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DEVELOPMENT OF ARTICULATE STORYLINE 360 MEDIA TO EXPLORE HOTS ACCORDING TO BROOKHART ON COMPARATIVE MATERIAL

Yulita Gustiani[1]*, Nani Ratnaningsih[2] , Sri Tirto Madawistama[3]
[1, 2, 3] Siliwangi University, Jln. Siliwangi No. 24, Tasikmalaya 46115, West Java, Indonesia
*Email: gustianiyulia21@gmail.com

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ABSTRACT

This study aims to describe the development procedure and test the effectiveness of the *Articulate Storyline 360 learning media* on comparative material, as well as to analyze the improvement of students' *Higher Order Thinking Skills* (HOTS) based on the Brookhart framework. The method used is research and development (R&D) with the *Multimedia Development Life Cycle* (MDLC) model which includes six stages: *Concept*, *Design*, *Material Collecting*, *Assembly*, *Testing*, and *Distribution*. The subjects of the study consisted of students who were selected purposively. The instruments used included HOTS tests, observation sheets, and questionnaires to measure the effectiveness of the media. The results of the study showed that the learning media developed through the MDLC stages were effective, with a significant increase in students' posttest scores compared to the pretest. This media has been proven to significantly improve students' understanding of concepts and HOTS abilities, so it is recommended for widespread use in mathematics learning to support the development of higher-order thinking.

This study aims to describe the development procedure and test the effectiveness of the *Articulate Storyline 360* instructional media on comparative topics, as well as analyze the improvement in students' Higher Order Thinking Skills (HOTS) based on Brookhart's framework. The research method used is research and development (R&D) with the *Multimedia Development Life Cycle* (MDLC) model, which includes six stages: *Concept*, *Design*, *Material Collecting*, *Assembly*, *Testing*, and *Distribution*. The subjects of the study were students selected purposively. The instruments used included HOTS tests, observation sheets, and questionnaires to measure the effectiveness of the media. The results show that the instructional media developed through the MDLC stages was effective, with a significant increase in students' post-test scores compared to pre-test scores. The media significantly improved students' understanding of the comparative concepts and their HOTS, making it recommended for widespread use in mathematics education to support higher-order thinking development.

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1. INTRODUCTION

In the 21st century, Higher Order Thinking Skills (HOTS) have become a fundamental requirement across various fields, including Human Resource (HR) management and education. HOTS encompass critical thinking, creativity, and problem-solving skills, which are essential for navigating the complexities of the modern world. In the HR context, these skills are crucial for adapting to change, particularly in upskilling and reskilling the workforce to keep pace with technological advancements and labor market dynamics (Ruíz-Valdés, 2023). Furthermore, education increasingly emphasizes HOTS development, as these skills contribute to better decision-making and problem-solving in professional settings (Akhvlediani et al., 2023).

Motivation plays a crucial role in HOTS development, as motivated individuals are more likely to engage in continuous learning, enhance their creativity, and improve their collaboration skills—key aspects of effective HR practices (Thanyaphongphat et al., 2023). However, not all HR professionals inherently possess HOTS, making continuous training and development essential to ensure these competencies are evenly distributed within organizations, enabling them to address modern challenges effectively.

HOTS are vital in education as they enable students to analyze, evaluate, and create effective solutions to complex problems. These skills include analytical, evaluative, and creative thinking, which form the foundation of problem-solving and decision-making (Nisa, 2023; Sirad & Arbain, 2023). Resnick (2017) highlights that HOTS involve "reflective thinking," allowing students not only to absorb information but also to evaluate and develop it into new ideas.

In Indonesia, HOTS have become the basis for the Minimum Competency Assessment (AKM) and Character Survey (SK), aimed at improving education quality (Salleh & Lestari, 2020; Adawiyah, 2024). Research indicates that 79% of reading literacy questions in the AKM require high-order thinking (Mukhlis et al., 2023). However, implementing HOTS-based learning faces numerous challenges, particularly in shifting from routine, lecture-based learning to more dynamic, project-based approaches (Wahyudi, 2021).

One of the primary obstacles in implementing HOTS is the dominance of traditional lecture methods in schools, such as at SMP YPI Al-Huda, where a limited number of teachers and inadequate learning facilities hinder the adoption of HOTS-based teaching (Mathematics Teacher, 2023). Additionally, a lack of teacher understanding of HOTS and limited resources further impede its effective implementation (Jazilurrahman, 2023). To overcome these challenges, strategies such as teacher training, the adoption of innovative teaching models, and the development of HOTS-based assessments are necessary (Murtopo et al., 2023; Mukhlis et al., 2023).

Integration of technology in education has emerged as a key solution for improving HOTS among students. Interactive media, such as Articulate Storyline 360, has been shown to significantly enhance student engagement and creativity, positively impacting the development of critical thinking and problem-solving skills (Gampala, 2023). Additionally, technology supports personalized learning, allowing students to learn at their own pace and in their preferred style (Kumar, 2023).

Furthermore, innovative teaching approaches such as project-based learning and gamification foster student independence and collaboration in problem-solving (Gampala, 2023; Verbivskyi, 2023). However, challenges such as the digital divide and resistance to change must be addressed to ensure equitable access to educational technology (Kumar, 2023).

While technology offers various benefits in enhancing HOTS, it is essential to balance its use with traditional teaching methods to ensure a holistic learning experience. Ongoing professional development for educators is also crucial to effectively integrate technology into the curriculum and maximize its potential in fostering HOTS (Kumar, 2023).

