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The Development of Local History Learning Media Enhanced with Geographic Information Systems

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Abstract. History education emphasizes not only chronological understanding and factual knowledge but also the development of spatial thinking to comprehend the locations and contexts of past events. Nevertheless, students often face difficulties in understanding the spatial dimensions of local history. This study aims to develop geographic information system (GIS)–assisted local history-learning media to enhance students' spatial understanding in Padang. The study employed a research and development approach using the Four-D model, encompassing the stages of Define, Design, Develop, and Disseminate. A needs analysis was conducted through questionnaires and interviews with teachers and students, followed by the development of an interactive digital map based on the coordinates of local historical monuments using ArcGIS and Google Earth Pro. The media were validated by experts and tested for practicality with 32 senior high school students. The results indicated that the developed media achieved a feasibility score of 83.1%

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(highly feasible) and a practicality score of 98.48% (highly practical). These findings demonstrate that the GIS-assisted media effectively visualize local historical events, are easy to use, and enhance students' motivation and spatial understanding. This study contributes to history education by integrating GIS-based digital mapping to strengthen spatial perspectives in local history learning.

Keywords: learning media; local history; GIS; digital map; Padang City

1. Introduction

Conceptually, history education aims not only to develop students' understanding of chronology and historical facts but also to foster historical thinking skills that encompass the comprehension of space, time, and social context. Spatial thinking constitutes a crucial element in history learning, as past events always occurred within specific geographical settings that shaped their dynamics, meanings, and impacts. Ideally, history instruction should integrate spatial dimensions in a contextual manner so that students can understand how historical events are shaped by geographical settings, human interactions, and temporal dynamics, thereby enabling them to construct a comprehensive, meaningful, and interconnected interpretation of the past (Setiawan et al., 2025).

However, classroom practices in history education continue to reveal a significant gap between ideal expectations and instructional realities. History is often taught in a textual and memorization-oriented manner, resulting in students' difficulties in linking historical events to their geographical locations. The limited integration of spatial perspectives contributes to weak contextual understanding, low student engagement, and reduced learning (Meechandee & Meekaew, 2025). This condition is further exacerbated by the insufficient use of innovative instructional technologies and the scarcity of local history-learning media that are capable of presenting the interconnections between events, space, and students' immediate environments in a visual and interactive way (Petousi et al., 2022).

Recent studies have demonstrated that geographic information systems (GIS) offer substantial potential to support spatially oriented learning through dynamic and interactive visualization of geographic data. Nevertheless, empirical research on the use of GIS in education has predominantly focused on geography and science education, while its application in history education—particularly in local history learning—remains limited and fragmented. Existing studies generally position GIS merely as a supplementary visualization tool rather than as an integrated instructional medium that is systematically designed to develop spatial thinking within historical contexts (Aurellia et al., 2023).

In addressing this research gap, the present study offers novelty through the development of GIS-assisted local history-learning media that are pedagogically and contextually designed rather than merely representing a simple technological adaptation. The proposed media integrate digital maps, spatial data, and local historical narratives of Padang City into a cohesive, interactive learning environment (Azzahra et al., 2023). The novelty of this study lies in (1) the explicit

use of GIS as a history-learning medium that targets the development of students' spatial understanding, (2) the emphasis on local history as an authentic learning context that strengthens students' connections to their socio-cultural environment, and (3) the development of media that are grounded in the actual needs of teachers and students. Accordingly, this study not only contributes to the advancement of technology-based learning media but also enriches pedagogical approaches in history education and extends the application of GIS beyond the domain of geography.

2. Methodology

The research employed a research and development (R&D) approach adapted from Thiagarajan's 4D model consisting of four stages: Define, Design, Development, and Dissemination (Zhakupov et al., 2024). The study was conducted during the odd semester of the 2025/2026 academic year at State Senior High School 6 Padang. The sample used for the trial consisted of tenth-grade students from State Senior High School 6 Padang who were selected through purposive sampling. The total number of participants in this study was 32 students.

2.1 Define

This stage focuses on determining the requirements for product development according to its specifications (Yafie et al., 2024). In the Define stage, a needs analysis for the learning media was conducted (Hilda & Prasetyaningtyas, 2024). The data for the needs analysis were obtained from questionnaires completed by the teachers and students. Measurement of the teachers' needs was based on three indicators, namely Relevant with Learning Objectives, Learning Materials, and Ease of Access and Access Availability.

