The smart box: can help students with intellectual disabilities at elementary school inclusive?

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KEYWORDS	ABSTRACT
	The research addresses the limited availability of learning media supporting education for children with special needs, particularly intellectually disabled students. The study aimed to develop Smart Box media and evaluate its effectiveness in enhancing the learning of Indonesian and Science subjects for these children. Following the ADDIE model, the research employed a research and development (R&D) approach. Data collection included observation sheets, interview sheets, expert evaluations, and student questionnaire surveys. Media expert validation resulted in 83% validity, categorized as very valid, while content expert validation yielded 79%, categorized as valid. Student responses to the trial questionnaire indicated an 88% feasibility rating. The media's effectiveness in supporting learning was evidenced by pretest and posttest scores, which increased from an average of 58 to 86 after its use. In conclusion, the Smart Box media is deemed feasible, engaging, and effective for intellectually disabled students. This research contributes to the advancement of learning media for special needs education, providing a valuable resource for educators and stakeholders in enhancing the learning experience for these students.

Introduction

Inclusive education ensures that children with special needs receive an education comparable to that of typically developing children. This is crucial because, as per PPK-LK (Directorate of Special Education and Special Services), stated in the 1945 Constitution Article 31 paragraph 1 and the National Education System Law No. 20 of 2003 Article 32 regarding special education, every Indonesian citizen, regardless of developmental status, has an equal right to receive quality and appropriate education. The quality and suitability of education for children with special needs can be assessed through the quality of teachers and the facilities supporting their learning. In the field, based on the researcher's observations at Elementary School Sukowinangun 02, Magetan, which is an inclusive school, challenges remain regarding the availability of learning media that can support the education of children

with special needs. This observation is consistent with the findings of Maryanti *et al.*, which indicate that the provision of education for children with special needs has not been adequately addressed, and supporting facilities are still very limited (Maryanti *et al.*, 2021).

Learning media for children with special needs faces several limitations and challenges that impact the educational experience of these children (Kasongole & Muzata, 2020). It's crucial to acknowledge these issues to effectively address and improve the existing learning tools and resources. Many learning materials lack proper accessibility features for children with various disabilities, such as visual or hearing impairments. Inaccessible formats can hinder the ability of these children to engage with the content effectively. Learning tools often lack the flexibility to be customized according to the specific needs and learning styles of individual children (Deniz & İlik, 2021). The one-size-fits-all approach may not cater to the diverse needs of children with special needs. Limited representation of diverse abilities and experiences in learning materials may create a sense of exclusion for children with special needs. Inclusion of characters and scenarios that reflect a broader range of abilities is essential for fostering a sense of belonging.

Many existing learning tools may lack interactive elements that could enhance engagement and promote active learning for children with special needs. Interactivity can be especially beneficial for children with learning disabilities or attention disorders (Papanastasiou *et al.*, 2018). Some children with special needs benefit from multisensory learning experiences, but many educational materials do not incorporate this approach. Integrating visual, auditory, and tactile elements can enhance the learning experience for children with various disabilities. From the teacher, educators may not receive adequate training to effectively use and integrate assistive technologies and learning resources designed for children with special needs (Shevlin *et al.*, 2013). Lack of ongoing support and professional development opportunities can hinder the implementation of inclusive teaching practices. Addressing these limitations requires a concerted effort from educators, content developers, and technology providers to create inclusive, accessible, and adaptable learning environments for children with special needs (Donath *et al.*, 2023).

Challenges for children with special needs can arise across all categories, including those with intellectual disabilities. Intellectual disability refers to individuals with below-average intelligence, typically characterized by an IQ below 70 and a high level of dependence on others (Shree & Shukla, 2016). Children with intellectual disabilities often struggle with abstract thinking due to their cognitive limitations. Specifically, they face obstacles in imagining or thinking abstractly, which hinders their cognitive development (Hronis *et al.*, 2017). Recognizing this, teachers should provide learning media to facilitate the learning

process for children with intellectual disabilities. Learning media for children with intellectual disabilities should be capable of translating abstract learning materials into concrete and simplified formats, making it easier for these children to understand (Räty *et al.*, 2023). This is crucial because children with intellectual disabilities have below-average intellectual abilities compared to typically developing children of the same age, making it challenging for them to comprehend materials, instructions, and information. One alternative learning medium that can be provided for children with intellectual disabilities is the Smart Box learning media.

