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Development of interactive STREAM-based mathematics teaching materials for the topic of ratio using Lumio

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Abstract

Mathematics education in the 21st century requires the integration of technology and interdisciplinary approaches to meet students' diverse learning needs. However, conventional teaching materials often fail to engage students actively or connect mathematical concepts to real-world contexts. This research aims to develop interactive teaching materials based on the Science, Technology, Religion, Engineering, Arts, and Mathematics (STREAM) framework for the topic of ratio by utilizing the Lumio platform to enhance the learning experience. This research employed the ADDIE development model consisting of Analyze, Design, Develop, Implement, and Evaluate stages. The study involved 3 expert validators, 1 mathematics teacher, and 42 Grade VII students, including 10 students in the small-scale trial and 32 students in the large-scale trial. The instruments used in this study included expert validation sheets, practicality questionnaires, and systematic thinking skill tests. At the same time, the data were analyzed using percentage techniques based on validity, practicality, and effectiveness criteria. The results showed that the developed teaching materials achieved validity scores of 85%, 84%, and 92%, categorized as "very valid." The practicality results reached 82% from students and 86% from the teacher in the small-scale trial, while the large-scale trial obtained a score of 80%, categorized as "practical" to "very practical." Furthermore, the effectiveness test showed an increase in student learning outcomes, resulting in an effectiveness percentage of 73%, categorized as "effective." These findings indicate that the STREAM-based teaching materials assisted by Lumio are valid, practical, and effective for teaching ratio topics.

Keywords: STREAM, Lumio, Teaching Material Development, Interactive Learning, Mathematics Education

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INTRODUCTION

Mathematics serves as a foundational subject in education, fostering students' abilities to reason, analyze, and solve problems across various disciplines (Handayuni &

Zainil, 2023). In today's rapidly evolving world, mathematical competence must go beyond computational fluency to include the ability to connect abstract concepts with real-life contexts. In Indonesia, the national curriculum outlined in Permendikbudristek No. 12 of 2024 emphasizes mathematics learning that cultivates analytical, logical, and creative thinking. However, many classrooms still rely heavily on printed textbooks and conventional delivery methods, which limit student engagement and understanding (Saleh & Nur, 2023).

One key mathematical topic introduced to Grade VII students is ratio, which underpins essential skills in proportional reasoning, scaling, and everyday decision-making (Sugilar et al., 2025). However, this topic is often taught abstractly, without sufficient contextualization or visualization, leading to difficulties in student comprehension (Zulkardi et al., 2021). Existing teaching materials typically present problems that lack meaningful application, making it difficult for learners to internalize concepts or transfer knowledge to real-world scenarios (Riyadi et al., 2021). This indicates that ratio learning requires instructional approaches that are contextual, interactive, and connected to students' real-life experiences to support deeper understanding.

The STREAM approach, integrating Science, Technology, Religion, Engineering, Arts, and Mathematics, offers a meaningful framework for contextualizing mathematical concepts (Castro & Collins, 2021). This approach enables students to connect mathematical ideas with real-world contexts through interdisciplinary learning experiences. In the context of ratio, STREAM can be effectively implemented through various activities, such as scientific experiments involving measurement comparisons (science), the use of digital simulations (technology), discussions on fair distribution and ethical decision-making (religion), design and scaling tasks (engineering), and visual representations or patterns (arts) (Mubarok et al., 2020). Through these integrated activities, students are expected to develop a deeper and more meaningful understanding of ratio concepts (Maryam & Sampoerna, 2021).

Advances in digital technology provide opportunities to support interactive and student-centered learning (Arifani et al., 2024). The integration of digital technology plays a crucial role in supporting the implementation of the STREAM approach in classroom practice. Lumio, a web-based platform developed by SMART Technologies, offers various features that enable teachers to design interactive and media-rich

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instructional materials. Through Lumio, teachers can incorporate animations, videos, simulations, and real-time collaborative activities that align with STREAM principles and facilitate students' active participation in learning (Wirda et al., 2023). The use of Lumio is expected to enhance the effectiveness of STREAM-based instruction, particularly in supporting students' understanding of abstract mathematical concepts such as ratio (Izzania, 2021).

Previous studies have predominantly focused on general STEM/STREAM implementation or the use of digital platforms separately (Averill & Herrelko, 2023). Research on STREAM tends to emphasize science-based contexts, while studies on digital platforms often focus on general media use rather than the development of topic-specific mathematics teaching materials (Mubarok et al., 2020). Very limited studies have specifically explored the integration of STREAM and Lumio in developing instructional materials for the topic of ratio, particularly in supporting students' systematic thinking skills (Wulandari et al., 2022).