Table 1: Indicators for analysis of teachers' needs regarding local history-learning media integrated with geographic information system

Indicators	Question Items	Scores (%)	
		Yes	No
Relevant with Learning Objectives	The learning media help me to explain chronology, cause-and-effect relationships, and the context and location of historical events.	100%	0%
	I believe that learning media can enhance students' motivation in studying history.	100%	0%
	I feel that learning media can increase students' motivation in learning history.	100%	0%

Indicators	Question Items	Scores (%)	
		Yes	No
Learning Materials	I find it difficult to explain abstract historical material without the help of learning media.	40%	60%
	In my opinion, it is important to include the local history of Padang City as learning material.	60%	40%
	I need digital-map-based learning media to show the locations of local historical events in Padang City.	80%	20%
Ease of Access and Access Availability	I need interactive media to present local history material in an engaging way.	80%	20%
	I often use visual media such as pictures, maps, or videos in history learning.	50%	50%
	I need training or guidance in creating or using digital history-learning media.	100%	0%
	Learning media that include local history are essential in contextualizing history learning.	100%	0%

To provide a clearer understanding of the results of the analysis of the teachers' needs regarding the digital-map learning media, the findings for each indicator are visualized in Figure 1 below.

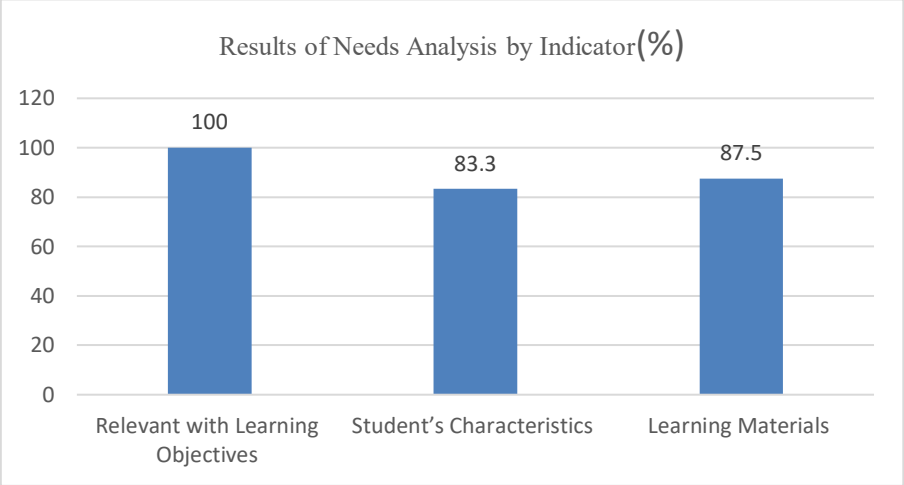

Figure 1: Teachers' needs analysis of digital-map learning media

The data for the learning-media needs analysis were obtained not only from teachers but also from students, as it was important to gather information about students' needs for learning media as well (Zulyadaini, 2024). To obtain information about students' needs for digital learning media, the researcher used a questionnaire instrument that was based on five indicators. Table 2 presents a detailed description of these indicators.

Table 2: Indicators for analysis of students' needs regarding local history-learning media integrated with geographic information system

Indicators	Question Items	Scores (%)	
		Yes	No
Relevant with Learning Objectives	Does the history-learning media you use help you to achieve the learning objectives?	100%	0%
	Is the history-learning media you use relevant to the learning objectives?	100%	0%
	I often find it difficult to visualize the locations of historical events without the help of pictures, videos, or other media.	70,6%	29,4%
	History learning, especially local history, becomes more engaging when accompanied by visual media such as maps, photos, or documentary films.	100%	0%

Indicators	Question Items	Scores (%)	
		Yes	No
Student's Characteristics	The learning media used suit my learning style.	97.1%	2.9%
	I prefer visual learning media (images only).	67.6%	32.4%
	I prefer audio-visual learning media (images and sound).	91.2%	8.8%
	I prefer digital learning media.	85.3%	14.7%
Learning Materials	In my opinion, it is important to study the local history of Padang City.	94.1%	5.9%
	Learning media help me to understand the locations of historical events.	97.1%	2.9%
	I find it easier to understand the local history of Padang City when it is accompanied by digital-map media.	85.3%	14.7%
	Have you ever received lessons on the local history of Padang City?	76.5 %	23.5%
	I know the locations of historical events based on the material I have studied.	77.2%	22.8%
Ease of Access and Access Availability	I have adequate access to devices (phone/laptop) and the internet to study history using digital media.	85.3%	14.7%
	I want to learn history using interactive digital media (e.g.) videos, infographics, or digital timelines).	97.1%	2.9%
	Media that presents local history of Padang City makes me more interested in learning history.	91.2%	8.8%

