Optimization of mathematical and language intelligence through Differentiation of Learning Object Materials Based on Multiple Intelligences

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Abstract— Differentiated Learning Object Material (DLOM) based on Multiple Intelligences is crucial for supporting the abilities of children with special needs (ABK). Children with special needs have unique abilities and learning styles, making conventional learning approaches often ineffective. The first urgency, namely DLOM based on Multiple Intelligences, is to provide opportunities for ABK to learn in a way that best suits their unique abilities. For example, children with kinesthetic intelligence can learn through physical activities, while children with visual-spatial intelligence can understand material through images or videos. The second urgency, namely the development of this DLOM, is very high because ABK often face challenges in accessing equal education. The objectives of this study are: 1) to design and develop differentiated DLOM based on MI and 2) to test the validity of DLOM based on MI. The validity of DLOM will be tested by design experts, learning/curriculum technology experts, and content experts. The development model used is the ADDIE model with a questionnaire as an instrument. The results of the validity test show that DLOM has very good validity in the media, design, and learning content aspects.

Keywords—multiple intelligences, learning, Differentiated

I. INTRODUCTION

Education for children with special needs (ABK) must be designed with a flexible and inclusive approach to meet their unique needs. According to UNESCO, teacher training for inclusive education is still minimal in many developing countries, including Indonesia. Learning tends to be uniform, making it less adaptable to the individual needs of students with special needs [1]. As a result, children with special needs struggle to follow lessons that are not suited to their learning styles, talents, and intelligence. Similarly, formal schools often lack supporting facilities, such as media, special learning aids, or physical accessibility, making it difficult for children with special needs to actively participate in learning activities [2], [3], [4]. Many learning media are not equipped with accessibility features such as alternative text, audio narration, or sign language. Some learning media are too abstract or visually complex, making it difficult for children with intellectual disabilities. Furthermore, children with sensory or motor disabilities can experience difficulties if digital media is not designed with Universal Design *for Learning (UDL*) principles.

Multiple Intelligences (MI) theory proposed by Howard Gardner [5]provides a framework for understanding that human intelligence is diverse and not limited to linguistic and logical-mathematical aspects alone. Gardner identified eight types of intelligence, such as linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist, all of which can be unique strengths for each individual [6]. In the context of education for children with special needs, MI-based learning becomes relevant because it takes into account the individual needs and learning styles of students [7], [8], [9], [10]. Gardner stated, "Intelligence is not a single ability, but a collection of potentials that can be developed in various ways according to the environment and individual experiences [5]." Children with special needs (ABK) require inclusive and adaptive strategies to accommodate their unique needs. One relevant approach is the differentiation of *Learning Object Materials* (LOM), namely the provision of learning materials designed according to the abilities, interests, and learning styles of individual students. This strategy helps ABK learn in a way that best suits their potential, while increasing engagement and learning success [11], [12], [13].

Differentiated instruction recognizes that students have varying backgrounds, readiness levels, and interests, and aims to meet those needs through tailored learning experiences. [14]In the context of special needs children with special needs, this means that learning materials must be tailored to support the development of their intelligence, social skills, and emotions. For example, special needs children with kinesthetic intelligence learn more effectively through physical activities, while those with visual-spatial intelligence understand material better through images or videos. The urgency of implementing LOM differentiation is also supported by the need to create inclusive learning. *Adapting instructional materials to the unique needs of exceptional learners is a fundamental principle of special education. [15]*LOM differentiation allows teachers to facilitate strength-based learning for students, thus helping students develop optimal cognitive, social, and emotional abilities [16], [17], [18]. In addition, LOM differentiation is in line with the goals of 21st-century education that emphasize personalized learning and the holistic development of student potential. With this approach, special needs children can gain more meaningful and empowering learning experiences, increasing their confidence to contribute to society. The problem formulation in this study is as follows.

(1) How is the design of DLOM based on *Multiple Intelligences* ?
(2) How is the validity of DLOM based on *Multiple Intelligences* based on *reviews by* media experts, learning design experts, and material experts?

II. LITERATURE REVIEW

Differentiated Instruction

Differentiated Instruction is a proactive, student-centered teaching approach in which teachers respond to students' individual learning needs to maximize their potential and growth.