This study aims to develop interactive mathematics teaching materials based on the STREAM approach using the Lumio platform for the topic of ratio in Grade VII. The novelty of this study lies not only in the integration of STREAM and Lumio, but also in the design of structured instructional materials that explicitly incorporate systematic thinking skill indicators through four stages: understanding, analyzing, implementing, and evaluating. The teaching materials are designed with contextual problem-based tasks, interactive multimedia features, and guided learning activities within the Lumio platform to support student engagement and conceptual understanding. This study is expected to contribute to the development of innovative, technology-integrated mathematics teaching materials that are relevant to 21st-century learning and aligned with the Merdeka Curriculum.

METHODS

This study employed a research and development (R&D) method using the ADDIE model (Analyze, Design, Develop, Implement, and Evaluate), a widely used instructional design framework aimed at producing effective and structured learning materials (Branch, 2009). The objective of this study was to develop interactive STREAM-based mathematics teaching materials on the topic of ratio for Grade VII students, implemented through the Lumio digital learning platform (Dyah et al., 2024). The research was

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conducted in the second semester of the 2024/2025 academic year at a public junior high school in West Java, Indonesia (Putra et al., 2024). The participants consisted of three expert validators with expertise in mathematics education and instructional media, one mathematics teacher with more than five years of teaching experience, and 42 Grade VII students. The students were divided into two groups: 10 students in the small-scale trial and 32 students in the large-scale trial. The selection of the school and participants was based on purposive sampling, considering the availability of supporting facilities, the implementation of the Merdeka Curriculum, and the characteristics of students with diverse academic abilities (Gravemeijer & Doorman, 1999).

The development process followed the five stages of the ADDIE model, namely Analyze, Design, Develop, Implement, and Evaluate. In the Analyze stage, the researchers identified students' needs, curriculum requirements, and learning problems (Fredricks et al., 2004). In the Design stage, the structure and content of the teaching materials were planned. In the Develop stage, the teaching materials were created and validated by experts. In the Implement stage, the materials were tested on students through small-scale and large-scale trials. In the Evaluate stage, revisions were made based on feedback and test results (Domu et al., 2022).

The instruments used in this study included expert validation sheets, practicality questionnaires, and systematic thinking skills tests. The validation sheets were used to assess the content, presentation, and media aspects of the teaching materials. The practicality questionnaires were administered to both teachers and students to evaluate the ease of use, attractiveness, and usefulness of the materials. The systematic thinking skills test was used to measure students' abilities based on four indicators: understanding, analyzing, implementing, and evaluating (Faeeza et al., 2021).

Data were collected through validation, questionnaires, and tests, and were analyzed using percentage techniques. The percentage score was calculated using the following formula:

$$P = \left(\frac{obtained\ score}{maximum\ score}\right) \times 100\%$$

The results were then interpreted based on predetermined criteria of validity, practicality, and effectiveness, as presented in Table 1.

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Table 1. Criteria of Teaching Material Validity, Teaching Materials Practicality, and Teaching Materials Effectiveness

Validity Level (%)	Validity Criteria	Practicality Criteria	Effectiveness Criteria
81 – 100	Very Valid	Very Practical	Very Effective
61 – 80	Valid	Practical	Effective
41 – 60	Quite Valid	Quite Practical	Quite Effective
21 – 40	Less Valid	Less Practical	Less Effective
0 – 20	Very Invalid	Not Practical	Not Effective

(Maryani & Reinita, 2023)

RESULT AND DISCUSSION

This study applied the ADDIE development model (Analyze, Design, Development, Implementation, and Evaluation) to develop STREAM-based teaching materials on ratio, assisted by Lumio. The analysis stage collected data through curriculum analysis, student needs, systematic thinking skills, and teacher perspectives. The Merdeka Curriculum emphasizes problem-solving and contextual learning. Students experienced difficulties in systematic thinking, especially in analysis and evaluation. Students also showed interest in interactive, technology-based learning. Teachers identified low achievement and limited media as challenges and supported the development of innovative teaching materials.