The Smart Box learning media is a resource containing thematic content for lower-grade Indonesian language and science classes, designed to be attractive and easy to use for children with special needs, especially those with intellectual disabilities. This media is expected to facilitate the understanding of educational materials for children with intellectual disabilities and enhance their interest in learning. This is supported by the research of Yuliastri *et al.*, which states that the Smart Box media can optimize children's cognitive abilities by training their memory and problem-solving skills, providing an enjoyable learning experience (Yuliastri *et al.*, 2021). Additionally, the research by Sukaryanti *et al.* suggests that the Smart Box media can enhance children's motivation to learn due to its colorful and visually engaging graphics, actively involving children in its use. Children with intellectual disabilities often struggle to retain lesson materials and can become disinterested in conventional teaching methods (Sukaryanti *et al.*, 2023). Therefore, the Smart Box media is considered feasible for development due to its visual appeal and direct engagement of children with intellectual disabilities in their school learning.

In assessing the feasibility of Smart Box media, a comprehensive evaluation was conducted based on several key criteria and parameters. Feasibility, in this context, encompasses the practicality and viability of implementing Smart Box media within diverse educational settings, especially for children with special needs. From an accessibility and inclusivity standpoint, Smart Box media ensures accessibility for learners with various disabilities, including features such as customizable interfaces, closed captions, and audio descriptions. Smart Box media aligns with existing educational standards, curricula, and frameworks, ensuring seamless integration into formal education systems. It is also compatible with existing educational technology infrastructures, ensuring easy integration into schools without significant technological challenges. Finally, regarding effectiveness and learning outcomes, Smart Box media's impact on learning outcomes was assessed, including improvements in engagement, knowledge retention, and academic performance for children with special needs.

Method

The study titled 'Development of Smart Box Media for Students with Intellectual Disabilities at Elementary School Inclusive Sukowinangun 02, Magetan' employed the research and development (R&D) method. This method was chosen to develop learning media for children with special needs. R&D is utilized to develop or validate products in education and learning (Hardiansyah & Wahdian, 2023). The researcher developed learning media in the form of a smart box, requiring validation to determine its feasibility before use. R&D methods are crucial in developing learning media, particularly for creating effective, inclusive, and innovative educational resources (Kurt, 2014). These methods enable a thorough understanding of the diverse needs of learners, including those with special needs, facilitating the development of customizable learning media that cater to various learning styles and abilities. The research was conducted at Elementary School Inclusive Sukowinangun 02, Magetan, with a population sample consisting of five students classified as intellectually disabled in the lower grades. Data collection techniques included observation and interviews. The researcher observed a 1st-grade class, which had five mildly intellectually disabled students. Subsequently, interviews were conducted with the 1st-grade teachers at the elementary school, providing information as data for developing media tailored to the needs of these intellectually disabled children. After collecting data from interviews and observations, data analysis was performed to assess the developed media. The assessment data were obtained from questionnaires filled out by media experts, content experts, and students who used the product. The questionnaire comprised answer alternatives rated on an interval scale of 1 to 5, as shown in Table 1.

Table 1   Linkert Scale (van Laerhoven *et al.*, 2004)

Alternative Answer	Score
Very good/ Very Feasible	5
Good/ Feasible	4
Pretty Good/Rather not Feasible	3
Not Good/ Not Feasible	2
Very not good/ very not Feasible	1

After obtaining the score for each question, it is added up and calculated to assess suitability in the form of a percentage, which can be briefly represented by the following formula, where P is Presentation, S is the total score obtained from research, and N is the maximum total score:

$$P = \frac{S}{N} \, x \, 100 \, \%$$
$$(1)$$

From the percentage results obtained, they are then matched to the criteria guideline table for determining media suitability according to Arikunto (Arikunto, 2019), see Table 2.

Table 2 Media Eligibility Criteria (Arikunto, 2017)

Eligibility Presentase	*Criteria*
81-100 %	Very Feasible
61-80%	Feasible
41-60%	Rather Not Feasible
21-40 %	Not Feasible
< 20%	Very not Feasible

The development research procedure in this study follows the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This model adapts the principles of learning design and focuses on the development of learning media (Januszewski & Molenda, 2013). The following is an explanation of the stages of the ADDIE development model as applied by the researchers:

1) Analysis

Researchers will conduct initial observations to determine the need for developing learning media for children with intellectual disabilities at SDN Sukowinangun 02, Magetan. This will involve identifying current gaps in the field and the desired outcomes (need assessment). Subsequently, the researcher will determine the necessary solutions to address the identified gaps (front-end analysis).