This approach recognizes that each student is unique—from the way they receive information to the way they demonstrate understanding—so teachers need to provide variety and choice in the learning process. 3 Key Pillars of Student Learning Needs.

Differentiated instruction begins by mapping (analyzing) three key aspects of student needs:

Readiness: Refers to the extent to which students have mastered prerequisite concepts or skills. This includes: Is the student a Beginner, Advanced, or Expert in the topic? What do they already know and what do they not yet know?

Interest: Refers to topics, hobbies, or areas of interest that motivate students. Tapping into interests can increase engagement and the relevance of the material.

Learning Profile: Refers to a student's preferred learning approach or style, influenced by Learning Style: Visual (seeing), Auditory (hearing), or Kinesthetic (moving/doing).

Environment: Does the student prefer to study alone, in a group, in a quiet place, or while listening to music?

Multiple Intelligences

According to Gardner, intelligence is not a single ability, but rather a collection of different and independent modalities or intelligences that each individual possesses in unique combinations and strengths. 8 Types of Multiple Intelligences

Gardner initially identified seven intelligences and later added an eighth (Naturalist). Some publications also list a ninth (Existential) intelligence as a suggested addition.

1. Linguistic (Word Smart). The ability to use language and words, both orally and in writing. Sensitive to the meaning of words, sequence, rhythm, and sound of language. Writers, Journalists, Poets, Lawyers, Teachers.
2. Logical-Mathematical (Number/Reasoning Smart). The ability to think logically, analyze problems, perform mathematical calculations, and recognize patterns and cause-and-effect relationships. Scientists, Mathematicians, Programmers, Accountants, Engineers.
3. Visual-Spatial (Picture Smart). The ability to visualize objects, space, and understand the world in three dimensions. Easily understands maps, graphs, and enjoys visual arts. Architects, Painters, Graphic Designers, Pilots, Sculptors.
4. Bodily-Kinesthetic (Body Smart). The ability to use the whole body or body parts (hands, feet, etc.) to solve problems, create products, or express ideas. Has good motor coordination. Athletes, Dancers, Actors, Mechanics, Craftsmen.
5. Musical (Music Smart). The ability to recognize, create, and appreciate rhythm, pitch, melody, and musical structure. Sensitive to sounds in the environment. Musicians, Composers, Singers, Conductors, Acousticians.
6. Interpersonal (People Smart). The ability to understand, interact, and empathize with others. Sensitive to the feelings, motivations, and desires of others. Teachers, Counselors, Negotiators, Politicians, Leaders.
7. Intrapersonal (Self-Smart). The ability to understand oneself, including emotions, strengths, weaknesses, goals, and personal motivations. Possesses high self-awareness. Philosophers, Researchers, Theorists, Independent Entrepreneurs.
8. Naturalist (Nature Smart). The ability to recognize, classify, and understand the natural environment, including plants, animals, and natural phenomena. Biologists, Veterinarians, Farmers, Environmentalists, Climbers.

Learning Object Materials (LOM)

For a piece of material to be categorized as an effective Learning Object, it must meet several key characteristics:

1. Granularity (Small and Specific): An LO is highly specific, ideally focusing on a single learning objective or explaining a single concept. Its duration is also relatively short (e.g., 2 to 15 minutes).
2. Self-Contained: Each LO must be self-contained and understandable independently without the need for external context or supporting materials.
3. Reusability: This is the most important characteristic. An LO can be used repeatedly across different courses, contexts, or learning management systems (LMS).
4. Interoperability: An LO must be designed to function across different platforms and technologies. This is supported by Metadata (see point 5).

5. Has Metadata: Each LO is accompanied by a detailed description of the information (metadata). This metadata includes the learning objective, keywords, author, file format, and technology requirements. Metadata functions like a library catalog card, allowing the LO to be easily searched, managed, and used by the LMS.
6. Aggregatable: Small LOs can be combined or chained together to form larger learning units, such as modules, chapters, or entire courses.