2. METHODS

The development of interactive learning media through Research and Development (R&D) methods, particularly using the Multimedia Development Life Cycle (MDLC) model, has shown significant potential in improving educational outcomes. This approach ensures that the media produced is not only engaging but also effective in meeting educational needs. The MDLC model consists of several key stages. The Concept stage involves generating initial ideas based on educational needs to ensure relevance to the target audience. The Design stage includes detailed planning of the media's structure and content, often incorporating expert feedback for refinement (Juistha, 2023). The Material Collecting stage involves gathering resources and materials necessary for the media while aligning with educational standards (Umayah et al., 2023). The Assembly stage is the actual development process, integrating various elements into a cohesive product (Tanjung et al., 2023). The Testing stage involves rigorous evaluation by experts and end-users to assess usability and effectiveness, often leading to iterative improvements (Wijayanto et al., 2023; Sofia et al., 2023). Lastly, the Distribution stage ensures that the finalized media is accessible for teachers and students in educational settings (Tanjung et al., 2023).

Research has demonstrated that interactive learning media significantly enhances student learning outcomes. For instance, one study showed an increase in average test scores from pre-test to post-test by 88% when using interactive media (Wijayanto et al., 2023). Additionally, user feedback has been overwhelmingly positive, with expert evaluations rating the media's quality highly, often above 90% (Wijayanto et al., 2023; Juistha, 2023). Despite the benefits of the MDLC model, certain challenges must be considered, such as the need for continuous updates to keep pace with technological advancements and evolving educational needs. This highlights the importance of ongoing research and adaptation in the development of educational media.

The research subjects included mathematics teachers and eighth-grade students (Class VIII-C) from SMP YPI Al-Huda, Tasikmalaya City. The selection was based on representational principles and direct involvement in the mathematics learning process.

According to Sugiyono (2012), selecting relevant research subjects is crucial for external validity, ensuring that study results can be generalized to a broader population. Mathematics teachers were chosen due to their key role in evaluating the effectiveness of the media. Meanwhile, Class VIII-C students were selected as they were studying the topic of proportionality, which was the focus of the developed media.

A comprehensive data collection approach was employed to enhance the validity and reliability of the findings on the effectiveness of the learning media. The study integrated interviews, validation questionnaires, student response surveys, and field trials to provide a holistic analysis of the media's impact on mathematics education. Interviews with mathematics teachers were conducted to identify their needs and assess the media's effectiveness in delivering complex concepts, with teachers providing critical qualitative insights for improvement (Aulia et al., 2023). Validation questionnaires were used to evaluate the media's design, interactivity, and content through assessments by subject matter and media experts, who assigned high validation scores (Kartika & Arini, 2023). A student response questionnaire, using a Likert Scale, measured students' attitudes toward the media in terms of engagement and usability, showing positive feedback with an average practicality score of 81.4% (Agung, 2023). Field trials were conducted in real classroom settings to assess the strengths and weaknesses of the media, revealing significant improvements in students' understanding of mathematical concepts (Rosidah & Ikram, 2023). While this mixed-method approach strengthens the research, potential biases in qualitative data and limitations in self-reported measures from students and teachers should be considered.

The development and validation of interactive learning media are essential for enhancing students' higher-order thinking skills (HOTS) in mathematics education. This process involves expert evaluations, student feedback, and adherence to structured development models. The media validity analysis ensures quality through expert validation, with studies reporting high validity ratings, such as 96% for 3D animation media (Afifuddin et al., 2023) and 81% for animated video media (Fajriati & Putra, 2023), confirming that the developed media meets educational standards. The student response analysis provides descriptive insights into media effectiveness. For example, interactive media developed using Articulate Storyline received a perfect score in practicality and effectiveness, indicating strong student engagement and learning benefits (Setiawani & Prihandini, 2023). The MDLC analysis ensures a structured development process. In the Concept stage, the media is designed to enhance HOTS for eighth-grade students (Fajriati & Putra, 2023). The Design stage incorporates active learning principles (Sari et al., 2023). The Material Collecting stage utilizes multimedia elements to support learning (Salshabila et al., 2023). The Assembly stage involves development using interactive tools such as Articulate Storyline (Setiawani & Prihandini, 2023). The Testing stage includes expert and student evaluations to confirm feasibility (Afifuddin et al., 2023). Finally, in the Distribution stage, validated media is implemented in classrooms (Fajriati & Putra, 2023). While interactive media proves effective, some educators emphasize the continued relevance of traditional methods, particularly for foundational mathematical skills. A balanced integration of both interactive and traditional approaches may yield the best learning outcomes.

To see the level of eligibility of learning media from expert validation data, the researcher provided validation sheets to material experts and media experts. To see and present in graphic form the results of the student response questionnaire to the learning media used, then the results of the questionnaire were calculated and the categories were determined and described. The student response questionnaire was measured using a Likert Scale with five answer choices, namely as follows:

Table 1 User Response Questionnaire Score Categories

Score	Category
5	Very good
4	Good
3	Enough
2	Not enough
1	Very less

To determine the interpretation, the following steps are carried out (Sundayana, 2014):

(a) Determine the maximum score (S_{max})

S_{max} = number of questionnaire items ×/ number of respondents ×5

(b) Determine the minimum score (S_{min})

S_{min} = number of questionnaire items ×/ number of respondents ×1

(c) Determine the range

Range = maximum score – minimum score

(d) Determine the class length (p)

$$p = \frac{rentang}{banyak\ kategori}$$

(e) Determining the response scale

Table 2 Interpretation of Response Scales

Total Score (ST)	Interpretation
$Smin \leq ST < Smin + p$	Very ugly
$Smin + p \leq ST < Smin + 2\ p$	Bad
$Smin + 2\ p \leq ST < Smin + 3\ p$	Enough
$Smin + 3\ p \leq ST < Smin + 4\ p$	Good
$Smin + 4\ p \leq ST < Smaks$	Very good

Articulate Storyline 360 media on *Higher Order Thinking Skills* according to Brookhart based on the results of *the effect size (ES) test* using the Cohen, Manion, & Morrison (2007) formula as follows:

$$ES = \frac{\text{mean of posttest} - \text{mean of pretest}}{\text{standard deviation of pretest}}$$

The effect size calculations are interpreted using the classification according to Cohen, Manion, & Morrison (2007) in the following table.