2) Design

Researchers initiated the determination of the design of learning media as a solution to the previously identified gaps. This involved establishing the start date for media production, designing the media sketch, identifying the tools and materials required for media development, and conducting an analysis of the materials to be included in the media.

3) Development

Researchers commence the creation of media products according to the design from the previous stage. Once the media is completed, it will be tested for suitability by media experts, who are lecturers specializing in learning media development in elementary schools, as well as practitioners/supervisors at Magetan inclusion schools, and material experts, specifically grade 1 teachers at Sukowinangun 02 Inclusion Elementary School, Magetan. Based on the results of testing by these experts, feedback in the form of suggestions and comments for improvement will be provided to ensure the media is suitable for implementation with students with intellectual disabilities.

4) Implementation

After refining the media in the previous stages, the researcher commenced implementation. The media was applied to children with intellectual disabilities, and initial evaluation was conducted based on student feedback during media usage.

5) Evaluation

The researcher evaluated the media after implementing it with students to assess its quality. Additionally, the researcher identified the strengths, and weaknesses, and provided recommendations/feedback for the developed media.

Results and Discussion

The development of Smart Box learning media for intellectually disabled children in this developmental research follows the ADDIE procedure. The first phase conducted was Analysis, during which the researcher identified the learning media needs of intellectually disabled children at Elementary School Inclusive Sukowinangun 02, Magetan. The researcher observed thematic Indonesian language and science lessons in grade 1 conducted by the teachers and then analyzed the lessons that were conducted. The analysis revealed that the teaching process primarily relied on worksheets and student textbooks without the use of supplementary learning media. The learning environment remained teacher-centered, with the teacher explaining the material and students subsequently working on exercises. This approach made the learning process appear dull and uninteresting to the students. They learned passively, fearing the teacher's reprimand, rather than being genuinely interested in learning. When the break bell rang, they would happily leave the classroom, indicating their lack of enjoyment and enthusiasm for learning, resulting in an ineffective learning process. Learning would be more successful if students responded to stimuli with happiness and satisfaction (Li *et al.*, 2020).

Further analysis included the examination of learning materials and objectives. Based on interviews with teachers, implementing combined Indonesian and Science lessons in grade 1 proved challenging for teachers to deliver effectively. Many students, especially those with intellectual disabilities, struggled to grasp the explained materials, leading to a shortfall in achieving the learning objectives. Based on the analysis results, the researcher determined the content to be included in the media, which focused on recognizing the human body parts, with the following objectives: (1) Students can name the parts of the human body; (2) Students can point out the parts of the human body; (3) Students can state the functions of some body parts and the human senses; (4) Students can explain how to care for body parts in their own words. During this stage, the researcher also analyzed the characteristics of the students. Grade 1 students, aged 7-8 years, are in the concrete operational thinking stage. According to Piaget, cognitive development during this age range allows for logical thinking, but there needs to be something concrete to guide the child's thinking. They cannot yet think abstractly, so if the teacher explains without clear illustrations during the learning process, it

will be challenging for the students to understand the teacher's message. Therefore, the availability of concrete learning media for elementary school students, especially for those with special needs, is crucial. Based on the analysis results, the research proceeds to the second stage, which is design. The researcher designed the Smart Box learning media to address the issues identified during the analysis stage. The design of the media begins with determining the timeline for media development, media design, identifying the necessary tools and materials, and preparing the content to be included in the media. The media will take the form of a large box that, when opened, reveals four different sides containing four materials presented engagingly. The media's design is illustrated in Fig. 1.
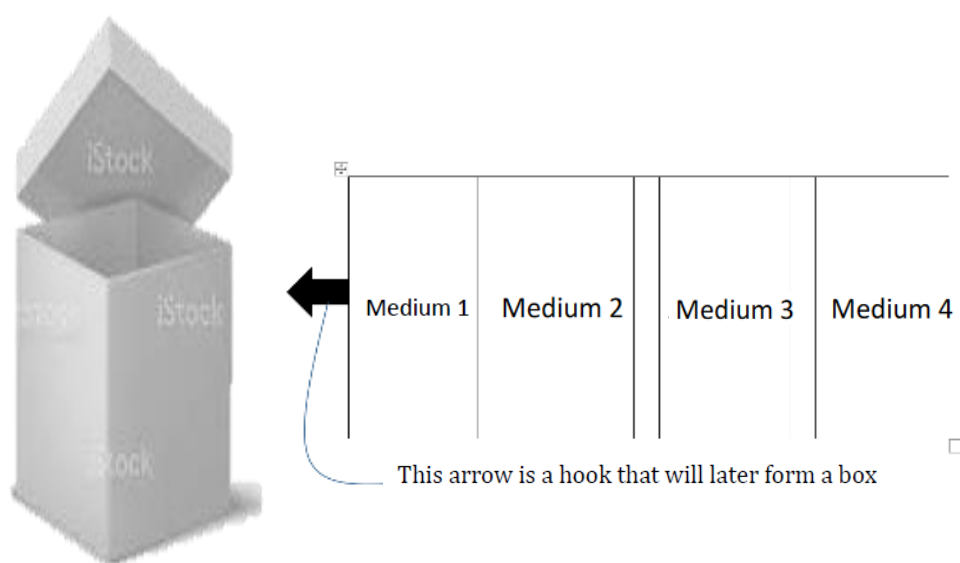

