Interactive Flipbook as a Learning Innovation for Regional Flagship Products Based on Local Wisdom

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Abstract

Instruction in Learning Natural and Social Sciences (NS&SS) within primary education necessitates contextual and engaging innovations. This study aims to develop and evaluate the effectiveness of an interactive flipbook that integrates distinctive regional commodities based on the local wisdom of Musi Banyuasin. This research employs a Research and Development (R&D) approach using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model, was implemented with two fifth-grade classes, consisting of an experimental group (n = 30) and a control group (n =31). The research instruments utilised included expert validation rubrics, learner practicality questionnaires (measuring ease of use and clarity of learning activities), and assessments of learning outcomes. The results indicate that the flipbook demonstrated high validity in terms of content, design, and linguistic suitability. Furthermore, user practicality was rated as very high (91.6%). The flipbook proved effective in enhancing learning outcomes, as evidenced by a high N-Gain score in the experimental class (0.73) compared to a low score in the control class (0.14), alongside a significant difference observed in the t-test ($p = 0.000 < 0.05$). Consequently, this innovation has the potential to serve as an engaging and meaningful pedagogical resource aligned with the demands of twenty-first-century education.

INTRODUCTION

Background of the Study

Learning Natural and Social Sciences (NS&SS), which are integrated into a single subject in the Indonesian Merdeka Curriculum at the primary education level, plays an important role in shaping learners' understanding of their surrounding natural and social environments (Kharisma et al., 2024). However, instructional practices in primary schools remain largely dominated by the use of textbooks that are generic, abstract, and decontextualised (Septia et al., 2025). This reliance renders NS&SS subject matter difficult to reconcile with learners' tangible experiences in their daily lives. Conversely, meaningful learning should ideally be grounded in the learners' immediate environment and socio-cultural reality. Consequently, there is a pressing need for learning materials capable of bridging NS&SS concepts with local contexts to ensure that instruction becomes more relevant and comprehensible. The integration of local wisdom and digital technology is posited as a viable strategy to address this

necessity (Li et al., 2024; Setianingrum et al., 2023). In addition to enhancing conceptual understanding, contextual NS&SS instruction has the potential to foster learners' creative thinking skills in exploring and solving problems related to the natural and social phenomena in their surrounding environment (Roemintoyo & Budiarto, 2021). This is because such learning actively engages students in observing real-world phenomena, connecting concepts with everyday experiences, and formulating multiple alternative solutions to the problems encountered.

Amidst rapid advancements in information technology, digital learning materials—such as interactive flipbooks—have emerged as a promising alternative (Mutiara & Emilia, 2022). These tools facilitate the presentation of material in a visual, engaging, and accessible manner (Prasetyono & Hariyono, 2020). When developed contextually, this teaching material effectively enhances learners' conceptual understanding while simultaneously introducing and valuing local culture and regional assets (Ristanto et al., 2020; Yuliana et al., 2023). Within the context of the Musi Banyuasin Regency, numerous distinctive regional commodities—such as Gambo tie-dye fabric, crafts derived from gambier, and other local natural resources—possess significant educational value (Sanita et al., 2024).

Problem of the Study

The central issue within NS&SS instruction in primary schools is the limited availability of interactive digital learning materials that integrate distinctive regional commodities based on local wisdom. Consequently, instruction remains generic and decontextualised (Khan et al., 2024; Pathan et al., 2024). As a result, current pedagogical materials fail to provide meaningful learning experiences relevant to learners' daily lives (Ssebanakitta et al., 2025; Tsai et al., 2021). However, the Merdeka Curriculum emphasises contextual, relevant, and meaningful learning that aligns with the characteristics and needs of students in each region (Asrial et al., 2021; Abdul Muizz et al., 2023). The prevailing condition restricts learners' opportunities to develop creative thinking skills in comprehending NS&SS concepts. Therefore, innovative teaching materials are needed that are engaging and interactive, and that showcase local wealth as the main content. Preliminary observations conducted at two primary schools in the Batanghari Leko District, Musi Banyuasin Regency, indicate that 85% of teachers continue to rely on conventional printed materials devoid of local content. Furthermore, interviews with teachers and learners revealed that the majority of learners are unfamiliar with the region's economic potential, such as gambier processing and Gambo tie-dye batik. This condition highlights a significant disparity between the richness of local potential and its utilisation in primary school science instruction.