Table 3. Effect Size Classification

The magnitude of *the Effect Size* (ES)	Interpretation
0 – 0.20	*Weak effect*
0.21 – 0.50	*Modest effect*
0.51 – 1.00	*Moderate effect*
> 1.00	*Strong effect*

Distribution (storage) at this stage the researcher stores the media in ZIP format which can then be used offline. The extracted ZIP file contains media that can be used by opening the file with the file name "story" with the "chrome" logo. At this stage the researcher also adds evaluation materials for the development of finished products to make them better. The results of this evaluation can be used as input for the *concept stage* on the next media .

2. RESULTS AND DISCUSSION

2.1. Results

The results of this research and development produced an interactive learning media product using Articulate Storyline 360 in the form of an application that can be used offline on a PC or laptop. This media is designed to explore Higher Order Thinking Skill (HOTS) according to Brookhart in students. This product is declared to be of high quality and suitable for use in learning. The research and development process was carried out using the MDLC (Multimedia Development Life Cycle) model developed by Luther Sutopo. The following is the procedure for developing Articulate Storyline 360 media to explore HOTS according to Brookhart.

1. **Concept Stage**
   This stage aims to determine the development objectives and identify the target audience. In this case, the development of Articulate Storyline 360 media is aimed at grade VII junior high school students in semester 2 who implement the 2013 Curriculum. This media is interactive, with a menu that allows students to interact directly with the material. The media includes learning materials, sample questions and discussions, and practice questions, all of which are designed to explore students' high-level thinking skills (HOTS), especially in comparative material.
2. **Design Stage**
   At this stage, media specifications are created, including project architecture, appearance, and material requirements. The development of Articulate Storyline 360 media is designed using *a flowchart* to describe the flow of interaction in the media. In addition, *a storyboard is also created* as a visual

guide in application development, which describes each interactive element and how to use it.

3. **Material Collection Stage (Material Collecting)**
   At this stage, the materials needed for media development are collected. The materials collected include learning materials on comparison, sample questions and discussions, practice questions, and quizzes related to comparison material. All of these materials are arranged to ensure that the media can be used effectively in learning and support students' HOTS abilities.
4. **Assembly Stage**
   This stage is the process of creating all objects and media materials according to the previously designed design. Each media element, including text, images, and interactive features, is programmed and assembled into one application that can be run offline. This process follows the steps that have been set in the design and *storyboard stages*.
5. **Testing Phase**
   Testing was conducted by involving material experts, media experts, and teachers and students as end users. Testing included validation of learning materials and questions used in the HOTS test, which had been designed based on HOTS indicators according to Brookhart. In addition, pretests and posttests were conducted on students to measure the effectiveness of the media in improving high-level thinking skills. A summary of the results of the validation of materials, questions, and learning media referring to HOTS indicators can be seen in Table 4.

Table 4 Summary of Validation of Materials, Tests, and Learning Media

Validation Types	Validators	Validation Date	Information
Material	V1	August 2, 2023	Valid Material
	V2	August 2, 2023	Valid Material
Test	V1	August 22, 2023	Valid Test
	V2	August 22, 2023	Valid Test
Media	V1	September 11, 2023	Valid Media
	V1	September 25, 2023	Valid Media

There are improvements in the sub-chapter of the material on the comparison of two quantities. The improvements are the conformity of the images displayed and the statements contained in the learning material on the sub-chapter of the material on the comparison of two quantities. Improvements to the learning material and the results of improvements to the material on the sub-chapter of the comparison of two quantities can be seen in Figure 1 below.

Figure 1 Photo Improvement on Material

Based on the media validator's suggestion, the following are the results of *the font improvements* that have been corrected. The improvements can be seen in the following figure 2.

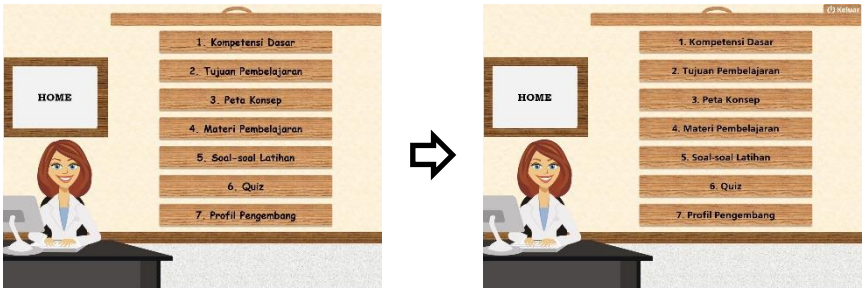

Figure 2 *Font* improvements in Learning Media

The next improvement is the menu form suggested by the validator so that the menu button form on the learning material page is elongated. Improvements can be seen in Figure 3 below.

