



Development of Interactive Learning Media Based on Microsoft Sway to Improve Spatial Thinking Skills

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ABSTRACT

Purpose - This study aims to develop an interactive learning media in Microsoft Sway to enhance participants' spatial thinking skills.

Methodology - Method study using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The study population consisted of grade 11 students at SMA N 1 Banawa across 8 classes. A sample of 30 participants was drawn from class XI C IPS. The instrument included 1) tests to think spatially as a pre-test and post-test, 2) questionnaire validation and eligibility expert technology learning, and 3) questionnaire teacher and participant responses to educate. Analyse data for effectiveness testing using the N-Gain test. Eligibility was measured based on expert validator results, technology learning outcomes, teacher and participant responses, and the educational use percentage formula.

Findings - Research results obtained results validation media expert with a score of 96.2 is included in the excellent category, or worthy, which is Very worthy, and did need to be revised; however, for perfection, the fixed validator product provides suggestions for improvement. From the effectiveness test, an N-gain value of 0.50, or an enter criterion of medium, was obtained, indicating that Microsoft Sway interactive media was developed effectively to improve spatial thinking. "Feasibility test results based on teacher and participant responses yielded scores of 82 and 86, respectively, both classified as Good. This indicates the media is suitable for use and requires no revision. The interactive media developed in Microsoft Sway is practical and feasible for enhancing participants' spatial thinking skills.

Contribution - This research provides a positive contribution to the application of technology, media, and digital teaching materials. Suggestions for future researchers include developing interactive Microsoft Sway-based media for other learning materials or subjects and conducting product trials on a broader scale.

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INTRODUCTION

Technological developments enable students to learn anytime and anywhere. 21st-century learning prioritizes a more flexible, fun, and technology-based approach. (Listiqowati et al., 2022). Various learning models can be used, including online, hybrid, blended, and flipped learning. Convenience in study should be balanced with the improvement of the quality of the process and results of the study, good from the aspect of mastery of content and skills. Geography is one of the key lessons at the level of education medium above. Geography learn a very complex phenomenon. It involves phenomena on the surface of the earth, within the earth, and the interaction of man with the environment. Through learning geography, participants are expected to develop control over various aspects of geography, have geography skills, and develop a care for the environment (Aksa, 2019; Listiqowati, 2021).

In geography learning, materials such as sustainable development contain complex concepts that require support from media that can present information interactively and facilitate the development of students' spatial thinking skills (Darung et al., 2020). Spatial thinking is the ability to understand, analyze, and manipulate information about space and location. Spatial thinking is an essential skill in geography and sustainable development studies (Silviariza et al., 2021). Sustainable development emphasizes the balance among economic, social, and environmental aspects, as well as a deep understanding of the relationship among space, natural resources, and regional management (Mensah, 2019; Rolnick et al., 2023; Tanjung et al., 2025). In the context of geography, this requires good spatial thinking skills. Thus, geography education must facilitate students' understanding of spatial components and their linkages to sustainable development. (Maryati et al., 2025).

One specific skill in geography is spatial thinking. Spatial thinking is a characteristic of typical learning in geography. Spatial thinking is a complex thinking skill that encompasses knowledge, skills, attitudes, and ways of thinking about spatial concepts (Aliman, 2016; Kurniawan, N., 2022; Listiqowati, 2025). Spatial thinking allows learners to observe, describe, and communicate in spatial terms. It enables conceptual understanding, spatial problem-solving through multiple strategies, and fosters environmental sensitivity. (Wijayanto et al., 2020). Spatial thinking can foster students' environmental awareness, problem-solving skills, and understanding of sustainable development (Cholifah et al., n.d.; Manek, 2023). Central Sulawesi is one of Indonesia's provinces with significant potential for renewable energy. For example, in the Regency of Donggala, the wealth source, natural power, spans various sectors, from the agricultural sector to the mining sector. Agricultural commodities include cocoa, coconut, robusta coffee, cloves, pepper, and cashew nuts. The region's mining potential encompasses gold, sandstone, natural gravel, crushed stone, natural sand, and foundation stones. These natural resources should be integrated into geography education as contextual study materials to equip future generations with the capacity to manage them responsibly and sustainably. However, geography learning remains non-contextual, with little connection between theory and students' real experiences. The process remains monotonous, lecture-dominated, memorization-focused, textbook-centred, and neglects to integrate local resources as learning materials. Geography learning is insufficiently contextual, with inadequate exercises and limited practice using the surrounding environment. Participants' lack of awareness of their spatial environment results in low spatial thinking abilities. The most frequently used media are static books or text-only displays, which provide insufficient motivation for students. However, 21st-century learners are more engaged with digital media.

