Indonesian Journal of Community and Special Needs Education

Journal homepage: http://ejournal.upi.edu/index.php/IJCSNE/

Developing Computational Thinking Questions for Upper Elementary Students with Mild Autism Spectrum Disorder

Dwi Novia Al Husaeni, M. Munir, R. Rasim, Yoga Budhi Santoso, Harsa Wara Prabawa, Jajang Kusnendar*

Universitas Pendidikan Indonesia, Bandung, Indonesia

*Correspondence: E-mail: dwinoviaalhusaeni14@upi.edu

ABSTRACT

This research developed questions to measure the improvement in computational thinking (CT) abilities of children with mild autism spectrum disorder (ASD). A quantitative approach was used in this research, with data collection through filling out expert judgment questionnaires by material experts and questions related to CT. The study results showed that the questions created were considered good for use in improving the CT abilities of children with ASD. The results of material expert validation showed an average value of 78.32%, which falls into the good category. In contrast, the question expert validation gives a perfect score, which confirms the validity of the questions created for the material and learning objectives used. The question instrument developed includes three main components of CT, namely decomposition, pattern recognition, and algorithm design, with a design that uses images and visual elements as well as simple instructions to facilitate understanding and involvement in children with ASD. This study bring a positive contribution to the development of more inclusive and effective CT learning for children with ASD.

ARTICLE INFO

Article History:
Submitted/Received 14 May 2024
First Revised 19 Jun 2024
Accepted 25 Aug 2024
First Available online 24 Aug 2024
Publication Date 01 Sep 2024

Keyword:
Autism spectrum disorder,
Computational thinking,
Elementary,
Instrument,
Student.

1. INTRODUCTION

Computational thinking (CT) is a way of thinking to solve problems by breaking them down into several stages that are effective, efficient, and comprehensive (Nisa & Mustofa, 2023). CT is considered important, especially in the current digital era. Therefore, CT is used as a basis for thinking and understanding complex problems that occur. CT ability is an important skill that every individual must have. This ability is not only relevant for those working in the information technology field but is also useful in various aspects of daily life. Therefore, it is important to integrate CT teaching into educational curricula, including basic education for children with autism spectrum disorder (ASD).

ASD, better known as autism, is a neurodevelopmental disorder that affects how a person communicates and interacts with things around him (Fitriana *et al*., 2024). Children with ASD often face challenges in conventional learning. However, research shows that many children with ASD have great potential in the areas of logic and problem-solving (Iuculano *et al*., 2014). With the right approach and tools, they can develop strong CT skills. Education tailored to their needs can help children with ASD to reach their full potential.

Many studies have been conducted regarding the ability of CT for children with ASD (Munoz *et al*., 2018; Arslanyilmaz *et al*., 2024; Castro *et al*., 2021; Kim *et al*., 2024). However, there are still few that discuss CT question instruments for children with ASD, especially mild ASD. Therefore, this research was carried out to develop CT questions for learning basic algorithms for children with ASD who are in the upper grades of elementary school.

This study comprehensively explained the questions to test the CT abilities of children with mild ASD, including CT components such as decomposition, pattern recognition, and algorithm design. This study can help educators in developing question instruments to improve CT abilities for children with ASD.

2. METHODS

A quantitative approach was used in this research. Data collection was carried out by creating an expert validation questionnaire. Apart from the questions, the material used to create the questions was also validated. The calculated values were then converted into several categories to find out whether the questions and materials created were valid and could be used or not. Conversion validation results are indicated in **Table 1**.

Table 1. Conversion of assessment scores to content validity categories (Renita *et al*., 2020).

Score Range	Categories
81-100	Very Valid
62-80	Valid
43-61	Fairly Valid
33-42	Invalid
< 33	Very Invalid

3. RESULTS AND DISCUSSION

3.1. Material Expert Validation Results

Validation of material experts involved three experts, namely 1 expert lecturer in the Computer Science Education (JK) study program, 1 expert lecturer in the Special Education study program (YG), and 1 expert teacher accompanying SD Hikmah Teladan (TA). The material validation instrument used was adapted from research conducted by Nisrina *et al*. in

DOI: http://dx.doi.org/10. 17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857

2022. The main aspects of this assessment are subject matter, auxiliary information, affective considerations, and pedagogy.