Fig 1. Design of the Smart Box Media with 4 content sides and varied materials

The third stage is development, where the researcher begins creating the media according to the design. The external appearance of the Smart Box media is shown in Fig. 2.

Fig 2. External Appearance of the Media

The external appearance is in the shape of a gift box featuring children's favorite cartoon characters, aimed at stimulating the curiosity of intellectually disabled students when the teacher brings the media into the classroom. When the gift is opened, it reveals a surprise through learning materials packaged with enjoyable game-based and visual methods for intellectually disabled students. When students become interested and motivated to learn, the subsequent learning process becomes more accessible and meaningful, ultimately leading to improved learning outcomes. This aligns with the research by Puspitarini *et al.* which states that students' motivation to learn, driven by their interest in the prepared learning media by the teacher, will enhance their learning outcomes (Puspitarini & Hanif, 2019). The internal appearance of the media when opened can be seen in Fig. 3.

Fig 3. Internal Appearance of the Smart Box Media

Subsequently, the completed media was evaluated for its suitability by media and content experts. The media expert was RPT, a lecturer in elementary school teaching media and a practitioner as well as a support teacher at the inclusive school in Magetan. RPT has a deep understanding of the characteristics of media suitable for children with special needs, including those with intellectual disabilities. Meanwhile, the content expert was a grade 1 teacher at State Elementary School Inclusive Sukowinangun 02, Magetan. The results of the validation by the media and content experts are presented in Table 3.

Table 3 Assessment Results by Media and Content Experts

Description	Percentage	Category
Media Expert Validation	83 %	Very Feasible
Content Expert Validation	79 %	Feasible

The score obtained from the media expert was 83%, categorized as 'Very Feasible.' The feedback and suggestions provided have been addressed as follows: (1) The material of the media box, initially made of cardboard, was replaced with plywood for added durability and strength; (2) On the first side of the media, many incomplete letters have been rectified; (3) On the second side of the media, color contrast and the shapes of people have been improved to accommodate all body shapes and facilitate understanding for intellectually disabled

children; (4) On the third side of the media, matching activities have been diversified instead of merely connecting lines with a marker, making them distinct from regular textbooks and more appealing to intellectually disabled children; (5) On the fourth side of the media, the paper puppet (*wayang*) material was replaced with acrylic-coated paper or other sturdier materials to prevent easy damage when used by intellectually disabled children.

The score obtained by the content expert was 79%, categorized as feasible without revisions, but there were suggestions and feedback. The content included in the media aligns with the intended learning objectives. A minor suggestion is to add information on what to avoid to maintain personal hygiene and how to maintain it, ensuring not only cleanliness but also the avoidance of factors that can harm sensory health. After revising the media based on the input from the media and content experts, the fourth stage involved implementing the media with 5 intellectually disabled students in grade 1, who were part of the inclusive class, to gather their responses to the media. The intellectually disabled students were guided to take turns trying the media, and with the teacher's assistance, they completed a trial questionnaire. The questionnaire results, filled out by the intellectually disabled students, yielded a percentage of 88% with the category 'Very Feasible,' indicating that, according to the intellectually disabled students, the media is highly engaging and supportive of their learning. The questionnaire consisted of 5 types of questions to be answered by intellectually disabled students by placing checkmarks on answer alternatives using a Likert scale, see Table 4.

