG includes Social Behavior, Social Communication, Emotional Expression, and Social Activities.

The usability tests demonstrated that the MAG application is practical and meets ease-of-use criteria. This is attributed to its compatibility with the Android operating system, which is familiar to children in their daily activities. Even CASD or intellectual disabilities can adapt to and navigate the application (Junaidi et al., 2020). Furthermore, according to the study, 50% of CASD are non-verbal and tend to be visually oriented. As a result, using Android technology is more engaging and effective for them during the learning process (Azadboni et al., 2024). The application proved usable independently among children aged 11-18, compared to those under 11. The tests revealed that children aged 11-18 found the application easy to operate. The application's ease-of-use indicators include text and audio commands that are simple to comprehend, enabling respondents to complete tasks efficiently. Consequently, most respondents could use the application independently, without teacher assistance.

The MAG app is designed with specific goals for each level, functioning as an intervention to foster moral awareness among CASD. For instance, in the Grouping Pictures activity, the goal is for children to differentiate between appropriate and inappropriate behavior. The game categorizes similar behaviors into these two groups because CASD learns categories in a structured manner (Uddin et al., 2024). Therefore, the Grouping Pictures activity serves as a fundamental exercise before progressing to conceptual understanding (Godbole et al., 2024). This aligns with the MAG app's usability indicator, with teachers' assessments reaching 92.9%. However, many respondents faced challenges in progressing through the Imitating Facial Expressions level. This activity involves imitation, a skill that CASD often struggles with (Bravo and Schwartz, 2022), resulting in difficulties for some respondents. Such challenges occur during the initial developmental stages of CASD, as the ability to imitate depends on cognitive-representational and visual-perceptual motor processes (Vulchanova et al., 2023). The imitation game is designed as an intervention for children with ASD to accurately display facial expressions (Yeung, 2022).

However, the failure of participants to mimic facial expressions accurately is not solely due to their ability to simulate. Usability tests revealed that some respondents encountered unreadable expression errors when using the app, limiting its effectiveness. The test results also included teacher assessments showing that respondents aged 8-11 struggled to use the app independently and required assistance. This difficulty is attributed to their inability to read written commands and the limited availability of audio commands at certain levels. Consequently, these participants needed additional help to operate the MAG app, even though they demonstrated an adequate understanding of instructions. According to the app's ease-of-use evaluation, a primary requirement for using the app is the ability to comprehend commands. Usability tests showed that all respondents could understand commands, which are also related to their language comprehension skills and intellectual abilities (Yeh et al., 2022). Thus, the test results are promising, demonstrating the app's potential for developing

moral awareness among CASD. However, there are also prerequisites for using the app, such as the ability to use a smartphone and understand commands. With these skills, CASD can use the app independently with minimal assistance.

5. Conclusion

The role of age significantly influences the level of independence in using the MAG app among CASD. Children aged 7-10 generally show less autonomy compared to those in the 11-18 age group. While the MAG app has the potential to illustrate ethical behavior effectively, its impact on promoting behavioral changes in daily life for CASD remains an area for further exploration. The app shows promise in enhancing moral awareness, particularly in higher-functioning CASD, but achieving substantial behavioral changes may require broader interventions and further development of the application tailored to individual needs. For instance, integrating adaptive features that personalize content and difficulty levels based on each child's profile could better suit their learning needs. Additionally, including elements that enhance motivation and engagement is crucial. Future research should experiment with diverse CASD characteristics and explore more detailed variables to determine the app's full potential.

Acknowledgment

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Compliance with ethical standards

Ethical considerations

Informed consent was obtained from all participants or their legal guardians, and confidentiality was maintained throughout.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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