The validation process was carried out in two stages. **Table 2** shows the results of the first stage. Based on **Table 2**, several parts need to be improved from each component in the material validation questionnaire. Improvements made include learning scenarios. Before improvements were made, the learning scenarios listed in the teaching module were still general. However, after improvements were made, the learning scenario was made more specifically for learning children with autism. After the improvement results, the final value is obtained as shown in **Table 3**.

Data analysis in this expert judgment activity used a rating scale. The rating scale calculation was determined. After the data was obtained, the data was translated using an interpretation scale. **Figure 1** shows the results of the expert judgment categorization of stage 1 material, while **Figure 2** shows the results of the expert judgment categorization of stage 2 material.

The average result obtained was an increase in value from the previous 73.72 (stage 1) to 78.32 (stage 2). The average obtained from the results of the expert assessment of the material that has been carried out is that the material created in the form of teaching modules falls into the "Good" category.

Table 2. Results of expert judgment on stage 1 material.

No	Assessment Criteria	Number of Expert	Number of Items	Ideal Score	Results	Percentage (%)
1.	Subject matter (related to content or subject matter)	3	12	180	100	55.55
2.	Auxiliary (additional information such as introduction, instructions, summary, etc.)	3	7	105	88	83.80
3.	Affective considerations (related to how the product motivates student learning)	3	3	45	34	75.55
4.	Pedagogy (related to learning strategies, interactivity, evaluation, and quality of feedback)	3	5	75	60	80.00
	Average					**73.72**

Table 3. Results of expert judgment on stage 2 material.

No	Assessment Criteria	Number of Expert	Number of Items	Ideal Score	Results	Percentage (%)
1.	Subject matter (related to content or subject matter)	3	12	180	107	59.44
2.	Auxiliary (additional information such as introduction, instructions, summary, etc.)	3	7	105	92	87.62
3.	Affective considerations (related to how the product motivates student learning)	3	3	45	37	82.22
4.	Pedagogy (related to learning strategies, interactivity, evaluation, and quality of feedback)	3	5	75	63	84.00
	Average					**78.32**

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857

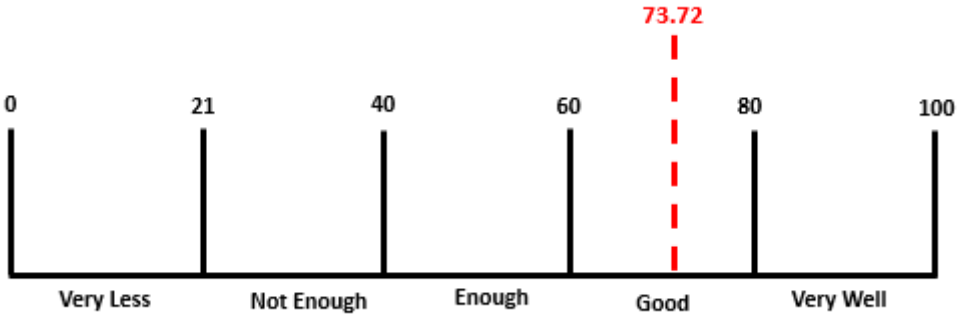


Figure 1. Results of expert judgment categorization of stage 1 material.