Spatial thinking encompasses the ability to understand location, patterns, distribution, and interrelationships between spaces. The local potential of Donggala Regency in the form of agriculture and mining can facilitate the enhancement of spatial thinking, for example: (1) Through analysis of the distribution of agricultural land and mining areas, (2) Understanding the relationship between geographical conditions such as soil, water, and topography with types of economic activities, (3) Examining spatial impacts, such as land conversion, pollution, or landscape changes. Thus, students learn about space not merely as a place, but as an interconnected system. Local context is important for students to study in order to foster awareness of the sustainability of local natural resources, which are not unlimited, as regional assets that must be

continuously preserved. Students can examine real examples such as agricultural land degradation, environmental damage from mining, and conflicts in spatial utilization, and analyze various resource management options: which are economically beneficial, which are environmentally friendly, and how to balance them. Learning based on local potential cultivates a sense of ownership and responsibility toward their region and encourages critical thinking about how to manage natural resources sustainably. Therefore, learning media that are practical, flexible, and easy to use are needed, capable of presenting natural resource materials and sustainable natural resource management in an engaging, contextually relevant manner. Consequently, the development of interactive digital media is essential to enhance student motivation and facilitate behavioral and skill development.

One possible solution is the development of interactive media, Sway, which presents dynamic presentations and engaging visuals (Himawan & Satrio, 2016; Pepermans & Maesele, 2016; Umam & Astawa, 2018). This media can help students understand the concept of sustainable development in a more engaging and easy-to-understand way. Sway is a Microsoft product, a digital application with various uses, including creating presentations, summaries, and other engaging documents. Sway is easy to use and offers several advantages that support the learning process, especially in blended learning contexts combining face-to-face and online learning (Merliana et al., 2021; Styamulya Mawarni et al., 2022). One of the main reasons is its ease of use. Microsoft Sway integrates various media, such as text, images, video, and audio, into a single interactive and engaging presentation (Merliana et al., 2021). This will help increase student interest and engagement in learning. Microsoft Sway can make it easier for teachers to create, store, and manage learning materials in one online platform. In addition, Microsoft Sway allows students to learn independently, without being bound by time or place.

The novelty of this research is that learning media using Microsoft Sway has not yet been developed for geography learning materials, specifically natural resources and sustainable development based on local potential in Donggala Regency. Therefore, the purpose of this research is to develop interactive learning media based on Microsoft Sway to enhance spatial thinking in sustainable development. The results of this development are expected to contribute to the implementation of digital media and technology in geography learning, improve students' spatial thinking skills, and motivate them to learn geography.

METHODOLOGY

Research Design

This research is a development study using the ADDIE model, which consists of five steps: Analyze, Design, Development, Implementation, and Evaluation. The ADDIE model was selected because it is systematic and structured, suitable for educational products, allows implementation across small to large trial groups, and has extensive research references. The flowchart of the ADDIE Model is as Figure 1.

First step is analysis. This stage is divided into two parts are needs analysis and feasibility analysis. Needs analysis including need for dynamic learning, need to enhance students' spatial thinking, need for accessible digital media and learning resources, and need for flexibility in blended learning, hybrid learning, online learning, flipped learning, and similar approaches. Feasibility analysis including scientific literature review on interactive Microsoft Sway-based learning media to improve learning processes and enhance spatial thinking, supporting facilities and infrastructure at the research site, and all students possess cellphones or Android devices. Second step is design. The researcher designed the Sway media product by determining learning objectives based on spatial thinking in sustainable development material, designing interactive learning channels in Microsoft Sway, and arranging content with interactive multimedia elements (text, images, videos, maps). Third step is development. This stage realizes the designs through, 1) creating content using Microsoft Sway features, 2) integrating interactive elements like quizzes and simulations, and 3) validating the media with learning media experts.

Fourth step is implementation. Implementation was conducted at SMAN 1 Banawa, Donggala Regency, through a limited trial of the Microsoft Sway-based interactive learning media in class XI C IPS with 30

students. The limited trial objectives were to test product feasibility and measure Microsoft Sway's effectiveness in enhancing students' spatial thinking. Fifth step is evaluation is evaluation was conducted in two types are formative and summative evaluation. Formative evaluation was conducted at each prior ADDIE stage to ensure the learning media aligned with the expected goals. A summative evaluation was conducted after the limited trial to assess the media's effectiveness in improving spatial thinking. Summative evaluation steps included: evaluating improvements in students' spatial thinking, assessing student responses, and obtaining teacher responses to the developed media product. After evaluation, the product was revised to achieve reliable development results.

