Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini
Volume 14, Number 3, 2025 pages 949-964
P-ISSN: 2301-9905 E-ISSN: 2775-409X
Open Access: https://jurnal.umt.ac.id/index.php/ceria/index

Utilization of Interactive Multimedia to Improve the Understanding of Autistic Students

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ARTICLE INFO

Article history:
Received: September 2, 2025
Accepted: October 20, 2025
Available online on: October 31, 2025

Keywords:
Special Needs Students, Autistic Students, Interactive Multimedia, Understanding Autistic Students

ABSTRACT

This study aims to improve the cognitive abilities of 4–5-year-old children in Group A of TK Aisyiyah Bustanul Athfal Mamboro using number card media. A two-cycle Classroom Action Research (CAR) design (Kemmis & McTaggart) was employed (Rahman *et al.*, 2017). Ten preschoolers (2024/2025 academic year) participated. Data were collected via classroom observations, interviews, and assignments, then analyzed descriptively by calculating percentage improvements. The results showed significant increases in cognitive performance from the pre-intervention stage to Cycle II. For example, the proportion of children correctly observing and naming numbers rose from 40.0% (pre-test) to 80.0% (Cycle II), and those recognizing number symbols improved from 36.7% to 80.0% (Cycle II). On average, cognitive skill indicators increased by about 40% between cycles. It can be conclude that using number card media effectively enhanced the children's mental abilities.

Introduction

Inclusive education demands special attention to the diverse characteristics of learners, including children with special needs such as students with autism. Autism is a neurological developmental disorder that affects an individual's ability to communicate, engage in social interactions, and comprehend abstract information (Association, 2013). The term "autism spectrum" refers to a range of developmental disorders characterized by limitations in social communication from an early age, along with repetitive sensory-motor behaviors that are believed to be strongly influenced by genetic and multifactorial causes (Lord et al., 2020). Autism spectrum disorder is a neurological condition marked by impairments in social interaction, communication, and behavior (Bernier et al., 2022). Students with autism spectrum disorder often face difficulties understanding learning materials through conventional instructional methods that are less adaptive to their needs.

Every individual has the right to receive educational services appropriate to their characteristics and needs, including learners with special needs such as children with autism spectrum disorder. In practice, autistic students frequently struggle to comprehend lessons delivered through traditional teaching methods (Wardany & Apriyanti, 2022). Barriers in communication, social interaction, and adaptive behavior necessitate more innovative and responsive educational approaches to meet their learning needs. Therefore, the development of effective learning strategies becomes crucial to support the improvement of conceptual understanding. The strategies employed

should align with each learner's individual characteristics, including those with special needs (Nasution, 2017). One subject that requires strong conceptual understanding is *Pancasila Education*, particularly the topic of diversity in our environment, which encompasses social, cultural, and tolerance values.

Pancasila Education serves as an educational vehicle to develop learners' moral and civic character through the practice of tolerance, cooperation, solidarity, and social justice (Hadi et al., 2023). The theme of diversity emphasizes the importance of recognizing differences among individuals and groups in society—be it in terms of ethnicity, religion, race, or customs. This content is essential in fostering inclusive and tolerant attitudes from an early age. Civic education also plays an important role in instilling the values of diversity and tolerance among students (Suwandi, 2018). However, for autistic students, understanding abstract and socially oriented concepts such as diversity can be particularly challenging. They require visual aids, concrete approaches, and engaging interactive media to fully grasp these concepts meaningfully.

One potential innovation to support the learning of autistic students is the use of interactive multimedia. In this context, the use of interactive multimedia emerges as an effective alternative solution. Interactive multimedia integrates visual, audio, text, and animation elements to create a more engaging and comprehensible learning experience—especially for students with visual learning preferences

and those who benefit from multisensory stimulation. The advantages of interactive multimedia include allowing students to learn at their own pace and readiness, offering patient virtual tutors that adapt to the learner's ability, providing immediate feedback, fostering technological literacy, and delivering novel learning experiences (Fenrich, 1997). Various studies have shown that interactive media can help autistic students improve focus, participation, and comprehension of complex subjects, including social values such as diversity (Alzrayer et al., 2014; Azman et al., 2020).