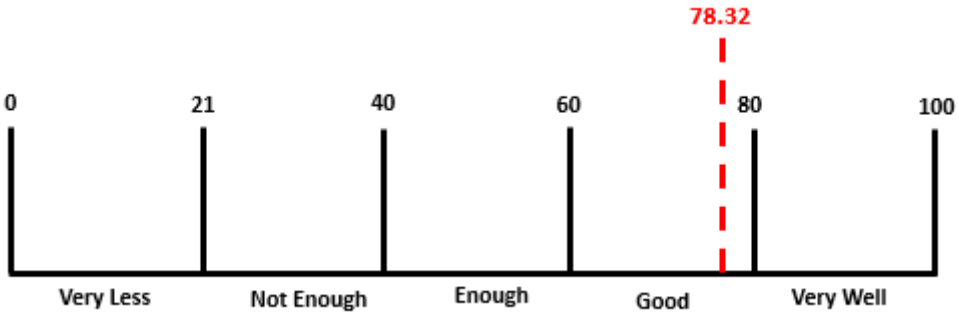


Figure 2. Results of expert judgment categorization of stage 2 material.

3.2. Expert Validation Results on CT Questions

Assessment of the content validity of the CT ability test instrument for children with mild ASD was carried out by three experts. The three experts come from various fields, namely a lecturer in the computer science education study program, a lecturer in the special needs education study program, and a teacher accompanying students with special needs. Assessment is carried out based on two main aspects, namely the suitability of the question items to the CT components being tested and the suitability of the question items to the learning objectives. The feasibility assessment is described in **Table 4**.

Table 4. Results of expert judgment validity test questions.

No.	Assessment Indicator	Number of Expert	Total Score	Ideal Score	Percentage (%)
1.	Correspondence of the question items to the CT components being tested	3	243	243	100
2.	Suitability of question items to learning objectives	3	243	243	100

Based on **Table 4**, the content feasibility aspect has a total score of 486 out of a maximum score of 486. This shows that 100% of the content eligibility criteria for the test instrument have been met and are classified in the very valid category. This assessment includes two main aspects, namely the suitability of the question items to the CT components being tested and the suitability of the question items to the learning objectives, both of which obtained a validity value of 100%. Thus, this test instrument was considered very valid by the experts

DOI: http://dx.doi.org/10. 17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857

who assessed it. **Figure 3** shows the scale of the results of the expert judgment on the questions that have been carried out, referring to the validity grouping (Renita *et al*., 2020).

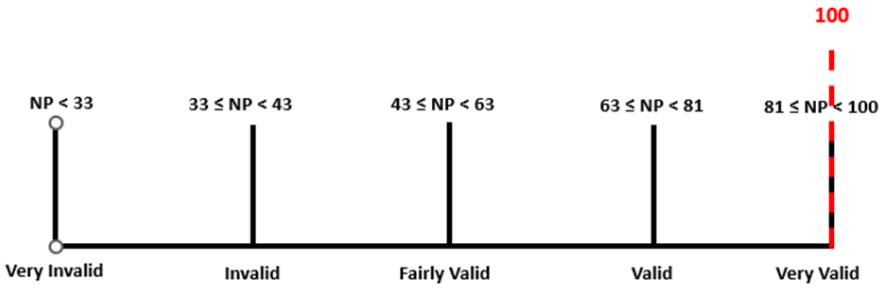


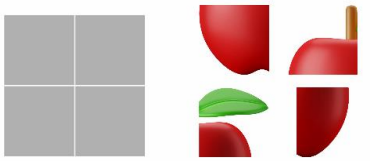
Figure 3. Results of expert judgment validity test questions.

3.3. Computational Thinking Question Form

From the validation results by experts, several question forms were obtained for the three CT components, namely decomposition, pattern recognition, and algorithm design which are shown in **Table 5**. The question forms can be implemented in puzzle or drag-and-drop games, dominated by pictures. The question instructions were made as simple as possible. This is done by the characteristics of children with mild autism, who tend to understand visual instructions more easily and require a simple and direct approach.