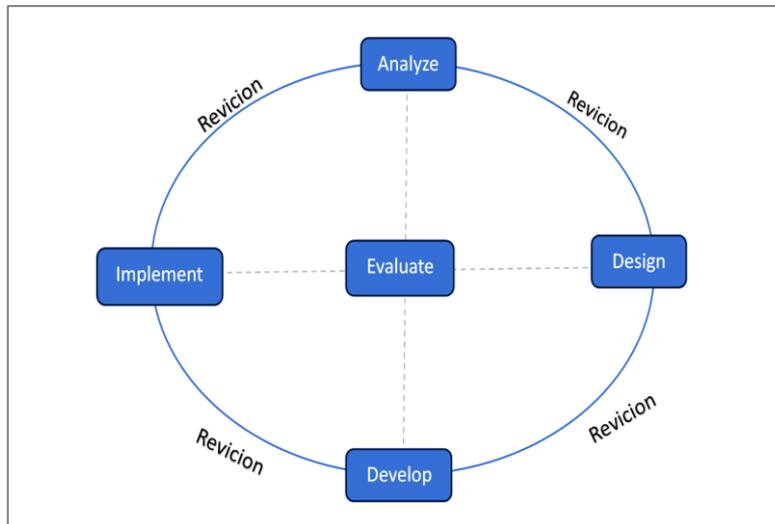


Figure 1. ADDIE Model Flowchart (Muryandari, 2025)

Population and Sample

The population in this study comprises all Grade XI Social Science students at SMAN 1 Banawa, totalling eight classes. The sample is class XI C IPS, comprising 30 students aged 16–17 years. The selection of this class is based on considerations of ability, with students having relatively similar academic abilities in the moderate category for spatial thinking skills, making it suitable for testing the effectiveness of the developed learning media. From a pedagogical perspective, the research focuses on the stability of the learning process and the alignment of geography material with spatial thinking competencies. The use of a single class is also in line with the research objective as a limited trial, which emphasizes evaluating the product's feasibility and effectiveness rather than comparisons between classes. The rationale for using only one class as the sample is that this is a limited experiment designed to reduce academic ability gaps between classes, minimize teacher influence, obtain homogeneous data, and focus on product feasibility and effectiveness rather than on class comparisons. The selection of SMAN 1 Banawa as the research location is based on a feasibility analysis: it has internet access, and teachers and students have smartphones or Android devices, but have not optimally utilized digital-based interactive learning media.

Data Collection

Effectiveness data were obtained through pre-test and post-test scores. Product feasibility data were gathered from product validation results by learning media experts using a Likert scale instrument. Additionally, data were collected from questionnaires administered to teachers and students to obtain their responses, suggestions, and recommendations.

Instruments

Test instruments, consisting of pre-test and post-test questions, were used to assess students' spatial thinking skills. These questions are based on the learning outcomes for natural resources and sustainable

development materials. A test blueprint was created based on learning outcomes and spatial thinking indicators. The pre-test and post-test blueprint is shown in Table 1 below:

Table 1. Spatial Thinking Test Instruments (Pre-test and post-test)

Indicator	Definition	Topics	No Question
Comparison	Compare places that have similarities and differences	Analyzing the influence of Indonesia's astronomical, geographical, and geological location on climate diversity, economic and cultural traffic, and the diversity of Indonesia's natural resources, Designing real-life activities based on Indonesia's astronomical, geographical, and geological location	9 and 10 11 and 12
Aura	Shows how an area's unique characteristics influence surrounding areas.	Analyze the management of natural resources, regional characteristics, impacts, and problems.	5, 13, 14, and 15
Region	Identifies and groups places with shared characteristics into unified regions	Show the distribution of Indonesia's natural resources	16, 17, 18, 19, and 20
Hierarchy	Shows places organized by hierarchy within an area.	Analyze the influence of Indonesia's astronomical, geographical, and geological location on climate diversity, economic and cultural traffic, and the diversity of Indonesia's natural resources.	6, 7, and 8
Transition	Analyzes sudden, gradual, or irregular changes in places	Develop simple and sustainable natural resource management plans	21, 22, 23, 24, 25, and 26
Analogy	Finds positions in other regions with similar conditions.	Describe the astronomical, geographical, and geological locations of Indonesia Apply locational concepts to the astronomical, geographical, and geological aspects of Indonesia	1, 2, and 3 4
Pattern	Explains the patterns or structures of phenomena or conditions within a region.	Describe the potential of Indonesia's natural resources	27, 28, 29, 30, 31, and 32
Association	Predicts paired phenomena that tend to occur together in the exact location.	Analyze natural resource management, its impacts, and associated problems.	33, 34, 35, 36, 37, 38, 39, and 40

Pre-test and post-test questions were previously pilot-tested at a different school, namely SMAN 1 Banawa Tengah, to ensure the confidentiality and consistency of the test items. The trial was conducted with 30 Grade XII students, after which validity and reliability were calculated. Validity and reliability test results showed that of the 40 test items created, six were invalid: questions 13, 18, 32, 33, 35, and 38. Therefore, the questions used in this study totaled 34 items. Furthermore, after data collection, analysis is conducted. The data analysis technique in this research is percentage analysis, which is then classified into spatial thinking skill classifications, as shown in Table 2 below.