Research's State of the Art

To date, research regarding the development of flipbook-based learning materials has demonstrated positive results in enhancing learners' interest and engagement (Brockman et al., 2021; Mashudi et al., 2022). Several studies have also shown that interactive digital learning materials have the potential to support the development of creative thinking skills through the presentation of contextual problems and open-ended learning activities (Sabri et al., 2023). However, scholarship specifically addressing the development of interactive science flipbooks based on regional commodities—integrating the local wisdom of Musi Banyuasin—remains scarce. This scarcity is reflected in the results of a needs analysis questionnaire completed by 127 Grade V teachers from various primary schools in the Musi Banyuasin Regency, which indicated that over 82% of NS&SS materials currently in use contain no elements of local wisdom. Conversely, results from the learners needs analysis indicate that 87.5% of learners prefer digital learning materials because they are visually appealing, comprehensible, and facilitate interactive learning. These findings suggest that the demand for contextual digital learning materials has not been adequately met within current NS&SS instructional practice.

In the context of Musi Banyuasin Regency, superior regional products such as Gambo jumputan cloth possess high educational value because their production process involves natural dyeing techniques using gambier extract. This process can be utilised to explain science concepts related to natural resources and environmentally friendly materials. Furthermore, once processed into Gambo jumputan fabric, the product attains a high market value, making it relevant for introducing social

science concepts such as local economic activities, value addition, and community livelihoods. However, these resources remain significantly underutilised as pedagogical materials within schools (Hertati et al., 2021).

Gap Study and Objective

The evident learner's preference for digital resources has not been matched by the availability of interactive NS&SS materials integrating Musi Banyuasin local wisdom (Sabri et al., 2023; Hertati et al., 2021; Mashudi et al., 2022; Khan et al., 2024). Most learners reported never having utilised interactive NS&SS materials that incorporate the potential of their immediate locality, resulting in instruction that remains generic and lacking in context. An analysis of NS&SS curriculum documents within the *Kurikulum Merdeka* (Merdeka Curriculum) reveals that the Learning Outcomes and Learning Objective Flows provide significant scope for integrating local contexts as learning resources. However, these curricular opportunities have not been optimally implemented within the materials currently used in schools. Consequently, the interactive flipbook developed in this study is specifically designed to foster learners' creative thinking skills through contextual and interactive NS&SS learning activities.

Addressing this gap, the present study aims to develop an interactive NS&SS flipbook based on local wisdom derived from the distinctive regional commodities of the Musi Banyuasin Regency. The development of this flipbook is directed towards producing digital learning materials that are contextual, engaging, and aligned with the characteristics of primary school learners. Furthermore, this study aims to assess the feasibility and practicality of the flipbook based on expert and teacher evaluations. Specifically, this research addresses the following questions: 1) How is the interactive NS&SS flipbook based on Musi Banyuasin regional commodities developed? 2) What is the level of feasibility and practicality of the flipbook as assessed by experts and teachers? and 3) To what extent is the flipbook effective in improving the conceptual understanding of primary school learners? This research is important because it has the potential to provide interactive learning media that is not only interesting but also prioritizes local wisdom values that are relevant to learners' lives. Without the development of these materials, teaching NS&SS in elementary schools is at risk of remaining dependent on general and less contextual content.

METHOD

Type and Design

This research utilized the developmental research model that includes Analysis, Design, Development, Implementation, Evaluation (ADDIE) to develop an interactive flipbook based on Musi Banyuasin local wisdom. Subsequent to product development and expert validation, the efficacy of the material was assessed using a quasi-experimental non-equivalent control group design. This design was selected because the research subjects were organised into pre-existing classes (intact groups), thereby precluding random assignment. The study involved two groups: an experimental class, which utilised the interactive NS&SS flipbook, and a control class, which utilised conventional learning materials. Both groups were administered a pre-test and a post-test to measure improvements in learners learning outcomes following the intervention. The non-equivalent control group design was employed to obtain an objective assessment of the flipbook's impact by comparing score differentials between the experimental and control groups. Ethical clearance for this study was obtained from the Research Ethics Committee of Universitas Sriwijaya under reference number: 1131/UN9.FKIP/TU.SB5/2025.