III. MATERIALS AND METHODS

This research is a development research using the ADDIE model.(29) which consists of 5 stages, namely: 1) *analyze, design* , *development* , *implementation, and evaluation.* This selection was based on ADDIE's generic model, easy-to-follow flow, and the positive impacts of several studies using this model [20], [21], [22]. The activities carried out at each stage are as follows.

1. **Analysis Stage**
   At this stage, the following are carried out: (1) analysis of student characteristics, (2) analysis of curriculum, (3) analysis of infrastructure and learning resources. Analysis of student characteristics is carried out to determine the variety of intelligences, learning styles, and learning interests. Curriculum analysis is carried out to determine the curriculum in force in schools to ensure it is appropriate to the application. Analysis of infrastructure is related to the infrastructure that supports the use of the developed application. Analysis of learning resources is related to the availability of media and teaching materials used to develop *Multiple Intelligences* in schools.
2. **Design Stage**
   At this stage, the following activities are carried out: (1) mapping types of intelligence with types of learning strategies and media, (2) designing *flowcharts* , (3) designing storyboards, (4) designing LOM based on *Multiple Intelligences* .
3. **Development Stage**
   At this stage, the following is carried out: (1) realizing the design, (2) testing the validity of the DLOM by 3 experts, (3) revising the DLOM
4. **Evaluation Stage**
   The type of evaluation applied is formative evaluation. This evaluation aims to improve *output* at each stage of development [20], [21], [23], [24].

The DLOM is validated by content experts, instructional design experts, and instructional media experts. This expert validation is essential to obtain input for product refinement and to ensure the DLOM is suitable for implementation in learning. The instruments for testing the validity, practicality, and effectiveness of DLOM are presented in Table 1 below.

Table 1. Development Stages and Types of Instruments

Stage	Object	Instrument	Subject/Data Source
Analysis	- Curriculum - Student characteristics - Facilities and infrastructure	- Observation sheet - Interview guidelines	- Teacher - Student
Design	- DLOM Learning Design - User interface - User experience	- Questionnaire	- Media expert - Design expert - Content expert
Development	- DLOM - Learning Tools	- Questionnaire	- Media expert - Design expert - Content expert

The questionnaire used to validate and test the practicality of DLOM from the aspects of media, learning design, and content was adapted from [19], [23], [25]while the questionnaire used to test the practicality was adapted from [26], [27].

The data obtained from the validity and practicality tests of the application are classified into 2, namely qualitative data and quantitative data. Qualitative data consists of criticism and suggestions put forward by experts. This data is used to improve DLOM. Quantitative data in the form of scores were analyzed using descriptive statistical analysis techniques to determine the quality of the developed DLOM. The scores obtained were then summed and averaged. Next , converted become mark with use table *criterion-referenced evaluation* scale5 like served on Table 2 .

Table 2 **.** Conversion Score become Mark on Scale Five

Achievement Level (%)	Qualification	Information
90-100	Very good	No need to revise

75-89	Good	Slightly revised
65-74	Enough	Revised as needed
55-64	Not enough	Many things were revised
0-54	Very less	Repeatedly making products

IV. Result and Discussion

There are two research objectives achieved in this study, namely: 1) designing and developing MI-based DLOM differentiation, 2) testing the validity of MI-based DLOM. The DLOM was developed in stages using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). The results of each stage and their relationship to the research objectives can be explained as follows.

1. Design DLOM

At this stage, the following activities are carried out: (1) mapping types of intelligence with types of learning media and (2) designing *a flowchart* for presenting material in DLOM. The results of each stage can be explained as follows.

a) Mapping of Intelligence Types

Mapping intelligence types with learning media is crucial. The appropriateness of the intelligence type and media will influence the student's learning process. The following is a mapping of learning media based on intelligence types.