Table 2. Classification of Spatial Thinking Skills

No	Achievement Level	Information
1	80.1-100	Very high
2	70.1-80	High
3	60.1-70	Moderate
4	50.1-60	Low
5	1-50	Very Low

Source: (Fitri. et al, 2023)

Data Analysis

The expected outcome of this research is to produce an interactive learning media product based on Microsoft Sway to enhance spatial thinking in sustainable development education.

Target Achievement Indicators

Effectiveness of Microsoft Sway-Based Interactive Learning Media in Improving Spatial Thinking. The N-Gain formula calculates pre-test and post-test results to determine effectiveness. The N-Gain formula measures the improvement in students' spatial thinking after receiving treatment with the Microsoft Sway-based interactive learning media product developed for this study. If there is a significant improvement, the Microsoft Sway-based interactive learning media is considered effective in enhancing students' spatial thinking.

Table 3. N-Gain Category Intervals for Learning Media

N-Gain Range	Category
N-Gain > 0.7	High
$0.3 \leq \text{N-Gain} \leq 0.7$	Moderate
N-Gain < 0.3	Low

Feasibility of Microsoft Sway-Based Interactive Learning Media for Improving Spatial Thinking. Teacher and student response data regarding the Microsoft Sway-based interactive learning media are calculated using the following formula:

$$P = \frac{x}{\sum x_i} \times 100\%$$

Where P is percentage score sought, x is total score from all respondents, $\sum x_i$ is maximum possible total score (ideal value), and 100% is Constant multiplier. However, the product feasibility is determined using the intervals in Table 4 below.

Table 4. Product Feasibility Assessment Criteria

Score value	Qualification	Information
90% - 100%	Very good	Highly feasible; no revision needed
75% - 89%	Good	Feasible; no revision needed
65% - 74%	Adequate	Moderately feasible; minor revisions needed
55% - 64%	Poor	Less feasible; significant revisions needed
0% - 54%	Very Poor	Not feasible; major revisions required

Source: (Listiqowati, 2025)

FINDINGS

This development study employed the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. The results of each stage are as follows:

Analysis

The analysis stage comprises two components: needs analysis and feasibility analysis. Needs analysis was conducted through observations and interviews with teachers and students. The results of observations to identify the needs of students and teachers at SMA N 1 Banawa can be seen in Table 5 below.

Table 5 shows that the learning process at SMAN 1 Banawa remains oriented towards memorization, with textbooks as the primary learning resource and the lecture method as the delivery method. It is also corroborated by the results of an interview with the teacher (MI) who said that:

"We lack variety in learning media, especially media and teaching materials based on local content such as natural resources and sustainable development. We also lack teaching with contextual discussions because our learning resources are only textbooks." (MI)

Based on the observation and interview results, the development of interactive learning media based on Microsoft Sway is needed to enhance spatial thinking in sustainable development.

Table 5. Results of Initial Observation of the Learning Process

No	Observed Points	Observation Results
1	Learning Outcomes Orientation	Memorization-based, not yet oriented towards spatial thinking skills
2	Learning Resources:	National textbooks, so teaching materials are not contextual to the local situation of the area
3	Media	Without using learning media
4	Method	Monotonous, dominated by the lecture method

Students require media that is practical, easily accessible via Android devices, and capable of encouraging active engagement. Microsoft Sway was selected because it is cross-platform compatible, cloud-based, easily accessible, and flexible for use across various learning models, such as blended learning and the flipped classroom. This media also enables multimedia integration that can enhance motivation, creativity, conceptual understanding, and spatial thinking skills. Regarding feasibility, existing literature indicates that interactive Sway media effectively enhances learning motivation, conceptual understanding, and higher-order thinking skills. School infrastructure supports implementation, with internet access available and Android devices owned by virtually all students. Consequently, the development of Microsoft Sway-based interactive learning media is feasible to improve the quality of geography instruction and develop students' spatial thinking abilities.