Multimedia incorporates various elements—text, sound, images, animation, and video—into an integrated system capable of creating more engaging and stimulating learning environments (Vaughan, 2004). Given these characteristics, interactive multimedia is believed to facilitate more effective information processing, enhance attention, and assist autistic students in understanding social diversity concepts, which often require concrete and visual approaches for better comprehension. Despite its great potential, the implementation of interactive multimedia for autistic learners still faces challenges such as limited resources, insufficient teacher training, and suboptimal media design tailored to individual needs. Hence, it is essential to conduct in-depth studies on the strategies for effectively utilizing interactive multimedia to improve autistic students' understanding of the diversity topic in their environment.

Previous studies have revealed that interactive multimedia in

special education contributes positively to students' engagement, motivation, and academic understanding. For instance, Hakim (2020) found that interactive multimedia motivates students to learn and makes it easier for them to understand lessons. Similarly, Maulidiyah (2020) demonstrated that interactive multimedia helps teachers deliver material effectively to students with special needs. Furthermore, Velinda et al. (2024) showed that the use of interactive media in learning activities for children with special needs enhances their creativity.

In the context of teaching diversity in the surrounding environment, interactive multimedia can clarify various forms of social differences—such as ethnicity, religion, culture, and traditions—in a concrete and comprehensible way for autistic students. Nevertheless, implementation challenges remain, including the lack of suitable media aligned with learner characteristics, the need for content adaptation, and teachers' limited competence in managing multimedia-based instruction. Therefore, further research is necessary to systematically examine the effectiveness, barriers, and optimization strategies for using interactive multimedia to enhance autistic students' understanding of diversity concepts.

This article aims to analyze the role of interactive multimedia in improving autistic students' understanding of the topic *diversity in our environment* and to identify supporting and inhibiting factors in its application. Through this study, it is expected that practical recommendations can be developed as a foundation for designing more

adaptive, inclusive, and effective learning programs for students with special needs.

Methods

This study employed a quantitative quasi-experimental design, specifically the *control group posttest-only design* (Creswell & Creswell, 2018). This design involves two groups: an experimental group and a control group, both of which were given the same posttest after different learning treatments. The control group participated in learning activities using interactive multimedia, while the experimental group engaged in learning without interactive multimedia.

The research subjects were six autistic students in the tenth grade at *Sekolah Menengah Atas Luar Biasa (SMALB) Bhayangkari 2 Gresik, Indonesia*. The purposive sampling technique was employed to select participants (Cozby & Bates, 2012). The selected subjects were autistic students who met specific inclusion criteria—namely, those who were capable of participating in the experimental activities and whose parents or guardians had provided consent. Each group consisted of students representing low, medium, and high comprehension levels, ensuring comparable characteristics across both groups.

The data collected in this study were quantitative, derived from posttest results. The research instrument used was a multiple-choice test, designed to assess students' understanding of the topic *diversity in our environment*. The test consisted of 10 items covering five key aspects of the topic:

(1) the concept of diversity,

(2) examples of diversity,

(3) positive impacts of diversity,

(4) negative impacts of diversity, and

(5) appreciating diversity.

Each aspect was represented by two questions.

The validity of the test items was determined using the Pearson correlation, and all items were found to be valid with coefficients greater than 0.754. The reliability test also indicated high reliability, with a Cronbach's Alpha value of 0.972 across the 10 items.

The data were analyzed using quantitative descriptive analysis to measure the effectiveness of interactive multimedia in enhancing students' understanding of the material. Given the small number of autistic participants (three students per group), no complex inferential statistics were applied. Instead, descriptive analysis was conducted to present the individual test results of each student after completing the learning activities and posttest.

Result and Discussions

After collecting and analyzing the research data, the findings are presented in Tables 1 and 2. These data were obtained after both groups completed their respective learning activities and took the posttest. The experimental group consisted of autistic students who participated in learning activities using interactive multimedia, whereas the control group learned without the use of interactive multimedia.

The test items represented all the learning materials that needed to be understood in the topic of tolerance. However, even-numbered items were designed to be more challenging than odd-numbered items, as they required a higher level of comprehension and were continuations of the preceding questions.