Table 1. Mapping of Intelligence Types with Media Types

Types of Intelligence	Types of Media or Learning Tools
Linguistic Intelligence (Verbal-linguistic Intelligence)	• Books and Texts: Textbooks, articles, essays, journals, and learning modules. • Audio: To listen to narration and stories. • Digital Dictionary or Thesaurus: Expands vocabulary and understands context. • Podcasts or Recorded Lectures: Help students understand the material through verbal explanations.
Logical-mathematical Intelligence	• Mathematical Simulation Software: Software like GeoGebra or Wolfram Alpha to solve mathematical problems. • Scientific and Graphing Calculator: For calculations and data analysis. • Logic or Puzzle Apps: Games like Sudoku or logic puzzles that train critical thinking skills. • Interactive Learning Media: Digital science experiment simulation tools. • Graphs and Charts: Visual tools for understanding data and statistics
Visual-spatial Intelligence	• Learning Videos: Animated or documentary videos that help visualize abstract concepts. • Concept Maps or Mind Mapping Tools: Applications like Coggle or MindMeister for designing diagrams and idea maps. • 3D Models and Maps: Physical or digital tools used to study geometry, geography, or science. • Graphic Design Tools: Software such as Adobe Photoshop or SketchUp for designing and creating visual works. • Presentation Slides (PowerPoint or Prezi): To organize ideas with visual support.
Bodily-kinesthetic intelligence	• Physical Teaching Aids: Anatomical models of the body, sports equipment, or mechanical props that allow for direct physical interaction. • Practical Tools: Laboratory or experimental equipment that allows students to interact directly with learning materials. • Motion Simulation (Virtual Reality/Augmented Reality): To simulate real environments or physical movement in learning. • Educational Games That Require Movement: Apps or games that incorporate physical activity such as Dance Dance Revolution or Wii Fit. • Interactive Whiteboard: Students can interact directly with the content using this tool.
Musical Intelligence	• Musical Instruments: Musical instruments such as piano, guitar, or drums used in

	learning. • Music Creation Apps: Software like GarageBand or FL Studio for creating and editing music. • Educational Songs or Jingles: The use of songs or rhythms to help remember lesson material. • Music Recording: An audio source containing a musical composition or sound recording for analysis. • Audio Editing Software: Applications for editing or analyzing audio files in a learning context.
Interpersonal Intelligence	• Online Discussion Forums: Platforms like Google Classroom or Moodle to collaborate and discuss with friends. • Collaborative Work Apps: Google Docs or Microsoft Teams that enable real-time group work. • Social Simulation Tools: Simulation games or role-play based learning tools that help understand social relationships. • Video Conferencing: Media such as Zoom or Skype for direct remote interaction. • Team-Based Educational Games: Games that require teamwork to complete tasks.
Intrapersonal Intelligence	• Self-Reflection Apps: Apps like Day One (journal app) or Habitica to track self-development and reflection. • Mindfulness and Meditation Tools: Apps like Headspace or Calm to help students focus and understand themselves. • Motivational and Self-Development Videos: Videos that motivate students to understand and achieve personal goals. • Personal Journal: A simple tool for recording self-reflection, thoughts, and emotional development. • Personality Questionnaires and Tests: Psychological testing tools that help students understand personal strengths and weaknesses.
Naturalist Intelligence	• Environmental Observation Tools: Microscope, binoculars, or camera to observe flora and fauna in nature. • Plant and Animal Identification Apps: Apps like iNaturalist or PlantSnap that help students recognize and understand the species around them. • Nature Documentary Videos: Documentary films that show life in the wild, natural phenomena, or certain ecosystems. • Environmentally Based Projects: Tools and materials for gardening or ecosystem research. • Map or Globe: Used to understand the geography and topography of the world or a particular area.
Existential	• Student worksheet • Inspirational videos

Source:[28], [29]

Of the various types of media identification, not all are developed for every type of intelligence, but those that are possible to be implemented in schools and schools have operational resources are selected.