Design

The design stage of the interactive learning media based on Microsoft Sway begins with the formulation of learning objectives and the design of content on natural resources and sustainable development. Content design integrates text, images, and videos. This multimedia integration creates an engaging, interactive, and user-friendly learning experience that supports students' independent or teacher-guided learning in developing critical thinking, creativity, and spatial thinking skills, aligned with student needs and established research objectives. The design process for Microsoft Sway Interactive Media on natural resources and sustainable development is shown in Figure 2 below.

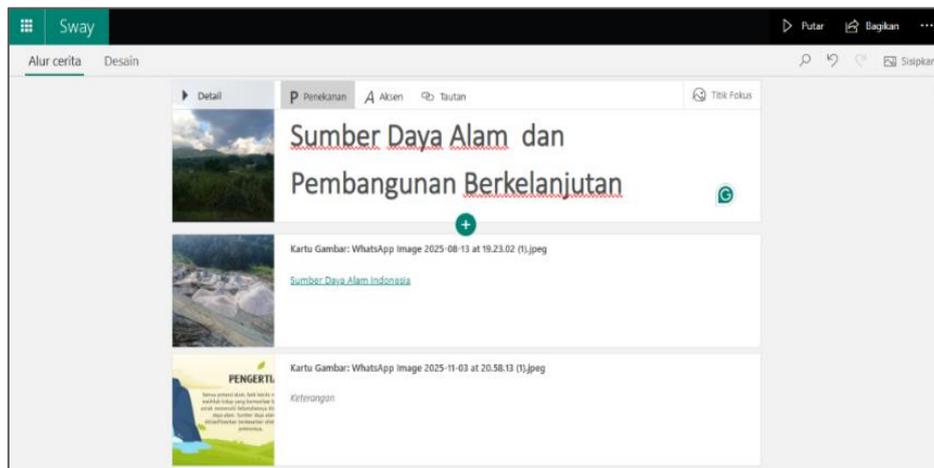


Figure 2. Sway Media Design Process

Development

The development stage involves turning the prepared design into an educational website using Microsoft Sway 365, followed by expert validation testing. The validation of the Microsoft Sway interactive media product was conducted by an Educational Technology expert who gave a feasibility score of 90.39%, categorized as "Very Good" –meaning it is highly feasible and does not require revision. However, for improvement purposes, the validator provided suggestions. The suggestions were to enhance color gradation, font size, and image layout. The Microsoft Sway media was then revised based on these suggestions to improve visual appeal, readability, and display proportions. This validation ensures that the media aligns with learning objectives and meets technical requirements, including design consistency, navigation, multimedia feature usability, and student-friendliness. The advantages of the developed Microsoft Sway 365-based interactive learning media product are its flexibility and ease of use on both Android phones and laptops. The link creator can easily update materials, and all link holders will automatically receive those updates. However, despite its advantages, this Microsoft Sway 365-based interactive learning media product has a weakness: expert validation involved only one validator, limiting the feasibility assessment. The appearance of the Microsoft Sway interactive media on natural resources and sustainable development.



Figure 3. Sway Interactive Media Accessed

Implementation

The implementation was carried out at SMAN 1 Banawa, Donggala Regency, through a limited trial of the Microsoft Sway-based interactive learning media in class XI C IPS with 30 students. The purposes of the limited trial were to: 1) test the effectiveness of Microsoft Sway in improving students' spatial thinking, and 2) assess the feasibility of the developed product. The detailed research results are as follows:

Effectiveness Testing through Quasi-Experimental Design

The effectiveness of Sway interactive media was tested using a quasi-experimental one-group pretest-posttest design, with one experimental class and pre- and post-test measurements. Effectiveness was assessed using the N-Gain formula. The pre-test and post-test scores are presented in Table 6 below:

Table 6. Pre-test and Post-test Values of Spatial Thinking Skills

No	Achievement Level	Information	Pre-test	Posts
1	80.1-100	Very high	2	21
2	70.1-80	High	19	5
3	60.1-70	Moderate	3	2
4	50.1-60	Low	3	1
5	1-50	Very Low	3	1
Amount			30	30

Table 9 presents the distribution of students' spatial thinking skills across achievement levels in the pre-test and post-test. In the pre-test, most students were classified in the High category (19 students), while only 2 students reached the Very High level. Several students were still in the Moderate, Low, and Very Low categories (3 students each). In contrast, the post-test results show a substantial shift toward higher achievement levels. The number of students in the Very High category increased markedly from 2 to 21 students. Meanwhile, the number of students in the High category decreased from 19 to 5 students, indicating that many students moved up to the very high level. The Moderate, Low, and Very Low categories also declined to 2, 1, and 1 student, respectively. Overall, these changes demonstrate a clear improvement in students' spatial thinking skills after the learning intervention, with most students achieving the Very High level in the post-test and fewer students remaining in the lower achievement categories.