Table 2. Initial Design

No	Components	Initial Design
1.	*Cover*	
2.	Learning Materials	

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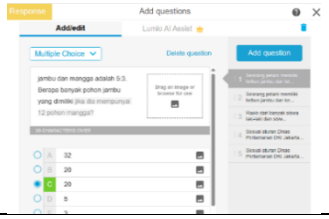
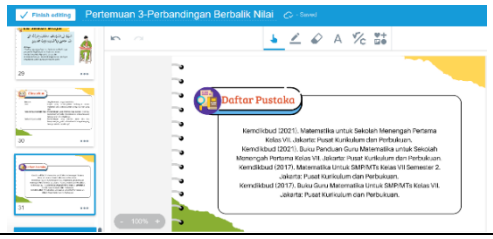
No	Components	Initial Design
3.	Student Activity Sheet	
4.	Evaluation	
5.	Bibliography	

The design stage focused on planning the structure and components of the teaching materials, including learning content, evaluation instruments, and practicality questionnaires. A storyboard was developed to organize the content flow and interactive features. The materials were designed as web-based content using Canva, supported by appropriate fonts, templates, and multimedia elements such as animated videos created with CapCut and integrated into Lumio. The design aligned with STREAM principles and student characteristics. These designs were presented in a structured Table 2 to guide development.

Development focused on producing STREAM-based mathematics teaching materials on ratio using Lumio. The materials were supported by animated videos created with CapCut, uploaded to YouTube, and integrated into Lumio to enhance student engagement and understanding. The validation results from three experts are presented in Table 3 and Table 4.

The media expert validation was conducted in two stages covering content, presentation, visual appearance, STREAM components, and language. The first stage resulted in a score of 66% (valid). The second stage increased to 85% (very valid) after revisions. These results indicate that the STREAM-based teaching materials assisted by Lumio meet media quality standards.

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Table 3. Validity Results Of Lumio-Assisted Stream-Based Teaching Materials From Media Experts

Aspect	Indicator	1st stage		2nd stage	
		Percentage	Category	Percentage	Category
Material	Material accuracy	60%	Quite Valid	80%	Valid
	Material suitability	75%	Valid	95%	Very Valid
	Breadth of material	60%	Quite Valid	80%	Valid
Serving Techniques	Systematics of presentation	68%	Valid	88%	Very Valid
	Completeness of teaching material components	60%	Quite Valid	80%	Valid
Display	Size of teaching materials	80%	Valid	100%	Very Valid
	Printers	70%	Valid	87%	Very Valid
	Text and image layout	67%	Valid	87%	Very Valid
	Design of teaching materials	64%	Valid	84%	Very Valid
Components STREAM	*Science*	60%	Quite Valid	80%	Valid
	Technology	70%	Valid	90%	Very Valid
	Religion	67%	Valid	87%	Very Valid
	Engineering.	60%	Quite Valid	80%	Valid
	Art	65%	Valid	85%	Very Valid
	Mathematic	60%	Quite Valid	80%	Valid
	STREAM steps	60%	Quite Valid	80%	Valid
Language and Readability	Language consistency	80%	Valid	100%	Very Valid
	The sentences used are in accordance with the correct rules of the Indonesian language	60%	Valid	80%	Valid
	The sentences used are in accordance with the EYD	60%	Valid	80%	Valid
Overall Score Percentage		**66%**	**Valid**	**85%**	**Very Valid**

The subject matter experts evaluated content accuracy, presentation, design, STREAM integration, and language quality. The first expert gave a score of 84% (very valid) and suggested improving material completeness, layout, text visibility, and adding instructional videos. The second expert assigned a score of 92% (very valid) and recommended presenting the material more gradually. The results indicate that the teaching materials are well-designed and suitable for classroom use, with improvements enhancing clarity and student engagement.

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Table 4. Validity Results of Lumio-Assisted Stream-Based Teaching Materials From Material Experts

Aspect	Indicator	Validator Two		Validator Three	
		Percentage	Category	Percentage	Category
Material	Material accuracy	86%	Very Valid	94%	Very Valid
	Material suitability	80%	Valid	85%	Very Valid
	Breadth of material	80%	Valid	100%	Very Valid
Components STREAM	*Science*	80%	Valid	80%	Valid
	Technology	80%	Valid	100%	Very Valid
	Religion	93%	Very Valid	93%	Very Valid
	Engineering.	80%	Valid	100%	Very Valid
	Art	80%	Valid	85%	Very Valid
	Mathematic	87%	Very Valid	87%	Very Valid
	STREAM steps	80%	Valid	90%	Very Valid
Supporting Material	Illustrations or images	80%	Valid	100%	Very Valid
	Contextual	90%	Very Valid	90%	Very Valid
	Elements of Teaching Materials	85%	Very Valid	85%	Very Valid
	Systematics	100%	Very Valid	100%	Very Valid
Language	Language Style	90%	Very Valid	90%	Very Valid
	Compatibility with Enhanced spelling	90%	Very Valid	90%	Very Valid
Overall Score Percentage		84%	Very Valid	92%	Very Valid

The implementation phase was conducted in two stages: small-scale and large-scale trials. The small-scale trial involved 10 students and focused on assessing practicality through student and teacher questionnaires regarding clarity, usability, and attractiveness. Learning outcomes were not evaluated in this stage. The large-scale trial involved 32 students to further assess the use of the materials. The results of both trials are presented in Table 5.