Data and Data Sources

Prior to the implementation of the research intervention, an interactive flipbook rooted in Musi Banyuasin local wisdom was developed utilising the ADDIE model. During the development phase, validity tests were conducted by experts in subject matter, media, and linguistics to ensure the suitability of the content, design, and language. Subsequently, product practicality was evaluated by observing learner engagement within the experimental class to assess the usability and appeal of the teaching materials. The participants in this study were fifth-year learners from two existing classes at a primary school in the Sekayu District, Musi Banyuasin Regency. The experimental class consisted of 30 learners, whilst the control class comprised 31 learners. The equivalence of the two groups was

established based on similar age ranges, the utilisation of the same curriculum, and comparable baseline pre-test scores prior to the intervention. This research was conducted in the second semester of the 2024–2025 academic year, which began in May 2025. Data collection was carried out through tests given to learner both before (pretest) and after (posttest) the use of flipbooks. Data sources in this research included pretest and posttest results from the experimental and control classes. To elucidate the research design employed, the framework of the non-equivalent control group pre-test–post-test design is presented in Table 1.

Table 1. Framework of the Non-Equivalent Control Group Pre-test–Post-test Research

Class	Intervention	Pre-test (O_1)	Post-test (O_2)
Experimental Class	X (intervention)	O_1	O_2
Control Class	Y (no intervention)	O_1	O_2

Key:
X = Instruction utilising the interactive (NS&SS) flipbook based on Musi Banyuasin local wisdom
Y = Instruction utilising conventional learning materials
O_1 = Pre-test
O_2 = Post-test

Based on Table 1, this research uses a non-equivalent control group Design, which involves the experimental and the control groups. The experimental group were was given intervention using an interactive flipbook based on the local wisdom of Musi Banyuasin (X). In contrast, the control group was not given special intervention learner (Y) and continued to use conventional teaching materials. Both groups were administered an initial assessment (pre-test/O_1) prior to instruction and a final assessment (post-test/O_2) upon the conclusion of the learning process. The application of this design enabled the researcher to objectively compare changes in learning outcomes between the experimental and control classes, thereby facilitating an analysis of the flipbook's effectiveness based on the differential gains in learning scores following the intervention.

Data Collection Technique

In the Analysis phase, data were collected through a needs assessment involving learners and teachers which aimed to identify discrepancies between curricular demands and the availability of existing NS&SS learning materials. The validity of the needs analysis data was ensured through expert review and triangulation of responses from teachers and learners, with data collected using structured questionnaires that had been reviewed beforehand by two educational experts. The questionnaires were distributed online via Google Forms to 655 learners and 127 teachers from 10 sub-districts in Musi Banyuasin Regency. Additionally, the results of the needs analysis were validated through expert review and cross-verification of teacher and learner's responses which ensured accuracy and reliability before they proceeded to the Design phase. The data obtained included quantitative metrics derived from learners and teacher needs questionnaires. Additionally, qualitative data were gathered in the form of feedback regarding the required subject matter, instructional media, learning activities, and evaluation methods. The findings of this needs analysis served as the foundation for determining the characteristics, content, and design specifications of the interactive flipbook based on Musi Banyuasin local wisdom.

In the Design phase, the flowchart and storyboard were validated by experts. The validation process was conducted to ensure their alignment with the learning objectives. It also checked whether the materials met the curriculum requirements. The results of the validation indicated that the learning sequence was clear. The content was aligned with the learning indicators, and the visual design was attractive and supported learners understanding. Overall, the storyboard and flowchart were deemed feasible to be used as a guide for the development of the flipbook.

In the Development phase, data were collected through product validation to assess the validity and feasibility of the interactive flipbook prior to its implementation in instruction. Validation was conducted by three experts: a subject matter specialist, a media specialist, and a language specialist. The results were reviewed and discussed among the experts to ensure consensus on the suitability of content, media, and language, and any discrepancies were resolved before finalizing the product.

Validation data were obtained using expert validation rubrics covering aspects of content suitability, media quality, and linguistic appropriateness, utilising a Likert scale of 1–5. The results of this validation were used as the basis for revising and refining the product prior to the implementation phase. In addition to product validation, this phase also involved the validation of the pre-test and post-test instruments to ensure their suitability for measuring learners learning outcomes. These instruments were reviewed and validated by the experts, with feedback incorporated to guarantee reliability and alignment with the learning objectives. The validation of the test instruments was conducted by three experts who assessed item construction, content validity, and linguistic mechanics. A summary of the expert validation results for the test instruments is presented in Table 2.