Table 7. Calculation of N Gain Value

Information	Pre-test	Postes	N Gain
Total Score	2 538.24	2 085.29	0.50

Table 7 shows the results of the N-Gain calculation based on students' pre-test and post-test scores. The total pre-test score was 2,538.24, while the total post-test score was 2,085.29. The calculated N-Gain value is 0.50, which indicates a moderate level of improvement in students' learning outcomes after the implementation of the learning intervention. This result suggests that the treatment was reasonably effective in enhancing students' performance from the pre-test to the post-test.

Product Feasibility Test

The feasibility assessment was conducted based on teacher and student responses obtained through questionnaires. Table 8 below presents the questionnaire results:

Table 8. Average Scores of Teacher and Student Responses to Sway Interactive Media

Average Teacher Score	Average Student Score	Category	Description
82	86	Good	Feasible; no revision needed

Based on Table 8, the product feasibility test results from teacher and student responses fell into the "Good" qualification, indicating the media is feasible and does not require revision. The teacher's response regarding the developed Microsoft Sway interactive media, in terms of usability, is that it is easy to access and use, and helps teachers deliver material. The content is appropriate to the learning objectives and student characteristics. The audio quality of the narrative voice is clear and can support the learning process. The visual quality is attractive and increases students' interest in learning. The narrative language quality is straightforward to understand. The video duration is appropriate to the learning time and does not cause boredom. Student responses regarding the developed Microsoft Sway interactive media indicate that it can increase learning interest and enthusiasm due to its attractive display. It supports learning independence through easy access and can be repeated whenever needed. It is easy to use on both smartphones and Android devices, as well as laptops. It is comfortable to use, with a neat visual display, a pleasing color combination, and precise text size.

Evaluation

The evaluation stage was conducted in two forms: formative and summative. Formative evaluation was conducted at each prior ADDIE stage to ensure the learning media aligned with the expected objectives. A summative evaluation was conducted after the limited trial to assess the media's effectiveness in enhancing spatial thinking. Summative evaluation steps included assessing improvements in students' spatial thinking, evaluating student responses, and obtaining teacher feedback on the developed media product. Following the evaluation, the product was revised to achieve reliable development results. The evaluation results can be seen in Table 9 below:

Table 9. Evaluation Results of the Developed Learning Media

Aspect	Main Findings	Product Advantages	Product Limitations	Revised Elements
Formative Evaluation (ADDIE Stages)	Evaluation was conducted at each ADDIE stage (Analysis, Design, Development, Implementation) to ensure media alignment with learning objectives.	The developed media aligns with learning needs and student characteristics; systematic material structure.	In the initial stage, inconsistencies in material flow were found in some sections.	Revision of content structure, adjustment of visual display, and revision of material presentation flow
Improvement of Spatial Thinking Skills (Summative Evaluate Student Response)	Limited trial results show improvement in spatial thinking skills after using the media	Media effectively visualizes concepts and enhances spatial understanding	Some students required adaptation time to understand the material	Addition of visual explanations, simplification of animations in certain sections
Teacher Response	Students responded positively to the use of learning media.	Media is attractive, interactive, easy to use, and increases learning motivation.	The duration in some sections was perceived as too long	Adjustment of video duration and condensing of material
Final Product Feasibility	Teachers gave good to excellent feedback on the developed media	Media helps the learning process and is easy to integrate.	Teachers suggested clarity and density of narration.	Narration Revision
	Media is declared feasible for use as learning media	Product meets criteria for usability, effectiveness, and comfort	Minor revisions are still needed before widespread use	Final revisions were made to produce a more reliable and optimal product

DISCUSSION

The development of Microsoft Sway interactive media on natural resources and sustainable development materials uses the ADDIE development model. The first stage is analysis, which includes needs analysis and feasibility analysis. This needs analysis is viewed from the problems faced by teachers and students in Donggala Regency. The problem is that no learning media contain locally relevant material on natural resources and sustainable development. The learning implemented is not contextual, resulting in low spatial thinking skills. Therefore, learning materials in this local context are important to study in order to foster awareness of maintaining the sustainability of natural resources. Microsoft Sway was selected based on the outcomes of the needs and feasibility analysis. Sway offers distinct advantages: cross-device flexibility, cloud-based accessibility, multimedia integration (text, images, videos, maps), and user-friendliness on Android devices, which are used by virtually all students (Astra & Kartini, 2023; D. A. Larasati & Yuanta, 2021). The existing literature confirms Sway's effectiveness in enhancing motivation, conceptual comprehension, and higher-order thinking skills (Himawan & Satrio, 2020).