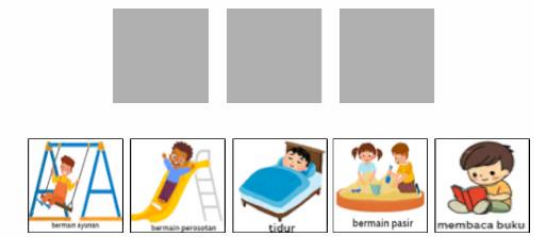
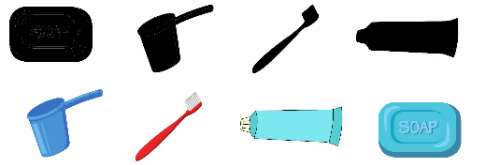
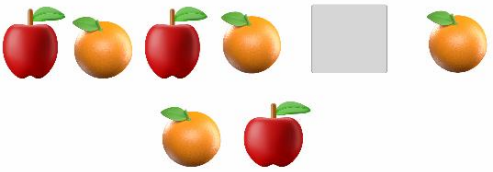
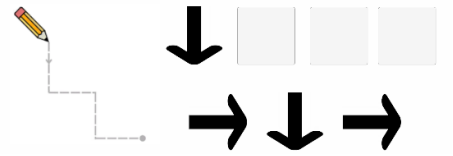
This opinion is in line with other research (Hayes *et al*., 2010), which states that children with ASD are more responsive to learning materials that use visual and interactive elements. They also emphasize the importance of clear, uncomplicated instructions to ensure optimal understanding. In addition, the use of interactive games, such as puzzles and drag and drop, can increase the involvement and motivation of children with ASD in the learning process (Hermawan *et al*., 2017). Thus, the form of questions that are dominated by pictures and simple instructions is expected to increase the effectiveness of CT learning for children with mild ASD.

Table 5. CT questions on basic algorithm concept material.

No.	Question	CT components
1.	**Task:** Arrange the pieces of the picture below to form an APPLE. **Guide:** Move and save each piece of image in the column provided! 	Decomposition
2.	 **Task**: The picture on the side shows Ayu playing with her friends. If Ayu plays on the playground, then what activities can Ayu do? **Guide:** Enter and save the appropriate image in the column provided!	Decomposition

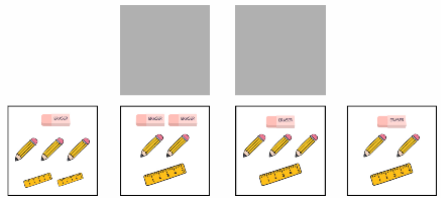
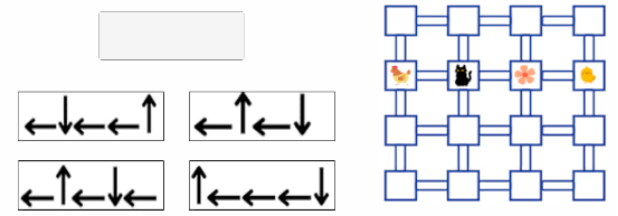
DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857

Table 5 (continue). CT questions on basic algorithm concept material.

No.	Question	CT components
		
3.	**Task**: In the bathroom, Budi can find various shapes of objects. Help Budi match the pictures of the shapes of existing objects! **Guide:** Enter and save the appropriate image in the column provided! 	Pattern Recognition
4.	**Task**: Pay attention to the rows of oranges and apples displayed. Fill in the blank column with the appropriate type of fruit. 1. If the previous fruit was an orange, then the next fruit is an apple. 2. If the previous fruit was an apple, then the next fruit is an orange. **Guide:** Move and save the letter image to the appropriate empty box. 	Pattern Recognition
5.	**Task**:  Thick the image on the left to make it look like the image on the right by arranging each symbol provided! **Gude:** Select the correct direction image. Then, save the image into an empty column! 	Algorithm Design
6.	**Task**: Order the steps for frying eggs below! **Guide**: Select and save the image into an empty column! 	Algorithm Design
7.	**Task:** Rani has 1 pencil case, but Rani's pencil case can only carry a maximum of 1 eraser, 3 pencils, and 1 ruler. The pencil case cannot hold more than 5 items in total but can hold less than 5 items. Rani wants to fill her pencil case. Help Rani choose the right combination. Thus, she can put it in her pencil case.**Guide**: Select and enter the appropriate image combination in the column provided!	Decomposition

DOI: http://dx.doi.org/10. 17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857

Table 5 (continue). CT questions on basic algorithm concept material.