Based on the data obtained (Table 1), autistic students in the experimental group who learned through interactive multimedia achieved an average score of 80. Specifically, students with medium comprehension scored 80, those with high comprehension scored 90, and those with low comprehension scored 70. As illustrated in Figure 1, all autistic students in the experimental group answered all odd-numbered items (1, 3, 5, 7, 9) correctly. For even-numbered items (2, 4, 6, 8, 10), two of the students answered correctly, except for item 2, which was answered correctly by only one student.

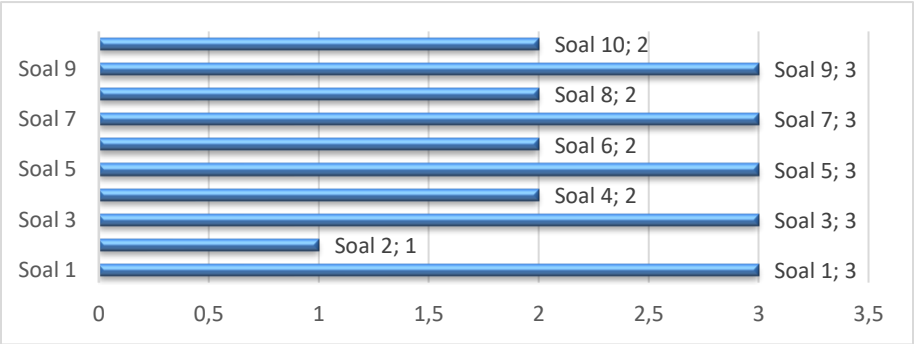
Conversely, as shown in Table 2, autistic students in the control group—who participated in regular learning without interactive multimedia—achieved an average score of 50. Students with low comprehension scored 40, those with high comprehension scored 60, and those with medium comprehension scored 50.

Table 1. Scores of Students in the Experimental Group

No.	Test Items										∑	K
	1	2	3	4	5	6	7	8	9	10		
Student 1	1	0	1	1	1	0	1	1	1	1	8	80
Student	1	1	1	1	1	1	1	1	1	0	9	90

2												
Student 3	1	0	1	0	1	1	1	0	1	1	7	70
Jumlah	3	1	3	2	3	2	3	2	3	2	AVG	80

Figure 1. Scores of Students in the Experimental Group



In Figure 2, the control group's performance shows that students answered all odd-numbered items (1, 3, 5, 7) correctly, except for item 9, which was correctly answered by only two students. Even-numbered items were mostly unanswered correctly, with only one student answering item 2 correctly, while items 4, 6, 8, and 10 were answered incorrectly by all. Each pair of odd and even items represented one complete aspect of understanding. Thus, full comprehension of an aspect was indicated when a student correctly answered both paired items.

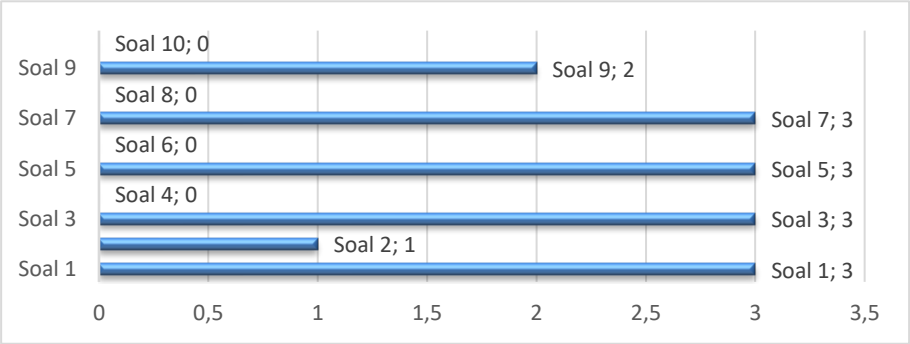
Based on the results, autistic students who engaged in learning activities using interactive multimedia demonstrated better conceptual understanding than those who did not. Their responses showed stronger comprehension across all test aspects, fulfilling the learning

objectives for the topic of diversity.