Table 2. Recapitulation of Expert Validation Results for Pre-test and Post-test Instruments

Validator	Mean Score	Percentage	Category
YA	4,23	84,62%	Highly feasible
IM	4,92	98,46%	Highly feasible
BM	4,46	89,23%	Highly feasible
Average	4,54	90,77%	Highly feasible

As presented in Table 2, the validation results for the pre-test and post-test instruments, assessed by three experts, reveal a mean percentage of 90.77%, classifying them as 'Highly feasible' (or highly valid). Each validator's assessment fell within the 'Highly feasible' category, indicating that the instruments satisfy the requirements for item construction, content validity, and linguistic mechanics. These results demonstrate that the test instruments possess an excellent level of feasibility. Consequently, the pre-test and post-test instruments were deemed suitable for assessing learners learning outcomes during the implementation phase.

During the Implementation phase, data were collected via the administration of pre-tests and post-tests to measure learners learning outcomes before and after the intervention. The observation and documentation data were also reviewed by experts to confirm that the recorded learners engagement accurately reflected classroom interactions. The assessments were administered to two groups: the experimental class, utilising the interactive (NS&SS) flipbook, and the control class, utilising conventional learning materials. The test instruments were structured in alignment with (NS&SS) learning indicators relevant to the material contained in the flipbook and had undergone prior expert validation. Quantitative data derived from pre-test and post-test scores were analysed to evaluate the improvement in learners learning outcomes following the application of the flipbook. Supplementing the testing, observations of learners' activity were conducted during the learning process in the experimental class to assess the level of learners' engagement and participation. Each indicator was assessed using a scale of 1–4, with observations performed by two independent observers to enhance data objectivity. The framework for the observation instrument is detailed in Table 3.

Table 3. Learners Activity Observation Grid

Observed Aspects	Success Indicators
Attention to learning	Learners listen to the teacher's explanations and flipbook material
Active participation in questioning and discussion	Learners ask and answer questions
Enthusiasm in using the flipbook	Learners appear interested and focused whilst reading
Involvement in group work and tasks	Learners contribute actively to discussions

Table 3 outlined the learners' activity observation grid, which encompassed four primary dimensions: attention to learning, active participation in questioning and discussion, enthusiasm for utilizing the flipbook, and engagement in group work and task completion. Each dimension was accompanied by specific success indicators employed to assess the level of learners' engagement during the learning process. This observation grid was structured to ensure that the observation process was conducted systematically and with specific focus. Consequently, the resulting data were

objective and relevant for depicting learners' activities during (NS&SS) instruction based on Musi Banyuasin local wisdom. This grid served as a reference for collecting observation data in a more focused and objective manner.

In the evaluation phase, data collection focused on measuring the effectiveness of flipbooks on improving learners learning outcomes. The data used were derived from learners pretest and posttest results. To ensure the validity of the evaluation, the pre-test and post-test instruments were reviewed by three subject matter experts prior to use, and the scoring was cross-checked by independent evaluators (see Table 2). In addition, observational data and documentation from the learning process were examined to validate the contextual accuracy of the learners engagement and learning outcomes. The data were analysed using the N-Gain test and an independent t-test to determine the level of improvement and differences in learning outcomes between the experimental and control classes. The results of this evaluation were used to determine the effectiveness of the interactive science flipbook based on Musi Banyuasin local wisdom as a learning medium in elementary schools.

Finally, documentation techniques were used to record the flipbook implementation process during the learning process. Documentation was conducted by taking photos of activities and recording field observations. This documentation provided a contextual overview of the learning process in the classroom. Furthermore, the documentation served as supporting data to strengthen the findings from the tests and observations.

Data Analysis

Data analysis in this study was conducted in stages and systematically. The analysis process included five stages: needs analysis as a basis for development, product validation analysis, learners learning outcomes analysis, differences in learning outcomes analysis, and learners' activity analysis. Each stage of analysis was carried out sequentially to obtain accurate data. These stages were arranged to obtain a comprehensive picture of the feasibility, practicality, and effectiveness of an interactive science flipbook based on Musi Banyuasin local wisdom.