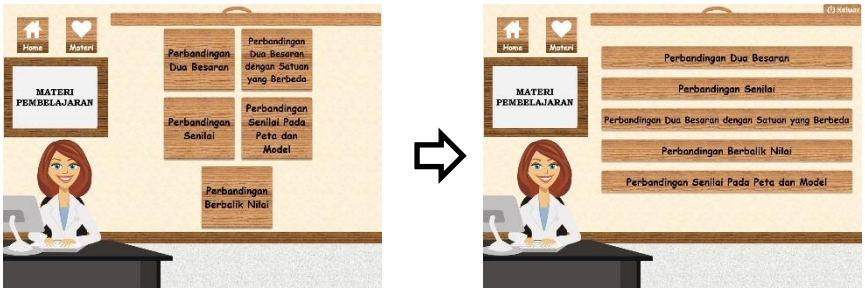

Figure 3 Improvements to the Menu Button on the Learning Material Page

At this stage, the *Articulate Storyline 360* comparison learning media was provided, followed by a user response questionnaire, the results of which are presented in the table below.

Table 4 Summary of Teacher and Student Responses Scale 5

No	Aspect	Teacher Response	Student Response
1	Text Clarity	5	4.69
2	Image Clarity	4.5	4.65
3	Animation Clarity	5	4.58
4	Audio Clarity	5	4.35
5	Use of Standard, Simple and Clear Indonesian	5	4.73

6	Application of Material in Real Life	5	4.27
7	Ease of Use of Learning Media	5	4.58
8	Ease of Learning Content	5	4.46
9	Motivating Students in Learning	4	4.65
10	Need to be Made for Other Materials	5	4.46

The comparison of the average *pretest* and *posttest scores* can be seen in Figure 4 below.

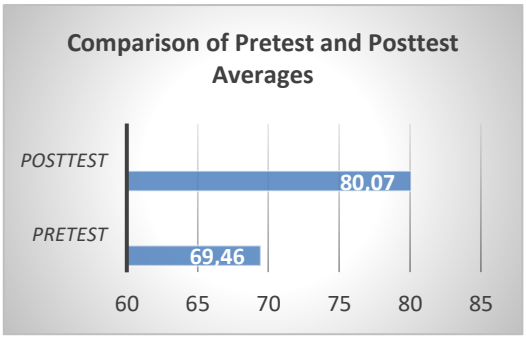

Figure 4. Comparison Graph of Average *Pretest* and *Posttest Scores*

6) At the distribution stage, the project is stored in a storage media. This stage can also be called the evaluation stage for the results of the development of finished products to make them better. The results of this evaluation can be used as input for the *concept stage* in the next product. At this stage, the author also distributed the *Articulate Storyline 360* comparison learning media to the vice principal for curriculum and for the report, it was also given to the principal of SMP YPI Al-Huda. In conducting this research, the author found several limitations of the findings, including that *Articulate Storyline 360* comparison does not contain learning videos, only images, animations and audio.

To determine the effectiveness of using the *Articulate Storyline 360 learning media* in comparison to *Higher Order Thinking Skills* according to Brookhart on students, the researcher calculated *the effect size (ES)* as follows.

$$ES = \frac{mean\ of\ posttest - mean\ of\ pretest}{standard\ deviation\ of\ pretest}$$

$$ES = \frac{80{,}07 - 69{,}46}{5{,}93}$$

$$ES = \frac{10{,}61}{5{,}93}$$

$$ES = 1{,}78$$

From the calculation, *the effect size is obtained*, which $1{,}78 > 1{,}00$is in the " *Strong Effect" criteria.* This means that the use of the *Articulate Storyline 360* comparative learning media in comparative learning activities provides a very strong effect quality on *Higher Order Thinking Skills* according to Brookhart on students.

2.2. Discussion

The development of interactive learning media using Articulate Storyline 360 to enhance Higher-Order Thinking Skills (HOTS) in students has undergone rigorous research and validation. Following the Multimedia Development Life Cycle (MDLC) model,

this media has demonstrated its effectiveness in educational settings, as evidenced by studies highlighting its validity, practicality, and positive impact on learning outcomes. The Research and Development (R&D) approach was employed, incorporating the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) (Gultom & Siagian, 2023; Mulyana et al., 2023). The MDLC model itself comprises six stages: concept, design, material collection, assembly, testing, and distribution (Gultom & Siagian, 2023). Validation results indicate high feasibility, with media experts rating the product's usability between 86% and 100% (Mulyana et al., 2023). Additionally, student and teacher feedback has been overwhelmingly positive, with engagement and effectiveness ratings reaching up to 94% (Safitri et al., 2023; Syafitriyani et al., 2023).

The impact of interactive learning media on student learning is evident, with studies demonstrating improvements in conceptual understanding and scientific literacy. A normalized gain score of 0.66 indicates moderate effectiveness in enhancing students' comprehension ("Development of Interactive Learning Media Based on Articulate Storyline 3 of the IPAS Project to Improve Scientific Literacy Skills," 2023). However, while interactive media has strong potential in improving learning outcomes, some research suggests that traditional methods remain valuable, particularly in establishing foundational knowledge. This finding underscores the importance of a balanced approach in educational strategies that integrate both interactive technology and conventional teaching methods.

A crucial aspect of effective learning media is defining clear objectives and identifying the target audience, particularly for grade VII students. Research suggests that a thorough understanding of learners significantly improves the relevance and impact of educational materials, enhancing student motivation and learning outcomes (Rahmah et al., 2023). Lestari (2020) emphasizes that audience recognition plays a vital role in increasing student engagement, which is essential for mathematics learning. Similarly, establishing clear learning objectives during the concept stage is critical for achieving desired educational outcomes (Setiawan et al., 2023). Hwang et al. (2019) assert that well-defined objectives serve as a foundation for developing effective learning media, ensuring that they meet students' educational needs. Despite these factors, challenges such as varying student backgrounds and differing levels of prior knowledge must be considered, as they can influence the overall effectiveness of the media.