b) Application Flowchart

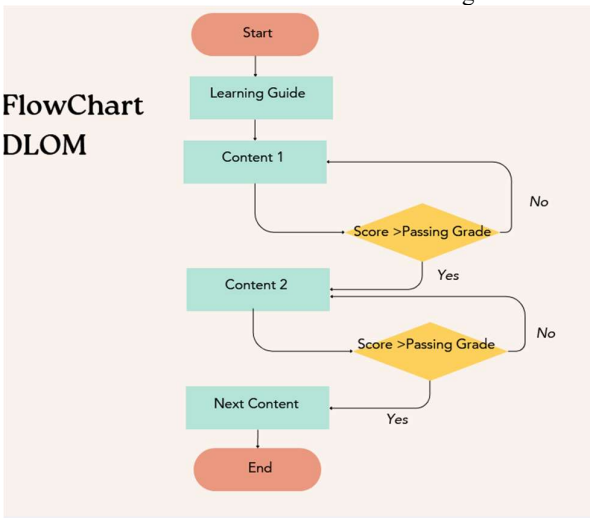

Figure 1. Digital DLOM flowchart

2. Development Stage

At this stage, the following were carried out: (1) realizing the design, (2) testing the validity of the DLOM by 3 experts, (3) revising the 1st DLOM, (4) testing the practicality by teachers (12 teachers) and students (12 students), (5) revising the 2nd. The following is a display of the DLOM according to the type of intelligence.

Figure 1. 3D Animation Video Media

This media is used to train students' intelligence in the fields of mathematical logic, spatial and kinesthetic.

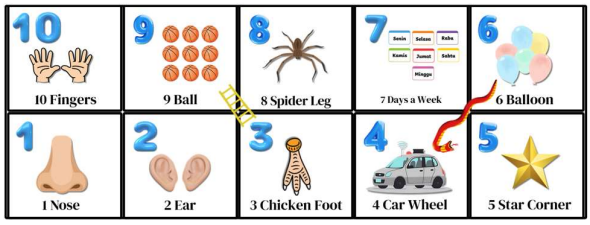

Figure 2. Digital Date Snake Media

Digital snakes and ladders are used to develop logical, kinesthetic, linguistic, intrapersonal, and interpersonal intelligence. This tool not only trains children's cognitive skills but also their motor skills.

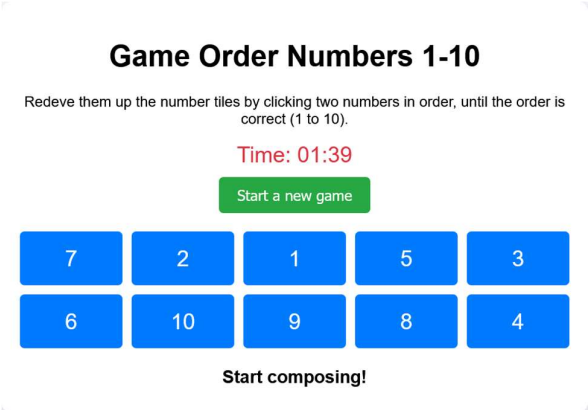

Figure 3. Interactive Multimedia (Game)
This media is used to develop students' naturalistic and interpersonal intelligence. It can present engaging simulations.

3. DLOM Validity Test

The DLOM validity test involved three experts: a learning design expert, a media expert, and a content expert. The test results are as follows.

Table 4. Learning Design Validity Test

Aspect	Score
Clarity of Competency Formulation	4
Competency formulation using operational verbs	5
Clarity of learning flow	5
Media types accommodate diverse intelligence	5
Accuracy of assessment techniques	4
Diversity of assessment techniques	5
Completeness of supporting elements (exercises and summaries)	4
Amount	32
Score	91.42
Category	Very good

Based on the table above, the validity of the Learning Design aspect of DLOM obtained a Very Good category.

Table 6. Validity Test of Learning Media Aspects

Aspect	Score
Visual display	4
Design consistency	5
Responsiveness	5
Ease of use	5
Clarity of media structure/flow	4
Interactivity	5
Use of color	5
Font type and size	4
Amount	37
Score	92.5
Category	Very good

Based on the table above, the validity of the Media aspect of the DLOM application is in the Very Good category.

Table 7. Validity of Content Aspects

Aspect	Score
Clarity of material	4
Relevance of material to learning objectives	4
Depth and Breadth of Material	5
Sequence of presentation of material	5
Accuracy of material	5
The connection of material with real life	4
Material Accessibility	5
Amount	32
Score	91.42
Category	Very good

A well-presented results section coupled with a convincing discussion will definitely prove the novelty and importance of your study. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Discussion

The learning media aspect of the Multiple Intelligences (MI)-based Learning Object Material (LO) development was awarded an excellent rating due to its ability to effectively accommodate the diversity of students' needs and learning styles. The following explains why this aspect was awarded an excellent rating.