Indicators	Question Items	Scores (%)	
		Yes	No
Effectiveness	I often feel bored when the teacher explains verbally without using any media.	78.8%	21.2%
	The learning media used help me greatly in understanding the locations of historical events.	77.1%	22.9%

To provide a clearer understanding of students' needs for learning media based on the indicators, the results are presented in Figure 2 below.

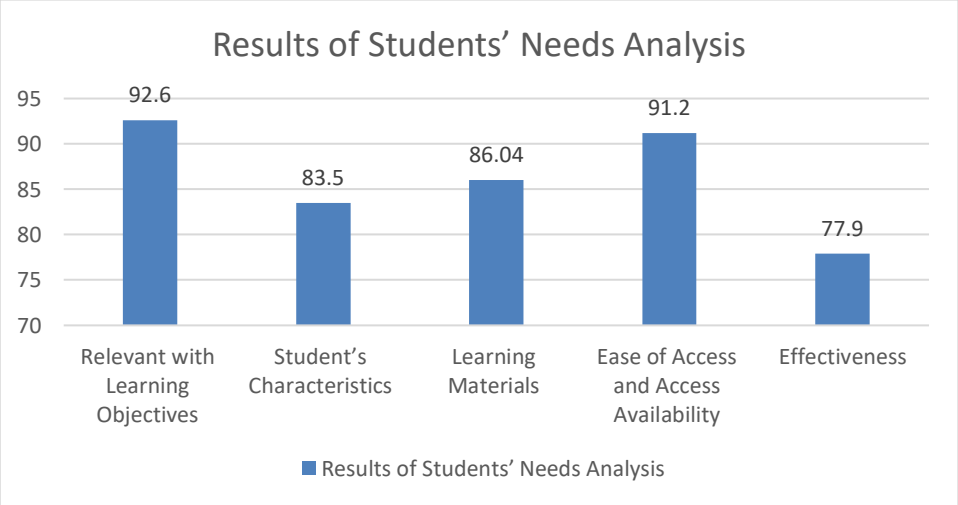

Figure 2: Students' needs analysis of digital-map learning media

2.2 Design

After obtaining the data from the needs analysis, which served as the basis for developing the learning media, the next step was designing the learning media. The product developed in this study was designed and constructed using ArcGIS software to ensure accurate spatial visualization and systematic integration of geographic data (Aurellia et al., 2023). The researcher first collected coordinate points of the research subjects, which consisted of historical monuments in Padang City (Agustinah et al., 2023). Collecting these coordinate points was essential because they served as data input for ArcGIS, thus allowing the visualization of the distribution of local historical sites in Padang City in the form of a digital map. Table 3 presents the coordinate data points.

Table 3: Coordinate points of historical monuments in Padang City

Coordinate Points of Historical Monuments in Padang City			
Number	**Monument Name**	**Coordinates**	
		X	**Y**
1	Bagindo Aziz Chan Monument	S $0^0$54'40.7986"	E$100^0$21'50.52303"
2	Pauh People's Struggle Monument	S $0^0$55'41.66436"	E $100^0$25'43.7502"
3	Bandar Buat Market People's Struggle Monument	S $0^0$56'57.336"	E $100^0$26'8.08692"
4	Gaung People's Struggle Monument	S $0^0$59'28.69152"	E $100^0$23'0.3066"
5	Linggarjati Monument	S $1^0$0'38.00448"	E $100^0$23'32.8524"
6	Sungai Barameh People's Struggle Monument	S $1^0$0'44.964"	E $100^0$23'28.42836"
7	Linggarjati Monument	S $0^0$57'30.1104"	E $100^0$23'56.0616"
8	Padang Area Monument	S $0^0$56'43.67868"	E $100^0$22'38.74188"
9	Youth Syarif Monument	S $0^0$56'57.19812"	E $100^0$21'19.23012"
10	Rimbo Kaluang Battle Monument	S $0^0$5'34.86576"	E $100^0$21'38.26764"
11	Linggarjati Tabing Monument	S $0^0$52'10.1082"	E $100^0$20'39.01704

After the data were entered into ArcGIS, the next step was to create a map visualization showing the distribution of local historical monuments in Padang City. This would later serve as the learning media. Figure 3 presents the map display created using ArcGIS.