First, a needs analysis was conducted during the Analysis phase to serve as the foundation for developing the interactive (NS&SS) flipbook. Data for this analysis were obtained from questionnaires administered to teachers and learners, alongside a document analysis of the (NS&SS) curriculum within the Merdeka Curriculum. Quantitative data from the questionnaires were analysed using descriptive statistics (percentages) to identify the level of necessity for digital learning materials grounded in local wisdom. Concurrently, qualitative data—in the form of suggestions and feedback—were analysed descriptively to identify the required characteristics of the subject matter, media, and learning activities.

Second, the analysis of product validation data was performed during the Development phase, based on assessments provided by subject matter experts, media experts, and language experts. Scores obtained from each indicator on the validation rubric were calculated by summing the scores of all assessment items and comparing them against the maximum potential score to derive a feasibility percentage. The feasibility percentage was calculated using the following formula:

$$Va = \frac{Tse}{Tsh}x100\%$$

(Wani et al., 2022)

Key:
Va = Expert validation
Tse = Total empirical score obtained
Tsh = Total maximum score

The resulting percentages were subsequently categorised into feasibility criteria as shown in Table 4.

Table 4. Expert Validation Criteria

Score Achievement	Validity Category
80% - 100%	Highly feasible
61% - 80%	Feasible
41% - 60%	Moderately Feasible
21% - 40%	Unfeasible
0% - 20%	Very Unfeasible

(Hiralda & Zulherman, 2023)

As detailed in Table 4, the expert validation criteria are stratified into five categories based on the percentage of achievement scores. A score range of 80%–100% is classified as 'Highly feasible', whilst 61%–80% falls within the 'feasible' category. Furthermore, 41%–60% is categorised as 'moderately feasible', 21%–40% as 'unfeasible', and 0%–20% constitutes the 'very unfeasible' category. These criteria served as the basis for determining the feasibility of the product prior to its implementation in instruction. Additionally, qualitative suggestions and comments provided by experts served as a reference for product revisions, ensuring compliance with feasibility standards before the commencement of the implementation and effectiveness testing phases.

Third, the analysis of learners learning outcomes was conducted by comparing pre-test and post-test scores across the experimental and control classes. Improvements in learning outcomes were analysed using the N-Gain calculation to quantify the level of improvement following the intervention. The resulting N-Gain values were then classified into low, medium, or high categories to interpret the effectiveness of instruction utilising the flipbook. Furthermore, to ascertain whether statistically significant differences existed between the two groups, the data were analysed using an independent-samples t-test with a significance level of 0.05. The formula employed to calculate N-Gain is as follows:

$$N_{gain} = \frac{S_{posttest-S_{pretest}}}{S_{maximum-S_{pretest}}}$$

The interpretation of N-Gain values adheres to the criteria established by Hasanah et al. (2023), as displayed in Table 5.

Table 5. N-Gain Calculation Criteria

N-gain	Category
N-Gain > 0.70	High
0.30 ≤ N-Gain ≤ 0.70	Medium
N-Gain < 0,30	Low

Fourth, the analysis of learners' learning outcomes was conducted to determine the improvement in learners' understanding after the use of the local wisdom-based flipbook. An independent t-test was then used to test the significance of differences in posttest results between the experimental and control classes. This test aimed to determine whether the observed differences in learning outcomes were significant. The analysis compared the average posttest scores of the two classes, and the t-test results served as the basis for assessing the effect of flipbook media use on learners' learning outcomes.

Fifth, the analysis of learners' activities was conducted to evaluate their engagement and interactions during the learning process using the local wisdom-based flipbook. Observation data on learners' activities were analyzed descriptively and quantitatively. The analysis was conducted by calculating the average score for each indicator on the observation sheet. The results were used to assess the level of learners' engagement and activity during learning and also illustrated learners' responses to the use of flipbooks. In addition, the documentation data were analyzed qualitatively by reviewing activity photos and field notes. This analysis aimed to identify the actual situation during the learning process and focused on learners' engagement, the use of flipbooks, and the learning dynamics

in the experimental class. The entire analysis process was conducted after data cleaning and validation and was supported by SPSS version 26.0 for quantitative data analysis.

RESULTS

The learners and teachers were the focus of a comprehensive needs analysis to determine their learning requirements for science materials based on local wisdom. The analysis examined five key aspects: learning outcomes and objectives, subject matter, media presentation, learning activities, and evaluation. This assessment aimed to identify which components were most essential to support effective teaching and learning. The results of this needs analysis, including the percentage of need and its category, are presented in Table 6.