The second stage is design, where the content for Microsoft Sway media is planned, including learning objectives, instructional materials, images, videos, and assessment instruments. The Microsoft Sway pages are designed to present content on natural resources and sustainable development in an attractive, practical, and efficient manner. This material is designed to make the learning process more realistic and to help students visualize various potential natural resources, environmental pollution problems, and damage resulting from natural exploitation in Donggala Regency. From these various depictions, an attitude of caring for the sustainability of natural resources will be fostered, thereby enhancing spatial thinking (Dwiranata et al., 2019). This design aligns with multimedia learning principles, which state that integrating visual and verbal elements enhances conceptual understanding and analytical abilities (Mayer & Fiorella, 2014). Aligning design with student needs enhances media effectiveness during implementation (Mensah, 2019; Pasquel-López & Valerio-Ureña, 2024).

The third stage is the development stage, the process of turning the design into a real product. The content is designed and uploaded to Microsoft Sway, complete with images and videos. Consequently, the resulting learning media is informative, engaging, efficient, and user-friendly. (Darung et al., 2020; Kamilah et al., 2023). Expert validation was conducted to ensure product quality and appropriateness. The validation results, with an accuracy rate of 90.39%, fall into the "Very Good" qualification, indicating that the solution is highly feasible and does not require revision; however, improvement suggestions were provided regarding colour adjustments, font size, and image layout. Revisions were made based on validator feedback, resulting in a more proportional and attractive media display. Product development must incorporate validator feedback to prevent content errors, ensure the product is user-friendly, meet the needs of both teachers and students, and achieve validation (Sukardi, 2008; Widodo, 2021). This validation confirms that the media meets the technical requirements, including design consistency, navigation, readability, and multimedia use. However, the development stage in this research has a weakness: it involved only one expert validator, namely an Educational Technology expert. Ideally, the learning media validation process involves several types of experts, such as content and language experts, to ensure product quality is reviewed more comprehensively.

The fourth stage is implementation. This stage aims to determine the effectiveness of Microsoft Sway interactive media on the themes of natural resources and sustainable development, and to assess the feasibility based on teacher and student responses. The pre-test and post-test results show an improvement in students' spatial thinking skills after using Microsoft Sway. In the pre-test stage, there were 19 students in the high category, 2 in the very high category, 3 in the moderate category, 3 in the low category, and 3 in the very low category. This indicates that, before using Microsoft Sway interactive media, students' spatial thinking skills were unevenly distributed, with gaps. After using Microsoft Sway, the post-test results showed significant improvement. The number of students in the very high category increased to 21. In contrast, the high category decreased to 5, the moderate category to 2, the low category to 1, and the very low category to 1. This shift indicates that most students improved their spatial thinking skills.

The N-Gain calculation of 0.50 falls into the moderate category. This achievement indicates that Microsoft Sway's interactive media is efficacious in improving spatial thinking skills, but its effectiveness has not yet reached the high end of the scale. This occurs due to several conceptual and contextual factors in the learning process. First, spatial thinking skills are high-level cognitive skills that are difficult to master fully in just one or two learning sessions. Spatial thinking involves visualization abilities, spatial orientation, understanding of location, comparison and analysis of spatial relationships, understanding of unique characteristics in a location, explaining the structural patterns of phenomena in a region, and predicting phenomena that may occur as a result of spatial interactions in a region. Therefore, although Microsoft Sway interactive media helps with concept understanding and strengthens spatial thinking skills, it still requires extensive practice, more time, and a variety of learning activities, such as field practice and laboratory work. This condition explains why the improvement is in the moderate category, not the high category. Second, from a media design perspective, although Microsoft Sway interactive media has used a combination of text, images, videos, and interactive elements, the level of interactivity remains limited to exploration and passive responses, such as reading, watching, and answering questions. This media has not fully facilitated manipulative spatial activities, such as dynamic simulations, interactive mapping, or GIS-based spatial exploration, which are theoretically very important in training spatial thinking skills. This is one of the obstacles to achieving improvement in the high category. Third, student characteristic factors, including differences in initial spatial thinking skills, prior learning experiences, and digital literacy levels, cause students' responses to the media to vary.