No.	Question	CT components
8.	 **Task:** Your job is to deliver the chicks to the mother hen. However, during the trip, you must pay attention to the following conditions. If you see flowers along the way, collect them. If you see a cat while traveling, avoid it. **Guide:** Choose and enter the correct answer into the blank column! 	Algorithm Design

4. CONCLUSION

This research has succeeded in developing a valid and effective question instrument to measure and improve CT abilities in children with mild ASD. Validation by material experts and problem experts shows that the instrument developed meets good criteria and is by learning objectives, especially in teaching algorithms and programming, with a focus on basic algorithm concept material. The question instrument was built using a visual approach and simple instructions, which have been proven to facilitate understanding and engagement in children with ASD. Additionally, the use of visual elements and simple instructions can be an effective tool for educators in supporting inclusive learning and improving CT skills in children with ASD.

5. AUTHORS' NOTE

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

6. REFERENCES

Arslanyilmaz, A., Briley, M. L., Boerio, G. V., Petridis, K., and Ilyas, R. (2024). Assessing the efficacy of an accessible computing curriculum for students with autism spectrum disorders. *Multimodal Technologies and Interaction*, *8*(2), 11.

Castro, L. M. C., Magana, A. J., Douglas, K. A., and Boutin, M. (2021). Analyzing students' computational thinking practices in a first-year engineering course. *IEEE Access*, *9*, 33041-33050.

Fitriana, M. A., Alma'fiyah, E. F., and Anjani, F. I. (2024). The role of innovative edible straw and spoon in improving eating independence in children with autism spectrum disorder

(ASD). *Community Development Journal: Jurnal Pengabdian Masyarakat*, *5*(5), 8590-8598.

Hayes, G. R., Hirano, S., Marcu, G., Monibi, M., Nguyen, D. H., and Yeganyan, M. (2010). Interactive visual supports for children with autism. *Personal and ubiquitous computing*, *14*, 663-680.

Hermawan, D. P., Herumurti, D., and Kuswardayan, I. (2017). efektivitas penggunaan game edukasi berjenis puzzle, RPG dan Puzzle RPG sebagai sarana belajar matematika. *Jurnal Ilmiah Teknologi Informasi*, *15*(2), 195-205.

Iuculano, T., Rosenberg-Lee, M., Supekar, K., Lynch, C. J., Khouzam, A., Phillips, J., Uddin, L. Q., and Menon, V. (2014). Brain organization underlying superior mathematical abilities in children with autism. *Biological psychiatry*, *75*(3), 223-230.

Kim, M., Kim, J., and Lee, W. (2024). Enhancing computational thinking in students with autism spectrum disorder and intellectual disabilities: a robot programming approach. *International Journal of Developmental Disabilities, 2024*, 1-16.

Munoz, R., Villarroel, R., Barcelos, T. S., Riquelme, F., Quezada, A., and Bustos-Valenzuela, P. (2018). Developing computational thinking skills in adolescents with autism spectrum disorder through digital game programming. *IEEE Access*, *6*, 63880-63889.

Nisa, L. C., and Mustofa, H. (2023). Penguatan metode computational thinking untuk guru madrasah dalam rangka meningkatkan minat belajar siswa pasca pandemi covid-19. *Warta LPM, 2023*, 1-10.

Renita, A., Setyowati, E., Fauziah, A., and Purwanto, N. (2020). Pengembangan ensiklopedia tumbuhan paku sebagai sumber belajar keanekaragaman hayati. *Jurnal Biologi Dan Pembelajarannya (JBandP)*, *7*(1), 1-6.

DOI: http://dx.doi.org/10. 17509/xxxx.xxxx
p- ISSN 2775-8400 e- ISSN 2775-9857