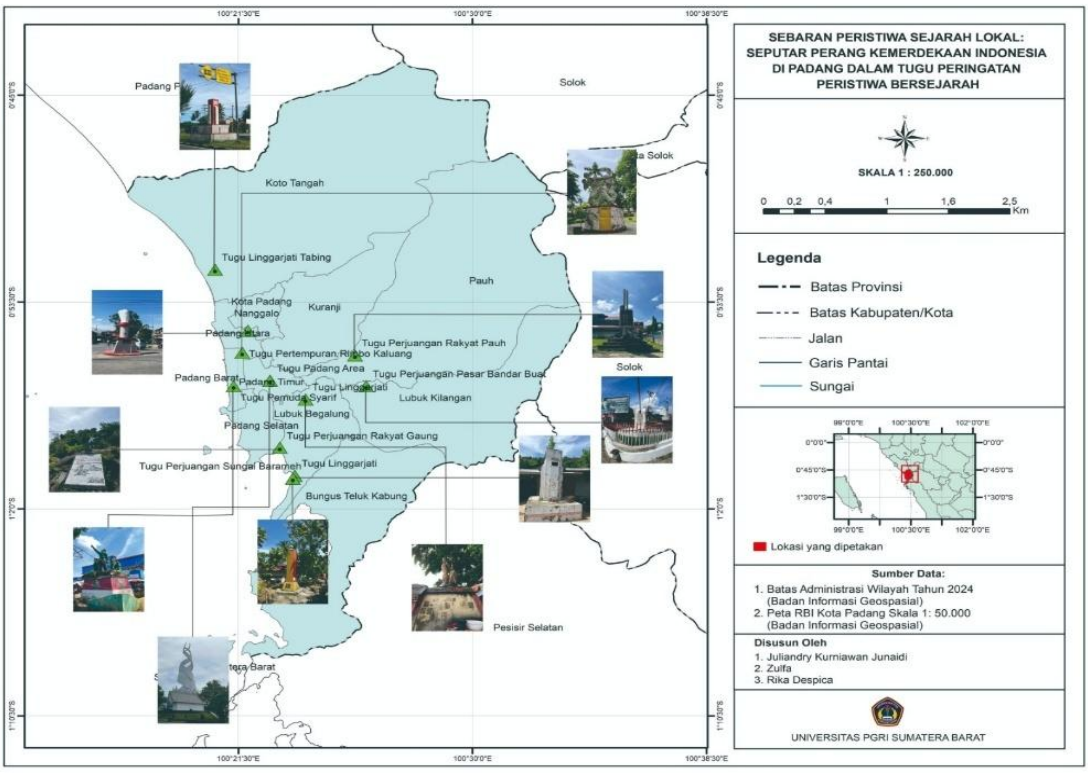

Figure 3: Distribution of historical monuments in Padang City by district

In the development of the digital-map learning media, the researcher used Google Earth Pro software to make the images appear more realistic. Google Earth Pro was used to display the locations of historical events in Padang City and to provide advanced geospatial data visualization. It was also used to record virtual tours and create videos from the explorations in Google Earth for presentation and information-sharing purposes. Figure 4 presents the learning-media product that was produced using Google Earth Pro.

Figure 4: Maps of historical monument areas after using Google Earth Pro

2.3 Development

The results from the Design stage of the history-learning media were then used to develop a complete digital map, which was subsequently validated by an expert validator. The product was revised based on the validator's feedback and suggestions to improve its quality (Handayani et al., 2024; Ubaidillah et al., 2022). The developed learning media were validated by a validator who was a lecturer in Information Technology Education. The media were evaluated based on four assessment aspects for learning media: design, language, audio, and visual animation. To calculate the validity of the learning media, the researcher used the Aiken's V formula as follows:

$$V = \frac{\sum s}{n(c-1)}$$

Description:
s = r − lo
r = score given by the validator
lo = lowest score on the scale
n = number of validators
c = number of scale categories (for example, Likert scale 1–5 → c = 5)
Interpretation:
V ≥ 0.80 → valid
0.40 ≤ V < 0.80 → needs revision
V < 0.40 → not valid

Table 4: Results of the learning media expert feasibility assessment

Number	Aspect	Total Score	Maximun Score	Percentage	Category
1	Design	19	25	76	Valid
2	Language	9	10	90	Valid
3	Audio	8	10	80	Valid
4	Visual Animation	13	15	86,7	Valid
	Average			83.1	

Based on the results of the learning media validation above, an average score of 83.1% was obtained, which is categorized as "Highly Feasible." This category is considered feasible because the score is ≥ 61%. This indicates that the developed learning media have met the indicators in the aspects of design, language, audio, and visual animation.