DLOM accommodates Multiple Intelligences. Howard Gardner's Theory of [1]*Multiple Intelligences (* states that intelligence is not a single entity, but is divided into several specific modalities (e.g., linguistic, logical-mathematical, visual-spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalist). Learning media developed based on MI presents materials in various formats and activities (modules, videos, audio, interactive exercises) that directly target different intelligences. By providing diverse learning resources, this media ensures that each student has the opportunity to learn using their dominant intelligence, which in turn improves understanding and learning outcomes.

Learning Objectives (LO) are components of electronic learning materials designed for reusability , adaptability, and interactivity. LOs enable structured (sequential, curriculum-based) and clear presentation of material, often complemented by assessments. In the context of MI differentiation, LOs are used to build collections of different materials (texts, simulations, videos, etc.) that students can access according to their needs. MI-based LO integration creates a flexible and focused learning environment, significantly improving student learning outcomes.

Reviewed from the color aspect that DLOM has fulfilled the Readability & Contrast aspects . The text color must have high contrast with the background (for example black on white, white on dark blue). Having Consistency , namely consistent colors so that the media looks professional and not confusing. In addition, there is also the Psychological Meaning of Color that can affect emotions and learning focus (for example blue for calming, red to attract attention, green for freshness). The choice of color is in line with Multimedia theory [2].

From the visual aspect, the use of images supports the content, not merely decoration. The images used are high-resolution to avoid pixelation or blurriness. According to Mayer's theory, relevant images can enhance comprehension by connecting verbal and visual information [3], [4]. The images used are also not excessive or overly ornate, as they do not support the main message.

The learning design and development of *Learning Object Material* (LOM) based on Differentiation and Multiple Intelligences (MI) received the predicate "Very Good" because fundamentally this design is able to accommodate and optimize the diversity of potential and learning styles of students. The design has covered three important things: the objectives to be achieved, the method of achievement and assessment [5]. DLOM has fulfilled the Principles of Differentiated Learning. This design received the predicate very good because it integrates differentiated learning, the essence of which is to adjust the learning process to the needs of individual students.

The material is also presented at varying levels of difficulty or complexity, allowing students to start at a level that aligns with their prior knowledge and skills. Differentiated LOMs can offer a choice of topics or contexts that align with students' interests (for example, students with an interest in music can learn concepts through song lyrics or rhythms).

The material presented has **Absolute Accuracy.** The material is *free* **from misconceptions** and is scientifically/factually verifiable. **Up-to-Date.** The information and data presented are the most **recent** or relevant to current developments in science and technology . **Source Credibility:** The reference sources used are clear and credible, indicating that the material has gone through an expert validation process.

Optimizing the Potential of Multiple Intelligences. The integration of Multiple Intelligences (a theory by Howard Gardner) ensures that the material is not only focused on linguistic and logical-mathematical intelligence (which often dominate conventional learning), but also includes eight or nine other types of intelligence.

V. CONCLUSION

. The DLOM was systematically developed using the ADDIE model. Based on formative assessments of media, design, and learning content, it was categorized as Very Good. This indicates that the assessed learning media has met or even exceeded the expected quality standards to support the teaching and learning process. The DLOM is a highly effective and efficient tool in facilitating the learning process, providing quality content, and supporting educators in providing ongoing feedback from expert perspectives.

CONFLICT OF INTEREST

Please declare whether or not the submitted work was carried out with a conflict of interest. If yes, please state any personal, professional or financial relationships that could potentially be construed as a conflict of interest. If no, please add “The authors declare no conflict of interest”.

Author ContributionsThe first author conducted research and developed the DLOM product. The second author analyzed

and interpreted the data. The third author conducted the DLOM test on the three experts.

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REFERENCES

[1] I. K. Sudarma, I. M. Tegeh, and D. G. A. P. Prabawa, "Pemanfaatan Aplikasi Diagnostic Multiple Intelligences System (DMIS) Pada Guru-Guru SMP," in *Proceeding Senadimas Undiksha*, LPPM Undiksha, 2024.