The design stage is essential in enhancing user experience and facilitating comprehension. Effective design visualization, including flowcharts and storyboards, helps present information clearly and engagingly (Baharuddin et al., 2023; Sutrisno, 2023). A user-centric design approach prioritizes user needs and preferences, ensuring usability through techniques such as interviews and observations (Mahadik et al., 2023; Andrianda & Dhewanto, 2023). Research also indicates that effective visual design directly impacts learning outcomes by improving accessibility and comprehension. A well-organized design flow enhances students' understanding and supports the development of HOTS (Li et al., 2023; Sutrisno, 2023). However, while clarity is crucial, an overly simplified design may lead to a loss of critical content depth, making it necessary to balance clear presentation with comprehensive information.

The material collection stage plays a crucial role in aligning content with learning objectives and ensuring student engagement. A systematic approach to gathering relevant materials, such as basic competencies, learning objectives, and discussion topics, enhances the effectiveness of educational content (Dewi & Supardi, 2023). Tools such as Material Analysis Sheets help assess student understanding and provide structured feedback for improving learning effectiveness (Dewi & Supardi, 2023). Additionally, development models such as ADDIE provide a systematic framework for designing teaching materials that meet educational standards (Ningsih & Tambunan, 2023; Purwaningtyas et al., 2023). While structured material collection is essential, adaptability in tailoring materials to different learning styles and educational contexts is equally important to maximize learning effectiveness.

The assembly stage in developing learning media using Articulate Storyline 360 is crucial for enhancing student engagement through visually appealing and interactive content. Research suggests that well-designed media incorporating attractive images and relatable characters significantly boosts student interest and improves information retention (Safitri et al., 2023; Syafitriyani et al., 2023). Beyond static visuals, interactivity enhances the learning experience by fostering a dynamic and enjoyable educational atmosphere, encouraging student involvement (Lestari et al., 2023). Evaluations of such media consistently receive high feasibility ratings from both students and teachers, reflecting strong approval and practical benefits in classroom settings (Hakim & Pebrina, 2023). However, while interactive and visually rich media offer significant advantages, traditional teaching methods still hold value, particularly for students who thrive in structured, less stimulating environments. Thus, striking a balance between interactive media and conventional approaches is key to accommodating diverse learning preferences.

The testing stage is fundamental to ensuring the quality and effectiveness of educational media. Expert evaluations play a key role in identifying strengths and weaknesses, allowing necessary refinements before classroom implementation. Research by Ningsih et al. (2020) and Indratno et al. (2020) highlights the significance of expert feedback in improving educational media, ensuring it meets pedagogical and technical standards. Similar to quality assessments in other fields, such as YouTube videos on sports nutrition, which are often of low reliability (Kiss et al., 2023), educational media must undergo rigorous evaluation to maintain high standards. Additionally, expert assessments align with a user-centric approach, ensuring that the media remains relevant to its intended audience (Georgiou et al., 2023). Despite these benefits, expert evaluation is not without challenges. Potential biases in expert opinions may not always reflect students' actual needs, emphasizing the importance of balancing expert insights with direct user feedback.

The distribution stage ensures that learning media, such as Articulate Storyline 360, effectively reaches its intended audience. This phase encompasses storage, accessibility, and continuous refinement through user feedback. A well-executed distribution strategy ensures that educational content remains relevant and widely available. Feedback mechanisms, such as surveys and focus groups, help optimize content delivery (Billert et al., 2022). Additionally, proper storage solutions, including hard disks and SD cards, facilitate easy access and duplication, enabling broader dissemination (Blok et al., 2023).

Post-distribution user feedback provides valuable insights into usability and effectiveness, guiding iterative improvements (Tang et al., 2022). However, challenges such as technological barriers and varying levels of user engagement must be addressed through adaptive distribution strategies to maximize the impact of educational resources.

The use of Articulate Storyline 360 significantly enhances students' HOTS by integrating interactive multimedia elements. Research suggests that interactive media fosters critical and analytical thinking, leading to improved learning outcomes. The fixative property ensures information retention through engaging content, the manipulative property allows interactive exploration of concepts, and the distributive property supports spaced learning for long-term retention (Shang & Ni, 2023). These properties collectively contribute to an effective learning experience. Additionally, immersive environments such as 360-degree videos increase engagement, leading to better academic performance (Hwang et al., 2022). Furthermore, narrative styles in interactive media enhance physical and social presence, improving recall and understanding (Hwang et al., 2022).

Beyond engagement, interactive media plays a vital role in developing critical thinking. Students exposed to interactive learning media tend to demonstrate higher-order cognitive skills compared to those using traditional methods (Blok et al., 2023; Wong & Hughes, 2022). However, individual differences in learning preferences and backgrounds must be considered. Not all students respond equally to interactive methods, highlighting the need for tailored educational strategies that optimize learning effectiveness.

3. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the development of the Articulate Storyline 360 learning media to explore Higher Order Thinking Skill according to Brookhart was carried out using the MDLC model through six stages: (1) **concept** , where the media is intended for class VII students in semester 2 with the aim of exploring Higher Order Thinking Skill; (2) **design** , which includes making flowcharts and storyboards; (3) **collecting materials** , where researchers collect basic competencies, learning objectives, concept maps, discussion materials, sample questions and their discussions, practice questions, and quizzes according to the Higher Order Thinking Skill indicators; (4) **making** , namely making learning media using Articulate Storyline 360; (5) **testing** , where the media is tested to material and media experts, so that it is declared valid and very suitable for use, and gets a positive response from two mathematics teachers and 26 class VIII-C students with a very good category; and (6) **distribution** , where the media is stored on a hard disk and SD card, ready to be operated and duplicated for publication. Researchers also distribute media to the deputy head of curriculum and the principal. The effectiveness of this learning media on Higher Order Thinking Skill shows the effect size value of the strong effect category. The posttest results showed a significant increase, with an average posttest of 80.07 and an average pretest of 69.46, resulting in a difference of 10.61.