Table 2. Scores of Students in the Control Group

No.	Test Items										∑	K
	1	2	3	4	5	6	7	8	9	10		
Student 1	1	0	1	0	1	0	1	0	0	0	4	40
Student 2	1	1	1	0	1	0	1	0	1	0	6	60
Student 3	1	0	1	0	1	0	1	0	1	0	5	50
Score	3	1	3	0	3	0	3	0	2	0	AVG	50

Figure 2. Scores of Students in the Control Group



Inclusive education requires special attention because it includes learners with special needs. Its primary purpose is to ensure equal educational opportunities for all students, including those with disabilities (Kasman, 2020). Through inclusive education, students with special needs can develop social interactions and relationships with their peers. Among these, autistic students require particularly tailored instructional approaches due to unique characteristics in communication, social behavior, and cognition. Individuals with autism

often experience barriers in social communication and require methods that specifically target these skills (Fonda, 2023). Furthermore, autistic students frequently face academic difficulties that impact their ability to comprehend material (Wardany & Apriyanti, 2022). Consequently, teachers must design strategies that effectively enhance the learning comprehension of autistic students.

Figure 3. The Interactive Multimedia

One of the practical efforts teachers can implement is the use of interactive multimedia in classroom learning. Visual aids play a significant role in supporting communication, social skills, and comprehension for autistic students (Wardany & Apriyanti, 2022). The interactive multimedia applied in this study was previously developed and customized to meet the learning needs and characteristics of autistic learners. Six autistic students participated—three in the experimental group and three in the control group—each representing varying levels of comprehension (low, medium, high). Both groups were taught the

same material, but the learning medium differed. The experimental group learned with interactive multimedia, while the control group used conventional methods without multimedia.

After the learning sessions, a multiple-choice test consisting of 10 items was administered. The results indicated that students who learned using interactive multimedia achieved better comprehension mastery. All three students in the experimental group demonstrated satisfactory comprehension, with an average score of 80, whereas the control group achieved an average of only 50.

The findings clearly indicate the positive impact of interactive multimedia in enhancing autistic students' understanding of learning materials. Several aspects of interactive multimedia contributed to this improvement, including:

1. **Visual appeal**, which helped maintain students' attention and reduce distractions during learning;
2. **Background music**, which created a more engaging and stimulating learning atmosphere; and
3. **Narrated text with clear audio**, which supported literal comprehension and improved understanding of the content.

During the classroom implementation, autistic students showed high enthusiasm when using devices with interactive multimedia. They were more focused and responsive to teachers' explanations supported by multimedia materials.

These findings are supported by previous studies. For instance,

Saranani (2022) confirmed that **multimedia-based learning models** are highly effective in improving language development among autistic children. Similarly, Rohmah and Sujarwano (2018) demonstrated that interactive multimedia significantly enhances **literal reading comprehension** in autistic learners. Hakim (2020) also found that interactive multimedia improves learning motivation among autistic students due to its engaging audio-visual components. Moreover, Maulidiyah (2020) emphasized that interactive multimedia enables teachers in special education settings to deliver materials more effectively by increasing students' motivation, enthusiasm, and memory retention.

Overall, this study confirms that interactive multimedia serves as an effective pedagogical tool for autistic learners. It fosters engagement, strengthens focus, and enhances comprehension, making learning more meaningful and inclusive.

Conclusion

The results of this study conclude that autistic students are children with special needs who experience difficulties in communication, social interaction, and especially in understanding learning materials. Therefore, they require specific attention and appropriate instructional strategies to support their learning process. In inclusive schools, autistic students must receive tailored learning approaches that enhance their comprehension abilities.

Teachers play a crucial role in providing the necessary support and

adjustments to facilitate autistic students' understanding of academic content. One effective effort is the utilization of **interactive multimedia**, which offers essential features that align with autistic students' learning needs. The findings of this research demonstrate that interactive multimedia significantly improves autistic students' comprehension of learning materials.

Through the use of interactive multimedia, autistic students displayed greater enthusiasm, focus, and active engagement in the learning process. The integration of visual, auditory, and textual elements helps create a multisensory learning environment that enhances comprehension and motivation. Hence, interactive multimedia can be considered an effective and inclusive instructional medium for improving the understanding and learning outcomes of autistic students.

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