[2] S. Haryono and Sri., "Evaluasi Pendidikan Inklusif bagi Anak Berkebutuhan Khusus (ABK) di Provinsi Jawa Tengah," *Jurnal Penelitian Pendidikan*, vol. 32, no. 2, pp. 50–57, 2016, doi: 10.15294/jpp.v32i2.5057.

[3] A. G. Wicaksono, O. Irmade, and Jumanto, "Analisis Kebutuhan Pengembangan Media Komik Kontekstual Dalam Pembelajaran Sains Sd," *Jurnal Komunikasi Pendidikan*, vol. 1, no. 2, p. 112, 2018, doi: 10.32585/jkp.v1i2.23.

[4] A. Asfiati and N. I. Mahdi, "Merdeka Belajar bagi Anak Kebutuhan Khusus di SLB Kumala Indah Padangsidimpuan," *KINDERGARTEN: Journal of Islamic Early Childhood Education*, vol. 3, no. 1, p. 59, 2020, doi: 10.24014/kjiece.v3i1.9620.

[5] H. Gardner, "The theory of multiple intelligences: Psychological and educational perspectives," 2018. [Online]. Available: https://api.elsevier.com/content/abstract/scopus_id/85074331494

[6] I. K. Sudarma, I. M. Tegeh, and D. G. A. P. Prabawa, "Pelatihan Micro-Content Berorientasi Multiple Intelligences Pada Guru-Guru SMP," in *Proceeding Senadimas Undiksha*, LPPM Undiksha, 2024.

[7] L. Deng, "Malus-metasurface-assisted polarization multiplexing," *Light Sci Appl*, vol. 9, no. 1, 2020, doi: 10.1038/s41377-020-0327-7.

[8] C. Caruntu, "A Concept of Multiple-lane Vehicle Grouping by Swarm Intelligence∗," 2019. doi: 10.1109/ETFA.2019.8868955.

[9] C. B. Shearer, "The neuroscience of intelligence: Empirical support for the theory of multiple intelligences?," 2017. doi: 10.1016/j.tine.2017.02.002.

[10] R. Setiawan, "Multiple intelligences-based creative curriculum: The best practice," *European Journal of Educational Research*, vol. 9, no. 2, pp. 611–627, 2020, doi: 10.12973/eu-jer.9.2.611.

[11] I. K. Sudarma, I. K. Suartama, I. G. B. Subawa, and D. G. A. P. Prabawa, "Meningkatkan Pengetahuan Multiple Intelligences melalui Diagnostic Multiple Intelligences System dengan Setting Belajar Proyek pada Guru SMP," *International Journal of Community Service Learning*, vol. 9, no. 1, Mar. 2025, Accessed: Apr. 10, 2025. [Online]. Available: https://ejournal.undiksha.ac.id/index.php/IJCSL/article/view/85188

[12] R. E. Mayer, *Thecambridge handbook of multimedia learning*. University of California, Santa Barbara, 2001.

[13] R. E. 2008. Mayer, *Learning and instruction*. New Jersey: Pearson Education, Inc, 2008.

[14] C. A. Tomlinson, *How to Differentiate Instruction in Mixed-Ability Classrooms*. Upper Saddle River, NJ: Pearson Education, 2001. Accessed: Apr. 10, 2025. [Online]. Available: https://www.scirp.org/reference/ReferencesPapers?ReferenceID=2464900

[15] D. P. Hallahan, P. C. Pullen, J. M. Kauffman, and J. Badar, "Exceptional Learners," *Oxford Research Encyclopedia of Education*, Feb. 2020, doi: 10.1093/ACREFORE/9780190264093.013.926.

[16] J. T. Leksut, J. Zhao, and L. Itti, "Learning visual variation for object recognition," *Image Vis Comput*, vol. 98, p. 103912, 2020, doi: 10.1016/j.imavis.2020.103912.

[17] D. Wiley, *Learning Object Design and Sequencing Theory*. USA: Brigham Young University, 2000.

[18] Kusnandar, "Pengembangan bahan belajar digital learning object," *Jurnal Teknodik*, vol. 17, no. 1, pp. 583–595, 2013, doi: https://doi.org/10.32550/teknodik.v0i0.69.