REFERENCES

Afifuddin, A., Santosa, B., Kuat, T., & Mahmudah, F. N. (2023). Pengembangan Media Pembelajaran Interaktif “Guru 3D” pada Mata Pelajaran Animasi 3 Dimensi. *Indo-*

MathEdu Intellectuals Journal, *4*(2), 1013–1027. https://doi.org/10.54373/imeij.v4i2.323

Akhvlediani, M., Abdaladze, L., & Lataria, K. (2023). The Challenges of the XXI Century – Development of Critical Thinking among the Students. *Šromebis Krebuli*. https://doi.org/10.52340/zssu.2023.15.11

Al-Usus Al-Ta'limiyah Li I'dadi Mawad Ta'lim Al-Lughah Al-'Arabiyah. (2023). *Cordova Journal*. https://doi.org/10.20414/cordova.v13i1.7717

Andrianda, J. M., & Dhewanto, W. (2023). Research, Development and Design for Product Development SAC: Interaction Design Mobile Web Application Using User Centered Design Methodology. *International Journal of Current Science Research and Review*, *06*(12). https://doi.org/10.47191/ijcsrr/v6-i12-82

Aulia, S., Egok, A. S., & Lestari, F. (2023). Pengembangan Media Kotak Berhitung Penjumlahan dan Pengurangan. *Journal of Elemantary School*. https://doi.org/10.31539/joes.v6i2.7097

Baharuddin, N., Rosli, H., & Juhan, Mohd. S. (2023). The Creative Process: Developing Visual Storytelling through Design Thinking. *International Journal of Academic Research in Business & Social Sciences*. https://doi.org/10.6007/ijarbss/v13-i10/19113

Bawadi, H., Elshami, S., Awaisu, A., Al-Jayyousi, G. F., Ashfaq, S., & Mukhalalati, B. (2023). A review of technical and quality assessment considerations of audio-visual and web-conferencing focus groups in qualitative health research. *Humanities & Social Sciences Communications*, *10*, 1–10. https://doi.org/10.1057/s41599-023-01989-0

Billert, M. S., Weinert, T., Thiel de Gafenco, M., Janson, A., Klusmeyer, J., & Leimeister, J. M. (2022). Vocational Training With Microlearning—How Low-Immersive 360-Degree Learning Environments Support Work-Process-Integrated Learning. *IEEE Transactions on Learning Technologies*, *15*, 540–553. https://doi.org/10.1109/TLT.2022.3176777

Blok, A. C., Bach-Stante, D., Merlotti, A., Schoville, R., Jones, H., Davis, K., Sicard, A., & Aebersold, M. (2023). Educational 360-video development for clinical practice improvement toward Deaf and Hard-of-Hearing Population. *Clinical Simulation in Nursing*, *83*, 101436. https://doi.org/10.1016/j.ecns.2023.101436

Brunnström, K., Djupsjöbacka, A., Billingham, J., Wistel, K., Andrén, B., Ozolins, O., & Evans, N. (2023). Video expert assessment of high quality video for Video Assistant Referee (VAR): A comparative study. *Multimedia Tools and Applications*. https://doi.org/10.1007/s11042-023-17741-4

Development of interactive learning media based on articulate storyline 3 of the ipas project to improve scientific literacy skills. (2023). *Jurnal Pendidikan Ilmu Sosial*. https://doi.org/10.23917/jpis.v33i1.22316

Dewi, L. L., & Supardi, S. (2023). *Penggunaan Lembar Analisis Materi Pada Metode Diskusi Presentasi dalam Upaya Peningkatan Efektivitas Pembelajaran*. https://doi.org/10.61332/ijpa.v6i2.71

Fajriati, D. Y., & Putra, A. (2023). *Validity and practicality of animation video-based learning media on various forces and inertial properties of objects*. https://doi.org/10.24036/ple.v1i3.74

Gampala, M. (2023). Innovative Aproaches to Teaching and Learning. *Shanlax International Journal of English*. https://doi.org/10.34293/rtdh.v12is1-dec.86

Georgiou, A., Li, J., Thomas, J., Horvath, R., Lindeman, R., & Westbrook, J. (2023). The delivery of safe and effective test result communication, management and follow-up. *Public Health Research & Practice*, *33*(3). https://doi.org/10.17061/phrp3332324

Gultom, J., & Siagian, P. (2023). Pengembangan Media Pembelajaran Interaktif Berbasis Articulate Storyline Untuk Meningkatkan Kemampuan Pemahaman Konsep Matematis Siswa SMA Negeri 2 Kabanjahe. *Atmosfer*, *1*(4), 14–27. https://doi.org/10.59024/atmosfer.v1i4.316

Hakim, N., & Pebrina, R. (2023). *Pengembangan Multimedia Interaktif Menggunakan Aplikasi Articulate Storyline 3 pada Mata Pelajaran PAI dan Budi Pekerti di SMA 2 Padang Panjang*. https://doi.org/10.31958/atjpi.v4i2.10706

Hidayati, B. T., & Saparudin, S. (2023). Higher Order Thingking Skills (Hots) dalam Konsep Integrasi Pendidikan Islam dan Sains. *EduInovasi*. https://doi.org/10.47467/edui.v4i1.5800