2.4 Dessimination

At the Dissemination stage, the researcher conducted a limited trial to determine the level of ease of use of the developed learning media. The practicality test of the learning media was carried out to assess the level of ease, usefulness, and feasibility of students using the media directly. The testing process involved 32 students as users, employing a Likert scale–based questionnaire that included three main aspects: usability (ease of use), effectiveness (achievement of learning objectives), and benefit (usefulness in the learning process). The analysis results showed that the learning media achieved an average practicality score of 98.48%, which falls into the "Highly Practical" category based on the feasibility criteria of 81%–100%. The visualization of the results for each practicality test indicator is presented in Table 5 below.

The formula that is most commonly used (referencing Sugiyono, Akbar, Nieveen, Riduwan and Akon.) for calculating the percentage score from the questionnaire responses is as follows:
P = "Obtained Score" / "Maximum Score" × 100%

Description:
Obtained Score = total score from respondents (teachers/students)
Maximum Score = number of items × highest possible score × number of respondents
P = practicality percentage

Table 5: Results of the learning media practicality test

Aspek	Average Score	Percentage	Category
Usability	3.93	98.15%	Highly Practical
Effectiveness	3.94	98.61%	Highly Practical
Benefit	3.93	98.15%	Highly Practical
Average		98.48 %	Highly Practical

Based on the practicality test involving the respondents, the average practicality percentage obtained was 98.48%. When converted using the interpretation criteria of Riduwan and Akon (2013), the learning media fell into the "Very Practical" category (81%–100%). Further analysis showed that all assessment aspects achieved high scores. The usability aspect (ease of use) reached 98.15%, followed by effectiveness (achievement of objectives) at 98.61% and usefulness (benefit for students) at 98.15%. These findings indicate that the learning media are easy to use, help students to understand the material, and provide an enjoyable and efficient learning experience. The variation in the respondents' scores was also very small (ranging from 95% to 100%), indicating consistent user acceptance of the media. Therefore, it can be concluded that the learning media are feasible for use in the learning process without major revisions, and they have high potential for broader implementation.

3. Results

3.1 Results of Teachers' Needs Analysis

In this study, the analysis of the learning-media needs of both teachers and students served as the database for developing the digital-map–based history-learning media using ArcGIS. Based on the questionnaire results, particularly the indicator related to learning objectives, teachers indicated the need for learning media that could help them to achieve instructional goals. This is evident from the 100% response rate on Questionnaire Item 1: "*The learning media help me to explain chronology, cause-and-effect relationships, and the context and location of historical events.*" This finding shows that learning media, especially digital maps, are useful for helping teachers to demonstrate the locations of historical events.

The digital-map–based history-learning media function as an innovative tool that enhances teachers' teaching experience by integrating geographical information with historical narratives (Lionar et al., 2024). It facilitates a deeper understanding of historical contexts and spatial relationships, making it valuable for various history-learning implementations. Tools such as the GIS enable historical map analysis, which assists students in comprehending complex historical dynamics. Digital history-learning media such as the GIS allow dynamic visualization of historical changes, enhance student engagement, facilitate primary source analysis, and support the development of historical arguments (Jaeger, 2024).

Educational media transmit messages from various sources to facilitate learning, improving understanding, engagement, and effective learning by aligning with teaching objectives, student interests, and learning conditions (López-García, 2023). Proper media selection enhances instruction delivery by aligning with learning theories that promote student interest, engagement, and motivation, ultimately leading to improved outcomes and more effective educational processes (Taha & Abdulrahman, 2023). The selection of appropriate learning media enhances lesson delivery by aligning it with specific learning theories, which increases students' interest, engagement, and motivation, ultimately leading to improved learning outcomes and a more effective educational process (Aldi et al., 2025).