Table 6. Needs Analysis Data Results

Aspect	Learners Need Percentage	Learners Category	Teacher Need Percentage	Teacher Category
Learning Outcomes and Objectives	92,97%	Highly Needed	95,6%	Highly Needed
Subject Matter	93,15%	Highly Needed	95,45%	Highly Needed
Media Presentation	94,63%	Highly Needed	96,37%	Highly Needed
Learning Activities	93,37%	Highly Needed	94,87%	Highly Needed
Evaluation	91,78%	Highly Needed	92,5%	Highly Needed
Average	93%	Highly Needed	95%	Highly Needed

Based on the needs analysis results presented in Table 6, there is an apparent and significant demand from both learners and teachers for teaching materials that support the achievement of learning objectives, effective delivery of material, and the provision of appropriate media, activities, and evaluation mechanisms. All aspects assessed showed percentages above 91% in both learners and teacher responses. The average need reached 93% for learners and 95% for teachers, which is categorized as 'very high'. These findings emphasize the urgency of developing innovative learning resources—particularly interactive flipbooks for science and natural sciences based on Musi Banyuasin local wisdom—to effectively meet these needs.

During the Design phase, the preliminary structuring of the format and content of the learning materials was undertaken. This process involved conceptualising an interactive flipbook containing NS&SS content that highlights distinctive regional commodities based on the local wisdom of Musi Banyuasin, including Gambo tie-dye batik, smoked fish (*salai*), durian *tempoyak* (fermented durian), and palm oil. The design process encompassed the selection of presentation formats, page layouts, interactive elements, and pedagogical activities aligned with specific learning objectives. The flipbook was designed to foster engagement through the integration of contextual visual imagery, interactive assessment items, and activities conducive to active learners' participation.

To ensure a systematic design approach, a content flowchart and storyboard layout were produced to serve as blueprints for media development. The flowchart delineates the structural progression of the flipbook, commencing with the introductory section, which comprises the title page, preface, table of contents, and concept map. Subsequently, the core instructional material is organised into four primary chapters covering gambier, fish processing, durian *tempoyak*, and palm oil commodities. Each chapter is supplemented with sub-topics and formative evaluations designed to reinforce learners' comprehension. Following the core content, a concluding section was composed, containing a summative evaluation, glossary, references, and author profile. This sequence represents a systematic, structured, and contextual compilation process, aligned with the specific local potential of the Musi Banyuasin Regency.

Subsequent to the development of the flowchart, the storyboard layout was created. At this stage, each page within the flipbook was detailed according to the sequence depicted in the flowchart. The storyboard layout encompasses the initial visual schematics, the arrangement of visual elements

(images, icons, and illustrations), text placement (titles, content, and instructions), and the integration of interactive components such as navigation buttons, multiple-choice questions, and project-based activities. An exemplar of a storyboard layout page for the flipbook is presented in Figure 1.
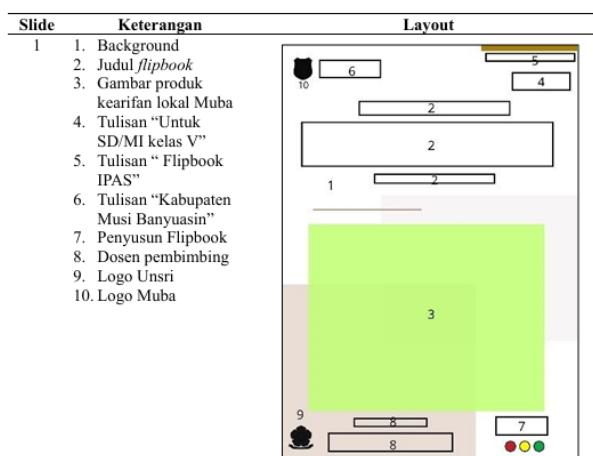

Figure 1. Storyboard Layout Page of the Developed Flipbook

Figure 1 shows one of the storyboard layout pages of the Science Flipbook developed for fifth-grade elementary school learners. This page is part of the visual design, which defines the layout of the important elements in the flipbook. These elements include the page title, supporting illustrations, material text, and learners activity instructions. The layout is arranged attractively, balancing visual elements, maintaining design consistency, and improving readability to help learners understand the material more easily and maintain interest in learning.