Hwang, A. H.-C., Kim, J., Lobo, S. N., Shu, Y., & Won, A. S. (2022). Being there to Learn: Narrative Style and Cross-platform Comparison for 360-degree Educational Videos. *Proceedings of the ACM on Human-Computer Interaction*, *6*(CSCW2), 1–28. https://doi.org/10.1145/3555169

Jazilurrahman, J. (2023). Design of HOTS-Based Learning Evaluation to Improve Critical Thinking Skills and Achievements in Islamic Education. *Journal of Community Service*. https://doi.org/10.61987/communautaire.v2i2.348

Juistha, A. A. (2023). Pengembangan Konten Interaktif untuk E-Learning di Lembaga Pendidikan Yayasan. *Ascarya*. https://doi.org/10.53754/iscs.v3i2.595

Karademir, T., Alper, A., Soğuksu, A. F., & Karababa, Z. C. (2021). The development and evaluation of self-directed digital learning material development platform for foreign language education. *Interactive Learning Environments*, *29*(4), 600–617. https://doi.org/10.1080/10494820.2019.1593199

Kartika, E. D., & Arini, A. Y. P. (2023). Pengembangan media pembelajaran crocle math untuk meningkatkan pemahaman konsep matematis. *Prismatika*. https://doi.org/10.33503/prismatika.v6i1.3427

Kiss, A., Soós, S., Temesi, Á., Unger-Plasek, B., Lakner, Z., & Tompa, O. (2023). Evaluation of the reliability and educational quality of YouTube™ videos on sport nutrition topics. *Journal of the International Society of Sports Nutrition*, *20*(1), 2278632. https://doi.org/10.1080/15502783.2023.2278632

Kumar, P. (2023). Transformative Role of ICT in 21st Century Learning: Enhancing Educational Effectiveness and Equitability. *International Journal for Research in Applied Science and Engineering Technology*. https://doi.org/10.22214/ijraset.2023.57028

Kumbo, L. I., Mero, R. F., & Hayuma, B. J. (2023). Navigating The Digital Frontier: Innovative Pedagogies for Effective Technology Integration in Education. *The Journal of Informatics*, *3*(1), 14–33. https://doi.org/10.59645/tji.v3i1.142

Lestari, S. P., Rostikawati, R. T., & Gani, R. A. (2023). Pengembangan media pembelajaran interaktif menggunakan articulate storyline 3 pada tema 8 lingkungan sahabat kita. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *9*(04), 1644–1653. https://doi.org/10.36989/didaktik.v9i04.1742

Li, J., Guo, X., Zhang, K., & Zhao, W. (2023). A knowledge-enabled approach for user experience-driven product improvement at the conceptual design stage. *Ai Edam Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, *37*. https://doi.org/10.1017/s0890060423000161

Mahadik, S., Antara, F., Chopra, P., Renuka, A., & Goel, O. (2023). User-Centric Design in Product Development. *Universal Research Reports*, *10*(4), 473–492. https://doi.org/10.36676/urr.v10.i4.1359

Mukhlis, M., Suwandi, S., Rohmadi, M., & Setiawan, B. (2023). Higher Order Thinking Skills in Reading Literacy Questions at Vocational High Schools in Indonesia. *IJoLE (International Journal of Language Education)*, *7*(4). https://doi.org/10.26858/ijole.v7i4.37603

Mulyana, Z. A., Kurniasih, S., & Handayani, R. (2023). Pengembangan media pembelajaran interaktif menggunakan articulate storyline 3 pada tema 8 subtema 1 pembelajaran

2. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *9*(04), 2271–2279. https://doi.org/10.36989/didaktik.v9i04.1855

Murtopo, D., Winarno, W., & Atmojo, I. R. W. (2023). *Preparation of HOTS-Based Learning Tools as Teacher Competency Development*. https://doi.org/10.20961/shes.v6i3.82310

Nanda, A. D., Hasan, R., Sukri, A., Lukitasari, M., & Rivera, A. T. (2023). Reinforcement analyze and evaluate of higher-order thinking skills using problem-based learning in ecosystem material. *Jurnal Pendidikan Biologi Indonesia*. https://doi.org/10.22219/jpbi.v9i3.28604

Ningsih, S., & Tambunan, H. P. (2023). Pengembangan Bahan Ajar Buku Bacaan Pada Tema VII Sub Tema 2 Anak SD Kelas VI Berbantuan Aplikasi Pinterest Sebagai Design Di SDN 066664 Medan. *Dewantara*, *2*(3), 179–189. https://doi.org/10.30640/dewantara.v2i3.1366

Nisa, N. C. (2023). Pembelajaran matematika berorientasi higher order thinking skills. *Jurnal Lebesgue*. https://doi.org/10.46306/lb.v4i3.448

Nugroho, A. S. (2023). Pengembangan Media Pembelajaran Matematika Interaktif Berbasis Pendekatan Kontekstual. *MEGA*, *4*(2), 615–622. https://doi.org/10.59098/mega.v4i2.1048

Purwaningtyas, N., Damayanti, S., & Permana, E. P. (2023). Pengembangan Media Pembelajaran Berbasis Construct 2 Untuk Meningkatkan Hasil Belajar Materi Organ Pencernaan Manusia pada Siswa Kelas V SDN Ngasem 1. *DIAJAR Jurnal Pendidikan Dan Pembelajaran*, *2*(2), 188–194. https://doi.org/10.54259/diajar.v2i2.1434