[19] R. M. Branch, *Instructional Design: The ADDIE Approach*. New York: Springer US, 2009. doi: 10.1007/978-3-319-19650-3_2438.

[20] I. Fitriyah, I. Wiyokusumo, and I. P. Leksono, "Pengembangan media pembelajaran Prezi dengan model ADDIE simulasi dan komunikasi digital," *Jurnal Inovasi Teknologi Pendidikan*, vol. 8, no. 1, pp. 84–97, Aug. 2021, doi: 10.21831/JITP.V8I1.42221.

[21] R. W. Arifin, H. Septanto, and I. Wignyowiyoto, "Pengembangan Media Pembelajaran Berbasis Video Animasi Dengan Model ADDIE Dalam Kegiatan Pembelajaran Blended Learning," *INFORMATION MANAGEMENT FOR EDUCATORS AND PROFESSIONALS : Journal of Information Management*, vol. 2, no. 2, pp. 179–188, Jun. 2018, Accessed: Dec. 18, 2023. [Online]. Available: http://ejournal-binainsani.ac.id/index.php/IMBI/article/view/946

[22] S. J. Yu, Y. L. Hsueh, J. C. Y. Sun, and H. Z. Liu, "Developing an intelligent virtual reality interactive system based on the ADDIE model for learning pour-over coffee brewing," *Computers and Education: Artificial Intelligence*, vol. 2, p. 100030, Jan. 2021, doi: 10.1016/J.CAEAI.2021.100030.

[23] W. Dick and L. Carey, *The systematic design of instruction*, 6th ed. Illinois: Scott, Foresman and Company, 2005.

[24] K. Martina, "Pengembangan Media Strip Comic Dengan Model Addie Pada Mata Pelajaran IPA Untuk Meningkatkan Motivasi Belajar Siswa Kelas V," *Jurnal Edutech Undiksha*, vol. 6, pp. 246–255, 2018.
[25] M. L. Fleming and W. H. Levie, *Instructional message design: Principles from the behavioral sciences*. Educational Technology, 1978. Accessed: Jan. 11, 2024. [Online]. Available: https://books.google.com/books/about/Instructional_Message_Design.html?hl=id&id=qr1u-iLqeE0C
[26] I. K. Sudarma and W. S. Y. Ilia, "Improving Children's Cognitive Ability Through Information Processing Theory-Based Digital Content," *International Journal of Elementary Education*, vol. 6, no. 1, pp. 118–126, 2021, doi: 10.23887/ijee.v6i1.
[27] I. Komang Sudarma, D. G. A. P. Prabawa, and I. K. Suartama, "The Application of Information Processing Theory to Design Digital Content in Learning Message Design Course," *International Journal of Information and Education Technology*, vol. 12, no. 10, 2022, doi: 10.18178/ijiet.2022.12.10.1718.
[28] H. Gardner, *Multiple intlegences. The theory in practice*. New York: Basic Books, 1999.
[29] McKenzie, *Multiple Intelligences and Instructional Technology - Walter McKenzie - Google Buku*. Washington, DC: Internasional Society For Technology in Education, 2005. Accessed: Sep. 30, 2024. [Online]. Available: https://books.google.co.id/books?id=-uhHXNQSwO8C&printsec=frontcover&hl=id&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
[30] H. Gardner, "Taking a multiple intelligences (MI) perspective," 2017. doi: 10.1017/S0140525X16001631.
[31] R. E. Mayer, *Multimedia learning*. New York: Cambridge University Press, 2021.
[32] L. Fiorella and R. E. Mayer, "Eight ways to promote generative learning," *Educ Psychol Rev*, vol. 28, no. 4, pp. 717–741, 2016, doi: 10.1007/s10648-015-9348-9.
[33] L. Fiorella and R. E. Mayer, "Principles for Reducing Extraneous Processing in Multimedia Learning," *The Cambridge Handbook of Multimedia Learning*, pp. 185–198, Nov. 2021, doi: 10.1017/9781108894333.019.
[34] Patricia L. Smith and Tillman J. Ragan, *Instructional Design*. Oklahoma: Wiley, 1993.