Table 4 Recapitulation of Questionnaire Results from Intellectually
Disabled Students on the Smart Box

No	Assesment Indicators	Likert Scale					%
		1	2	3	4	5	
1.	Smart box makes it easier for me to study				2	3	92
2.	The smart box makes me enthusiastic about learning				1	4	96
3.	The smart box contains an attractive and clear visual display			1	1	3	88
4.	The smart box makes me actively involved in learning			1	3	1	80
5.	I'm more interested in learning about smart boxes				1	4	96
	Total						452
	Average Presentase						90
	Category						Very Feasible

The effectiveness of the media in supporting learning can be observed from the improvement in pretest to posttest results. Before introducing the media to intellectually disabled students, a pretest was administered. The pretest results are presented in the table, followed by the introduction of the Smart Box media to 5 intellectually disabled students in the inclusive class. They were asked to use the Smart Box and interact directly with the media. After using the media, the intellectually disabled students took a posttest. The results of the pretest and posttest are shown in Table 5.

Table 5 Comparison of Pretest and Posttest Results for Intellectually Disabled Students

Students Name	Pretest Score	Postest Score
Zulfikar	50	90
Julian	50	70
Fandi	70	90
Zahra	60	80
Prasdeva	60	100
Total	290	430
Average	58	86

From the research conducted on 5 intellectually disabled students, the pretest results were only 58, and after using the media, the average post-test score was 86. Therefore, the Smart Box media is considered effective in helping intellectually disabled students understand the material presented by the teacher. The score of 86 indicates that the students are able to meet the minimum passing grade (KKM) criterion of 75, as determined by Elementary School Inclusive Sukowinangun 02, Magetan. This is supported by the opinion of Ariesta, which states that media that can improve learning outcomes can be considered effective. The fifth stage is evaluation, where after all the stages are completed, an evaluation is conducted to determine the quality of the developed media (Ariesta, 2019). The research results have shown that the Smart Box media is feasible for use by intellectually disabled students, as indicated by the media expert's validation score of 83% and the content expert's score of 79%. The feedback from the validators has been implemented to further improve the media for implementation with intellectually disabled students. This is in line with the research conducted by Yuliastri *at al.,* (Yuliastri et al., 2021). In that study, the research concluded that the validation results from content experts obtained a percentage of 88.3% with the criteria "Valid," while the validation results from media experts obtained a percentage of 83.3% with the criteria "Valid," indicating that the media is feasible for use in learning. The Smart Box media for intellectually disabled students enhances their enthusiasm for learning and their interest in the subjects explained by the teacher. The questionnaire results indicate a score of 90%, signifying that the Smart Box media actively engages them in learning due to its attractive, varied appearance and its ability to be used for both learning and playing. Caroline also added that interactive games can capture the attention of intellectually disabled students (Koh, 2022). These modifications to the Smart Box media have greatly interested intellectually disabled students, enabling them to concentrate and find enjoyment in their learning.

Conclusion

The Smart Box media has been demonstrated as highly feasible, engaging, and effective for intellectually disabled students, as validated by media and content experts with scores of

83% and 79%, respectively. Student feedback further supported its efficacy, with 90% strongly agreeing on its benefits for learning. The media's impact was evident in posttest scores, which increased significantly from an average pretest score of 58 to 86. Recommendations for future research include exploring its application for other special needs children and continuing to refine its design based on expert feedback. The research and development (R&D) methods utilized in this study underscore the importance of addressing diverse educational needs, particularly for special needs learners. Moving forward, integrating diverse accessibility features, fostering interdisciplinary collaboration, leveraging emerging technologies, and incorporating multisensory elements will be key in advancing inclusive education practices and enhancing learning outcomes for all students.

References

Ariesta, F. W. (2019). Effectiveness of E-Learning Media to Improve Learning Outcomes Natural Science in Primary Schools. *Journal of Education Research and Evaluation*, *3*(2), 88–95. doi: 10.23887/jere.v3i2.17203

Arikunto, S. (2017). *Pengembangan instrumen penelitian dan penilaian program* (Vol. 53). Pustaka Pelajar.

Arikunto, S. (2019). *Dasar-dasar Evaluasi Pendidikan (edisi revisi)*. Bumi Aksara.