The development phase involved compiling and producing a flipbook using Canva and Heyzine software. At this stage, researchers began developing the flipbook's content and layout digitally. This development process resulted in a prototype storyboard that served as a visual reference for compiling the flipbook's content. A view of one page of the prototype storyboard is shown in Figure 2. The interactive flipbook product that integrates distinctive regional commodities based on the local wisdom of Musi Banyuasin can be accessed via the following link: http://bit.ly/4sqZkoR .

Figure 2. Storyboard Prototype Page of the Developed Flipbook

Figure 2 depicts a representative page of the storyboard prototype developed during the initial design phase of the flipbook. This figure illustrates the preliminary design, encompassing the textual layout, illustrations, and page navigation mechanisms, all of which are structured to be simple yet

informative. The creation of this storyboard serves to visualise the flow and content of the material prior to its evolution into a fully interactive flipbook, thereby facilitating the systematic organisation of content to ensure comprehensibility. Upon the completion of the prototype, a validation process was conducted by subject matter experts, media experts, and language experts. A summary of the validation results derived from these three expert assessments is presented in Table 7.

Table 7. Product Validation Results of the Developed NS&SS Flipbook

Validity Test	Obtained Score	Maximum Score	Percentage	Category
Media Validity Test	71	75	95%	Highly feasible
Subject Matter Validity Test	69	75	92%	Highly feasible
Language Validity Test	63	75	84%	Highly feasible

Table 6 presents the data derived from the analysis of validity assessments concerning media, subject matter, and linguistic appropriateness in the development of the flipbook. The media validity test yielded a score of 71 out of a maximum of 75, resulting in a percentage of 95%, which falls within the 'Highly feasible' category. Similarly, the subject matter validity test achieved a score of 69, equivalent to 92%, which is also categorised as 'Highly feasible'. Concurrently, the language validity test recorded a score of 63 out of 75, with a percentage of 84%, also classified as 'Highly feasible'. These results indicate that the developed flipbook satisfies the feasibility criteria across all assessed dimensions and is suitable for deployment as a pedagogical medium. Guided by these validation results, a series of revisions were undertaken to enhance visual quality, linguistic precision, and the alignment of the subject matter with learning indicators. Figures 3, Figure 4, and Figure 5 illustrate the modifications implemented in response to expert suggestions.

Figure 3. Revisions Based on Subject Matter Expert Suggestions

Figure 3 illustrates the modifications made to the creative thinking questions in response to recommendations from the subject matter expert. In the pre-revision iteration, the questions were considered overly generic. Post-revision, these inquiries were refined with more specific instructions—such as delineating the type and objective of the promotion—thereby enhancing contextual alignment and stimulating learners' critical thinking faculties. An example of the revisions implemented based on the media expert's feedback is depicted in Figure 4.
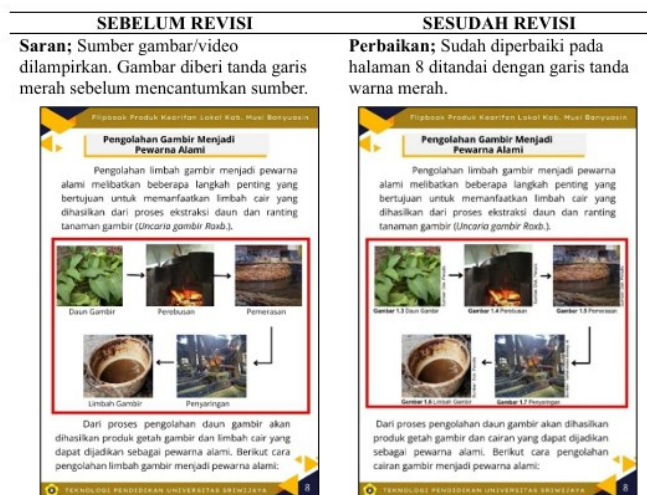
Figure 4. Revisions Based on Media Expert Suggestions

Figure 4 highlights improvements made to the image depicting the processing of gambier into natural dye. In the initial version, the image lacked a source citation, an omission which had been highlighted during the review (indicated by the red line). Consequently, the image source was appended in the revised version, adhering to the expert's advice. An example of revisions undertaken based on the language expert's suggestions is shown in Figure 5.

Figure 5. Revisions Based on Language Expert Suggestions

Figure 5 depicts the corrections applied to the cover page. Specifically, the term *"Penyusun"* (Compiler/Author), previously situated at the bottom of the page, was removed as per the expert's suggestion. This modification is highlighted by a red box in the revised image. Complementing the validation of the flipbook itself, the assessment instruments intended for the pre-test and post-test also underwent expert validation.