The practicality assessment was conducted through small-scale and large-scale trials. The small-scale trial involving 10 students resulted in scores of 82% (students) and

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86% (teacher), categorized as very practical. The slightly higher score from the teacher may be attributed to the teacher's broader pedagogical perspective and familiarity with instructional materials, allowing a more comprehensive evaluation of the materials' suitability, organization, and alignment with learning objectives. Meanwhile, students tended to focus more on the usability, visual appearance, and learning experience during the implementation process. The large-scale trial with 32 students showed a score of 80%, categorized as practical. These results indicate that the materials are easy to use, visually appealing, and supportive of learning.

Tabel 5. Practicality Results of Lumio-Assisted Stream-Based Teaching Materials

Aspects	Indicator	Small-scale Trials				Large-scale Trials	
		Students		Teacher		Students	
		Score (%)	Category	Score (%)	Category	Score (%)	Category
Presentation of Materials	Serving order	84%	Very Practical	81%	Very Practical	81%	Very Practical
	Material completeness	85%	Very Practical	75%	Practical	86%	Very Practical
Display	Design of teaching materials	83%	Very Practical	96%	Very Practical	82%	Very Practical
Facilities	Ease of use	80%	Practical	75%	Practical	77%	Practical
	Material convenience	84%	Very Practical	88%	Very Practical	78%	Practical
Learning	Motivation	81%	Very Practical	88%	Very Practical	80%	Practical
	Material	80%	Practical	94%	Very Practical	79%	Practical
Overall Score Percentage		82%	Very Practical	86%	Very Practical	80%	Practical

Student feedback showed positive responses. Students found the materials engaging and expressed interest in continued use of Lumio. Suggestions were given to improve functionality. Students in the large-scale trial also reported a better understanding of the material, indicating that the teaching materials effectively supported comprehension.

The effectiveness of the STREAM-based teaching materials assisted by Lumio was evaluated through pretest and posttest in a large-scale trial involving 32 students. The pretest measured initial understanding, while the posttest assessed learning outcomes after implementation. The results showed an increase in students' systematic thinking

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skills across all indicators, with significant improvement in questions 1 and 2. The recapitulation of these results is presented in Table 6.

Table 6. Results of the recapitulation of the overall indicators of systematic thinking ability

Indicator	Questions	Pretest				Posttest			
		$\bar{x}$	σ	%	Category	$\bar{x}$	σ	%	Category
Understanding system relationships	1	2.62	0.92	66	Medium	3.43	0.67	86	Hight
System analysis	2	1.75	1.10	44	Low	1.90	0.95	48	Low
System installation	4	0.60	0.85	15	Very Low	0.96	0.94	24	Very Low
System evaluation	3	1.62	0.93	41	Low	1.90	0.89	48	Low
	5	0.37	0.64	9	Very Low	0.68	0.74	17	Very Low
Average		1.39	0.89	35	Low	1.94	1.77	40	Low

Table 6 presents the recapitulation of pretest and posttest results based on five indicators of systematic thinking skills. The average scores increased on all indicators, although not significantly. The highest score was found in understanding system relationships (3.43, high), while the lowest was in evaluating the system on question 5 (0.68, very low). The overall average score increased from 1.39 to 1.77, both in the low category, indicating limited improvement after using the teaching materials.

The results demonstrated a significant improvement in students' scores. The average pretest score was 6.78, which increased to 10.91 in the posttest, reflecting a gain of 4.13 points. This improvement corresponds to an effectiveness percentage of 73%, which falls under the “effective” category based on established criteria. Additionally, individual student performance showed that 22 out of 32 students experienced score increases, with the highest gain reaching 19 points.

The evaluation phase assessed the overall quality and impact of STREAM-based teaching materials assisted by Lumio for Grade VII students. The assessment focused on validity, practicality, and effectiveness based on expert, teacher, and student evaluations using qualitative and quantitative data (Irkhamni & Najibufahmi, 2024).

Validity was determined through evaluations by three experts covering material accuracy, STREAM integration, layout, and language. The average score was 87%, categorized as very valid, indicating that the materials are suitable for classroom use (Hermawanti et al., 2025). Practicality was evaluated through small-scale and large-scale trials. The small-scale trial with 10 students showed scores of 82% (students) and 86%

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(teacher), categorized as very practical. The large-scale trial with 32 students resulted in a score of 80%, categorized as practical. These results indicate that the materials are easy to use, engaging, and beneficial for learning (Tiwow et al., 2022).