Nevertheless, improvements in spatial thinking skills indicate that the developed Microsoft Sway interactive media help students understand the material more effectively. Presenting material in Microsoft Sway using a combination of text, images, videos, and interactive elements enables students to learn more visually and contextually, thereby facilitating understanding of natural resources and sustainable development concepts. This aligns with research (Permatasari, N, & Puspitawati, R.P., 2025) that Microsoft Sway media trains and improves scientific literacy skills through inquiry-based investigation activities that are appropriate for spatial thinking enhancement activities. These inquiry-based investigation activities can

improve spatial thinking by training students to describe phenomena scientifically, formulate scientific investigation questions, evaluate investigation results, analyze data, and draw conclusions. Research (Maesaror et al., 2023) shows that learning using Microsoft Sway enables students to practice high-level thinking, such as spatial thinking, increase creativity, engage in challenging learning activities, demonstrate flexibility, and improve critical thinking.

Analysis within the context of sustainable development shows that integrating natural resources and sustainable development materials provides opportunities for students to relate spatial phenomena to environmental, social, and economic dimensions in an integrated manner. Through this learning content, students not only understand the location and distribution of natural resources but also recognize the implications of their use for ecosystem balance, community welfare, the sustainability of natural resources, and the regional economy. The use of local context in the Banawa Regency area strengthens learning relevance, as students can reflect on sustainability issues that are real and close to daily life, such as the use of coastal resources, land-use changes, and environmental pressures from local mining activities. This local context becomes a focal point in training students in problem-based spatial analysis skills, as they are invited to identify patterns, cause-and-effect relationships, and the spatial impacts of human activities. Therefore, strengthening learning grounded in local context and spatial data is key to encouraging students to develop a more reflective and critical understanding of sustainable development issues. This improvement occurred because multimedia content in Sway facilitates students' understanding of spatial relationships and geographic phenomena (A. D. Larasati, 2021). Videos, visualizations, and interactive channel structures provide more concrete and meaningful learning experiences (Asfar & Asfar, 2021; Kolvoord et al., 2011).

Product Feasibility Based on Teacher and Student Responses. The questionnaire results show average scores of 82 for teachers and 86 for students, both falling within the "Good" category, indicating feasibility and suggesting that no revision is required. This indicates that teachers and students will receive Microsoft Sway-based interactive media that is easy to use, visually appealing, and helps students understand the material. These findings demonstrate that the Microsoft Sway-based interactive learning media received positive responses from both user groups. Teachers assessed the media as feasible because its presentation aligns with curriculum needs and learning outcomes, is easy to operate, and supports more transparent and systematic material delivery.

Meanwhile, students gave higher assessments, indicating the media is engaging, easy to understand, and helps students learn more independently and interactively. Both findings confirm that Microsoft Sway-based interactive media effectively improves spatial thinking and is feasible for use in educational settings. This proves the media is relevant to user needs, enhances learning engagement, and aligns with contemporary digital learning characteristics. Thus, Sway media can be viewed as an appropriate, effective, practical, and engaging learning solution to support the school learning process (Himawan & Satrio, 2020; Merliana et al., 2021).

Fifth stage evaluation: Formative and Summative Evaluation. Formative evaluation was conducted at each stage of the ADDIE model, from needs analysis and design to expert validation (Pujiantiningtyas et al., 2022). This ensures the development process proceeds correctly and the resulting product meets standards (Alwan, 2017). A summative evaluation was conducted after implementation to assess the effectiveness of the media and user responses. Evaluation results show that the media have successfully improved students' spatial thinking (moderate N-Gain), received positive responses from students and teachers, and are feasible for use in learning. Evaluation was followed by minor revisions to ensure the final product is more optimal in terms of aesthetics, technical aspects, and pedagogy.

These findings imply a need to develop interactive media that enhance spatial exploration, problem-solving, simulations, and practical work. Thus, Microsoft Sway interactive media should not only serve as a means of presenting information, but also as media that can enhance exploration, problem-solving, and field practice activities, thereby improving spatial thinking skills to a high level. In addition, it is necessary to include validators from both educational technology and content and language experts to obtain comprehensive input and achieve maximum results.

CONCLUSION

The research results conclude that Sway interactive media is feasible. Validation by an Educational Technology expert yielded a score of 90.39%, placing it in the very high category, indicating that the interactive Sway media is both valid and feasible. Implementation results from small-group trials using the quasi-experimental method yielded an N-Gain value of 0.50, falling within the moderate range, demonstrating that the developed Microsoft Sway interactive media is effective in enhancing spatial thinking. Feasibility testing, as indicated by teacher and student responses, yielded scores of 82 and 86, respectively, in the "Good" category, indicating feasibility and suitability for use in learning. It is recommended that future researchers consider the function of Microsoft Sway interactive media not only as a means of presenting information, but also as a means of developing media that enhance spatial exploration, problem-solving, simulations, and field practice to improve spatial thinking skills to a high level. In addition, it is necessary to involve multiple validators to obtain comprehensive input and better results.

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