Rahmah, S. E., Huda, S., & Firmanshah, B. (2023). *Improving Mathematics Learning Activity and Outcomes through the Culturally Responsive Teaching (CRT) Learning Approach for Class VII Middle School Students*. https://doi.org/10.30587/icls.v1i1.6971

Rosidah, R., & Ikram, F. Z. (2023). Effectiveness of Using Video Project and Google Classroom in Mathematics Learning of Numerical Methods Course. *Jurnal MediaTIK*, 196–199. https://doi.org/10.59562/mediatik.v6i3.3090

Ruíz-Valdés, S. (2023). Trends and challenges in the upskilling and reskilling of the workforce in the 21st century: an analysis of the strategies and results in the acquisition of skills for adaptation to technological and labor change. *Revista de Formación de Recursos Humanos*, 13–20. https://doi.org/10.35429/jhrt.2023.24.9.13.20

Safitri, D. W., Purnamasari, R., & Suchyadi, Y. (2023). Pengembangan Media Pembelajaran Interaktif berbasis Articulate Storyline 3 Pada Tema 8 Subtema Manusia dan Lingkungan. *Jurnal PGSD*, *16*(2), 157–167. https://doi.org/10.33369/pgsd.16.2.157-167

Salshabila, S., Mahmudi, M. R., & Friska, S. Y. (2023). Pengembangan media game edukasi berbasis web wordwall pada materi balok dan kubus kelas iv sd dalam kurikulum merdeka. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *9*(04), 1015–1018. https://doi.org/10.36989/didaktik.v9i04.1699

Sari, S. Y., Hirahmah, A., Hidayati, H., & Rahim, F. R. (2023). Validity of Interactive Learning Media Integrated Critical and Creative Thinking Skills Aided by the Lectora Inspire Application. *Jurnal Ilmiah Pendidikan Fisika*, *7*(2), 204. https://doi.org/10.20527/jipf.v7i2.7404

Setiawan, H., Handican, R., & Rurisman, R. (2023). *Revolutionizing Math Education: Unleashing the Potential of Web-based Learning Media for Enhanced Mathematical Problem Solving Skills*. https://doi.org/10.32939/jdime.v1i2.2978

Shang, S., & Ni, N. (2023). Understanding the Impacts of Storytelling and Player Perspective on Learning Outcomes: The Mediating Roles of Engagements. *International Journal of Human-Computer Interaction*. https://doi.org/10.1080/10447318.2023.2288732

Sirad, L. O., & Arbain, A. (2023). The effectiveness of hots-oriented learning on achievement of student hots. *JME (Journal of Mathematics Education)*. https://doi.org/10.31327/jme.v8i2.2048

Skyba, Y. A. (2023). Skills of the 21st Century: Adaptation of Educational Programs of the National Higher Education Institutions. *Problemi Osvìti*. https://doi.org/10.52256/2710-3986.2-99.2023.05

Sofia, A., Syafrudin, U., & Yulistia, A. (2023). Interactive Media for Increasing Logical-Mathematical Intelligences in Differentiated Instruction Practice. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *7*(6), 7445–7452. https://doi.org/10.31004/obsesi.v7i6.5593

Sutrisno, A. (2023). Simplifying the Process of Designing Motion Graphics for Content Creators. *KnE Social Sciences*. https://doi.org/10.18502/kss.v8i15.13911

Syafitriyani, D., Komariah, K., & Wahyuningsih, Y. (2023). *Rancang bangun media pembelajaran interaktif articulate storyline pada mata pelajaran ips jenis-jenis pekerjaan di sekolah dasar*. https://doi.org/10.29303/pendas.v4i2.1509

ssTang, Z., Zhao, Y., Zheng, W., & Korotkov, A. (2022). A study of immersive technology for product usability improvement design based on comprehensive value evaluation. *Applied Mathematics and Nonlinear Sciences*, *0*(0). https://doi.org/10.2478/amns.2021.2.00326

Tanjung, N. A., Azhari, I., & Milfayetty, S. (2023). Development of Interactive Media with Using PBL to Improve Student Learning Outcomes in Grade 4th Social Science Subject. *Randwick International of Education and Linguistics Science Journal*. https://doi.org/10.47175/rielsj.v4i4.865

Thanyaphongphat, J., Tapingkae, P., Daungcharone, K., & Thongkoo, K. (2023). *Exploring the Relationship between 21st Century Skills and Motivation: A Study Using Contextual Inquiry Project-based Learning*. https://doi.org/10.58459/icce.2023.1381

Umayah, U., Winandika, G., Azhari, D., & Nofiani, D. (2023). Development of soft skill-based interactive media on thematic learning. *Alifmatika*. https://doi.org/10.35316/alifmatika.2023.v5i2.156-170

Verbivskyi, D. (2023). Innovative technologies in higher education institution. *Naukovij Vìsnik Užgorods'kogo Unìversitetu. Serìâ Pedagogìka, Socìal'na Robota*. https://doi.org/10.24144/2524-0609.2023.53.30-33

Wijayanto, A., Khoiriyah, S. U., Setyowati, E., & Taman, M. R. (2023). Inovasi Pembelajaran: Pengembangan Media Interaktif Sistem Pencernaan untuk Meningkatkan Prestasi Belajar pada Siswa Madrasah Ibtidaiyah. *Itqan: Jurnal Ilmu-Ilmu Kependidikan*. https://doi.org/10.47766/itqan.v14i2.1541

Wong, J. T., & Hughes, B. S. (2022). Leveraging learning experience design: digital media approaches to influence motivational traits that support student learning behaviors in undergraduate online courses. *Journal of Computing in Higher Education*, 1–38. https://doi.org/10.1007/s12528-022-09342-1