Deniz, S., & İlik, Ş. (2021). The Professional Competence of Teachers in Inclusive Practice and their Advice for Prospective Teachers. *Asian Journal of Contemporary Education*, *5*(2). doi: 10.18488/journal.137.2021.52.57.74

Donath, J. L., Lüke, T., Graf, E., Tran, U. S., & Götz, T. (2023). Does Professional Development Effectively Support the Implementation of Inclusive Education? A Meta-Analysis. *Educational Psychology Review*, *35*(1), 30. doi: 10.1007/s10648-023-09752-2

Hardiansyah, F., & Wahdian, A. (2023). Improving Science Learning Outcomes Through the Development of the Magic Card Box Learning Media. *AL-ISHLAH: Jurnal Pendidikan*, *15*(1), 823–833. doi: 10.35445/alishlah.v15i1.2711

Hronis, A., Roberts, L., & Kneebone, I. I. (2017). A review of cognitive impairments in children with intellectual disabilities: Implications for cognitive behaviour therapy. *British Journal of Clinical Psychology*, *56*(2), 189–207. doi: 10.1111/bjc.12133

Januszewski, A., & Molenda, M. (2013). *Educational technology: A definition with commentary*. Routledge. doi: 10.4324/9780203054000

Kasongole, G., & Muzata, K. K. (2020). Inclusive Education for Learners with Learning Disabilities in Two Selected Primary Schools of Kabwe-Zambia: A Myth or Reality. *International Journal of Humanities, Social Sciences and Education*, *7*(1), 1–16. doi: 10.20431/2349-0381.0701001

Koh, C. (2022). A Qualitative Meta-Analysis on the Use of Serious Games to Support Learners with Intellectual and Developmental Disabilities: What We Know, What We Need to Know and What We Can Do. *International Journal of Disability, Development and Education*, *69*(3), 919–950. doi: 10.1080/1034912X.2020.1746245

Kurt, S. (2014). Creating technology-enriched classrooms: implementational challenges in Turkish education. *Learning, Media and Technology*, *39*(1), 90–106. doi: 10.1080/17439884.2013.776077

Li, L., Gow, A. D. I., & Zhou, J. (2020). The Role of Positive Emotions in Education: A Neuroscience Perspective. *Mind, Brain, and Education*, *14*(3), 220–234. doi: 10.1111/mbe.12244

Maryanti, R., Nandiyanto, A. B. D., Hufad, A., & Sunardi, S. (2021). Science Education for Students with Special Needs in Indonesia: From Definition, Systematic Review, Education System, to Curriculum. *Indonesian Journal of Community and Special Needs Education*, *1*(1), 1–8. doi: 10.17509/ijcsne.v1i1.32653

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2018). Patient-centric ICTs based healthcare for students with learning, physical and/or sensory disabilities. *Telematics and Informatics*, *35*(4), 654–664. doi: 10.1016/j.tele.2017.09.002

Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, *4*(2), 53–60. doi: 10.29333/aje.2019.426a

Räty, L. M. O., Vehkakoski, T., & Pirttimaa, R. A. (2023). Tablet-Supported Self-Assessment in a Class for Students with Intellectual Disability. *Journal of Intellectual Disabilities*, *27*(2), 483–500. doi: 10.1177/17446295221088163

Shevlin, M., Winter, E., & Flynn, P. (2013). Developing inclusive practice: teacher perceptions of opportunities and constraints in the Republic of Ireland. *International Journal of Inclusive Education*, *17*(10), 1119–1133. doi: 10.1080/13603116.2012.742143

Shree, A., & Shukla, P. C. (2016). Intellectual Disability: Definition, classification, causes and characteristics. *Learning Community-An International Journal of Educational and Social Development*, *7*(1), 9–20. doi: 10.5958/2231-458X.2016.00002.6

Sukaryanti, A., Murjainah, M., & Syaflin, S. L. (2023). Pengembangan media pembelajaran kotak pintar keragaman di Indonesia untuk siswa kelas IV SD. *Jurnal Pendidikan : Riset Dan Konseptual*, *7*(1), 140–149. doi: 10.28926/riset_konseptual.v7i1.675

van Laerhoven, H., van der Zaag-Loonen, H., & Derkx, B. (2004). A comparison of Likert scale and visual analogue scales as response options in children's questionnaires. *Acta Paediatrica*, *93*(6), 830–835. doi: 10.1111/j.1651-2227.2004.tb03026.x

Yuliastri, N. A., Fitriani, R., & Ilhami, B. S. (2021). Pengembangan Media Smart Box Dalam Meningkatkan Kemampuan Kognitif Anak Usia 5-6 Tahun. *Jurnal CARE (Children Advisory Research and Education)*, *8*(2), 29–36.