The effectiveness results indicate that the developed teaching materials were able to support students' learning outcomes and enhance their understanding of ratio concepts (Cahyani et al., 2022). Most students demonstrated improvement after the implementation of the STREAM-based teaching materials assisted by Lumio, particularly in understanding system relationships (Rani et al., 2024). These findings suggest that the integration of interactive activities, contextual problems, and multimedia features contributed positively to student engagement and conceptual understanding during the learning process (Purnama et al., 2024). This is in line with (Umam et al., 2024), who state that instructional tools can be considered effective when they are able to improve student learning outcomes (Auliya et al., 2026). The most notable improvement was observed in the indicator of understanding system relationships, while other indicators showed moderate gains (Hmelo-Silver, 2004). Despite a few students experiencing score drops due to possible non-academic factors, the majority demonstrated significant progress (NCTM,2000).

The findings align with the ADDIE model, which emphasizes systematic and iterative instructional design. The evaluation phase supports both learning assessment and material improvement (Jonassen,2004). The results are also consistent with constructivist learning theory, highlighting active and meaningful learning. The integration of STREAM and Lumio enhances students' cognitive experiences, interdisciplinary understanding, and motivation through real-world contexts, which emphasize that students build understanding through active engagement and meaningful contexts (Sukajaya, 2023). The integration of STREAM and Lumio technologies enriched students' cognitive experiences and supported interdisciplinary learning (Putri et al., 2022). This also resonates with (Sari et al., 2021), who highlighted the importance of real-world context in enhancing student motivation and understanding through digital mathematics education.

CONCLUSION

The ADDIE-based development process produced teaching materials that met quality standards across three dimensions. Expert validation scores of 85%, 84%, and

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92% confirmed the materials are very valid in content accuracy, STREAM integration, visual design, and language. Practicality assessments from students and teachers ranged from 80% to 86%, indicating that the Lumio platform supported classroom use and sustained student engagement. Effectiveness reached 73%, demonstrating the materials' capacity to improve ratio learning outcomes beyond what conventional instruction typically achieves.

A key contribution of this study lies in its instructional architecture. By structuring STREAM activities around four systematic thinking skill indicators — understanding, analyzing, implementing, and evaluating — the materials move beyond surface-level interdisciplinary integration toward a framework that is both operationalized and assessable. This design principle, linking STREAM components to identifiable cognitive stages, offers a replicable model for developing mathematics instructional materials that target higher-order thinking rather than content coverage alone.

These findings advance the field in two directions. Theoretically, they provide evidence that integrating a religiously and culturally contextualized framework (STREAM, which includes the Religion component absent in standard STEM/STEAM) with an interactive cloud-based platform can produce materials that are simultaneously valid, practical, and effective within a single development cycle. Practically, these materials offer a ready-to-adapt model for teachers implementing the Merdeka Curriculum, particularly for technology-mediated instruction on proportional reasoning.

Limitations must be acknowledged. Implementation was confined to one school in West Java with 42 students and a single topic. More critically, despite a 73% effectiveness score meeting the "effective" threshold, systematic thinking skill averages across most indicators remained in the low to very low category after the intervention. This suggests a single implementation cycle is insufficient to substantially shift higher-order reasoning — an important finding implying that STREAM-based materials may be more effective for concept acquisition than for developing complex analytical skills within a short instructional period.

Future research should pursue three directions. First, multi-cycle implementations are needed to determine whether sustained engagement produces stronger gains in the analyzing, implementing, and evaluating indicators that showed minimal improvement here. Second, the STREAM-Lumio model should be tested across other mathematical topics and grade levels to establish generalizability. Third,

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comparative studies contrasting STREAM-Lumio against STEM-only or non-interdisciplinary digital instruction would help isolate the specific contribution of the Religion and Arts dimensions to learning outcomes. An ongoing study by the research team is currently examining these materials across two schools with differing digital infrastructure, which will further illuminate the equity implications of Lumio-dependent instruction.

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AUTHOR CONTRIBUTIONS

The following are the contributions made by each author in this research:

Anjani Akmal Fauziah: Conceptualization and design of the STREAM-based teaching materials, manuscript preparation and editing, development of visual components, and review and refinement of the article.

Rahayu Kariadinata: Responsible for expert validation of the content and provided academic supervision during the research and development process.

Hamdan Sugilar: Provided instructional media validation and guidance in supervising the development of interactive teaching materials using Lumio.

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