Regarding the third indicator, the questionnaire results revealed that teachers need learning media that are easily accessible. The responses reached 100%, with teachers emphasizing the need for engaging local history-learning media that incorporate local historical contexts (Jamiludin & Darnawati, 2022). Interactive history-learning media have emerged as vital tools in enhancing educational experiences by integrating modern technology with historical content. Such media aim to engage students more deeply, foster historical thinking, and improve learning outcomes through innovative approaches. These multimedia resources encourage students to engage in objective discussions, seek information, and collaborate in idea sharing. The system design prioritizes high usability and intuitive user interfaces, making the media accessible to both teachers and students and thus fostering a more interactive and inclusive learning environment in modern history education.

3.2 Results of Student Needs Analysis

The results of the analysis of students' needs for local history-learning media show that such media play a significant role in improving the effectiveness of history learning. Based on questionnaire responses, 100% of the students stated that the learning media used by teachers helped them to achieve learning objectives. This indicates that the presence of media in learning has a positive impact on achieving educational goals. These findings are consistent with studies asserting that learning media serve as tools to enhance motivation and learning outcomes (Arrasyid et al., 2019). Additionally, all students acknowledged that the media were relevant to learning objectives, meaning that the media functioned not merely as a supplement but as an integral component aligned with the intended competencies. This supports the argument that selecting media that are consistent with instructional objectives is key to successful learning and the development of students' spatial knowledge (Aldi et al., 2025).

However, regarding the questionnaire item on the difficulty of imagining the location of historical events without media, 29.4% of students reported challenges. This confirms that history learning requires visual media that are capable of representing the location and context of historical events concretely. Therefore, the development of digital-map–based media becomes highly relevant to address this issue. According to Malysheva et al. (2022), the use of digital maps in history learning can enhance students' spatial understanding of historical events.

Concerning the terms of media preferences, in the current study, 91.2% of students preferred audio-visual–based learning media over static-visual media. This demonstrates that today's generation is more attracted to interactive and dynamic media. These findings are consistent with multimedia learning theories, which suggest that combining images and sound can improve retention and understanding of abstract concepts (Petousi et al., 2022).

Regarding learning content, 94.1% of students stated that learning the local history of Padang City is important. Most students also agreed that digital maps make it easier to understand the locations of historical events (85.3%). Moreover, 91.2% said they were more interested in learning local history when it was presented using interactive digital media. This indicates that GIS-based media have the potential to increase student engagement in history learning. Concerning effectiveness, 78.8% of students reported feeling bored when teachers delivered lessons verbally without media. This underscores the urgency of using instructional media to prevent student fatigue and increase learning motivation. Several studies have shown that engaging learning media can reduce boredom, foster motivation, and help students to understand material more extensively (Humble, 2023).

Overall, the need-assessment results show an urgent need to develop GIS-based local history-learning media in the form of interactive digital maps. Such media not only address students' difficulties in understanding historical locations but also enhance learning motivation, material relevance, and overall learning effectiveness. By using geospatial technology, students can explore historical landscapes interactively, making the learning experience more meaningful (Robinson et al., 2021). Thus, these findings form a strong foundation for developing GIS-based local history-learning media as an innovative solution to improve the quality of history education in Padang City.

3.3 Practicality of Learning Media

The practicality test results for the developed learning media showed an average score of 98.48%, which is categorized as "Highly Practical." This high percentage indicates that the learning media possess optimal usability, effectiveness, and usefulness. These findings confirm that the developed media are not only theoretically sound but also practically applicable in real learning situations.

3.3.1 Usability

In terms of usability, the media achieved an average score of 3.93 (98.15%), indicating that they are very easy to use by both students and teachers. This ease of use is reflected in its simple interface, clear navigation, and easy-to-understand usage instructions. These results align with previous studies, which assert that the practicality of media depends on how easily users can operate them in real situations (Geng et al., 2019). Highly usable media allow students to engage independently without extensive teacher assistance. This supports self-directed learning, a crucial skill in 21st-century education. Therefore, these learning media not only simplify the learning process but also foster students' independence.

3.3.2 Effectiveness
In terms of effectiveness, the media achieved an average score of 3.94 (98.61%), indicating that it is highly effective in supporting learning objectives. The media effectively help students understand materials, maintain focus, and actively participate in learning (Ibrahim et al., 2018). This high effectiveness shows that the developed media can significantly enhance students' learning outcomes.

3.3.3 Usefulness
The usefulness aspect received an average score of 3.93 (98.15%), demonstrating that the media are not only practical but also provide tangible added value to the learning process. Students experienced greater ease in understanding material, increased motivation, and more interactive and enjoyable learning experiences. Useful media encourage students to be more active, creative, and critical in processing information

4. Discussion

The results of the analyses of the teacher and student needs show a shared tendency: the need to develop GIS-based local history-learning media in the form of interactive digital maps. Questionnaire data revealed that current learning media help students to achieve objectives but still lack features that aid in visualizing historical locations. This reinforces earlier studies emphasizing that learning media serve strategic functions in clarifying information, increasing motivation, and enhancing comprehension (Tirado-Olivares et al., 2024).

Most students (97.1%) stated that media help them to understand historical event locations. However, 29.4% of students still experience difficulty when learning without media, indicating a specific need for visual and spatial-based media that present historical information more concretely. Additionally, students' preference for audio-visual media (91.2%) shows that today's learners are more responsive to interactive learning than static formats. This aligns with Mayer's Multimedia Learning Theory, which states that combining text, images, and sound enhances comprehension and retention (Bikar et al., 2022).

Students' boredom when teachers rely solely on lectures (78.8%) also underscores the urgency of integrating technology into learning. Regarding content, 94.1% of students considered Padang's local history important, yet 23.5% had never been formally taught it. This gap between student needs and available content highlights the importance of GIS-based media—not only as a learning tool but also as a means of preserving local knowledge (Setiawan et al., 2025). From the teachers' perspective, the need for interactive digital maps is equally evident, as they help present historical event locations more clearly and engagingly. Hence, there is alignment between student and teacher needs—students want interactive media and teachers require tools to support their instruction. This finding aligns with previous research emphasizing that integrating digital technology in education enhances engagement for both teachers and learners (López-Meneses et al., 2025).

Combining both teacher and student data demonstrates that GIS has significant potential in addressing the needs of both groups. Interactive digital maps provide visual-spatial representations that not only display historical locations but also allow for interactive exploration (Corrales-Serrano et al., 2019). Other studies have shown that the GIS in history education strengthens students' spatial, analytical, and critical-thinking skills (Sofias & Pierrakeas, 2023). Hence, this medium aligns with 21st-century learning competencies (Yamauchi et al., 2025). The novelty of this research lies in its focus on applying the GIS specifically to history learning in Padang using ArcGIS and Google Earth Pro to provide a detailed spatial understanding of historical events. While previous studies have focused mainly on the GIS to support comprehension or motivation, this research emphasizes both technical implementation and empirical classroom impact on learning outcomes and motivation (Yamauchi et al., 2024).

5. Conclusion

This study was conducted to address the problem of students' limited spatial understanding in history learning, particularly in the context of local history in Padang City, as outlined in the introduction. The lack of instructional media that are capable of integrating spatial perspectives with historical content constituted the primary rationale for developing GIS-assisted local history-learning media in the form of interactive digital maps. The findings demonstrate a clear alignment between the initial research expectations and the empirical results obtained in this study. Both teachers and students expressed a strong need for visually rich, interactive, and technology-based learning media to support the understanding of historical locations and contexts.

These findings reaffirm that effective history learning should not be confined to chronological and factual dimensions but must also emphasize spatial understanding to enable students to construct more comprehensive and meaningful historical knowledge. The development of GIS-assisted learning media using ArcGIS and Google Earth Pro resulted in an interactive digital mapping product that was evaluated as highly feasible by expert validators, achieving an average feasibility score of 83.1%, and as highly practical by students, with a practicality score of 98.48%. These results indicate that the developed media are sufficiently practical for implementation in the learning process and are easy to use. Therefore, these media are considered sufficiently appropriate to be used as a supportive instructional tool in history learning.

Substantively, this study confirms that integrating GIS into local history learning can bridge the gap between abstract historical narratives and concrete geographical realities. Interactive digital maps function as an effective medium for strengthening students' spatial literacy, fostering greater interest in local history and enriching learning experiences in line with the demands of 21st-century education. Future research is recommended to extend this study to large-scale implementation and examine the effectiveness of GIS-assisted media in improving students' learning outcomes, spatial thinking, and historical reasoning skills.

However, this study has several limitations, including a relatively small sample size, implementation within a single educational setting, reliance on self-reported data, a short trial duration, and the absence of a comparison group. These limitations may restrict the generalizability of the findings. Therefore, future research is recommended to conduct broader implementation studies involving larger and more diverse samples, longer intervention periods, and experimental designs in order to examine further the effectiveness of GIS-assisted learning media in improving students' learning outcomes and spatial thinking skills.

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