Subsequently, during the Implementation phase, a practicality test was conducted to evaluate the usability and user acceptance of the interactive (NS&SS) flipbook within an instructional setting. This test involved nine learners possessing diverse academic abilities. Throughout the implementation, learners utilised the flipbook both individually and in groups to study the material, engage in discussions, and complete simple tasks aligned with the flipbook's content. The primary objective of this activity was to assess the usability, visual appeal, and overall utility of the flipbook in supporting the learning process. A summary of the results from the flipbook practicality test is presented in Table 8**.**

Table 8. Summary of Flipbook Practicality Test Results

Aspect	Obtained Score	Ideal Score	Percentage Result	Criteria
Appearance	251	270	93,0 %	Highly practical
Content	241	270	89,3 %	Highly practical
Accessibility	125	135	92,6 %	Highly practical
Average	**205,7**	**225,0**	**91,6 %**	**Highly practical**

As indicated in Table 7, the summary of results demonstrates that the mean practicality values for the design, content, and accessibility aspects fall within the 'Highly practical' category. These results suggest that the flipbook is user-friendly and easily navigable for learners during the learning process. Furthermore, the aesthetic design and lucid presentation of the material assist learners in comprehending the subject matter more effectively. Subsequently, the results of the learners' pre-test and post-test scores are presented in Table 9.

Table 9. Pre-test and Post-test Data Acquisition (Non-Equivalent Control Group)

Class	Variable	Pre-test	Post-test
R (Experimental)	X (implemented/flipbook)	1478	2599
		Mean: 49,3	Mean: 86,6
R (Control)	Y (no implementation)	1412	1649
		Mean: 45,5	Mean: 53,2

As evidenced in Table 9, there is a distinct disparity in the improvement of learning outcomes between the experimental and control classes. In the experimental class, which received the implemented intervention in the form of the local wisdom-based flipbook, the total pre-test score was 1478 with a mean of 49.3; this increased to 2599 on the post-test, with a mean of 86.6. Conversely, in the control class, which received no specific intervention, the total pre-test score was 1412 with a mean of 45.5, rising only to 1649 on the post-test with a mean of 53.2. The superior improvement observed in the experimental class indicates that the utilisation of the flipbook contributed positively and significantly to enhancing learners understanding and learning outcomes compared to the class that did not utilise the flipbook.

Subsequently, an N-Gain analysis was conducted to assess the intervention's effectiveness in learners learning outcomes. This analysis was used to measure the magnitude of score improvement from the pre-test to the post-test. The calculation accounts for the difference between the obtained scores and the maximum possible score. The summary of the N-Gain test results, processed using SPSS version 26, is presented in Table 10.

Table 10. Summary of N-Gain Results for Experimental and Control Classes

Class	Number of Learners	Total N-Gain	Average N-Gain	Minimum Value	Maximum Value	Category
Experimental Class	30	21,80	0,73	0,30	0,90	High
Control Class	31	4,28	0,14	0,00	0,33	Low

Table 10 presents the summary of the N-Gain calculation results for the experimental and control classes. The N-Gain metric is utilised to quantify the effectiveness of the improvement in learning outcomes based on the normalised difference between pre-test and post-test scores. In the experimental class, an average N-Gain of 0.73 was obtained, categorised as 'High'. This indicates that the utilisation of the local wisdom-based flipbook significantly improved learners learning outcomes. In contrast, the control class recorded an average N-Gain of only 0.14, falling into the 'Low' category, indicating that without the specific intervention, the improvement in learners learning outcomes was negligible. Thus, Table 9 reinforces the finding that the use of the flipbook in instruction yields a significantly more effective impact compared to conventional learning devoid of such materials.

The subsequent stage, Evaluation, involved conducting further effectiveness testing using the t-test. The t-test was employed to ascertain whether there was a statistically significant difference between the learning outcomes of students in the experimental and control classes following the intervention. The test results reveal a Sig. (2-tailed) value of less than 0.05, which indicates a statistically significant difference between the two groups. This finding suggests that students who learned using the IPAS flipbook based on Musi Banyuasin local wisdom achieved superior learning outcomes compared to students who underwent conventional instruction. Furthermore, the independent t-test confirmed a significant divergence between the post-test results of the experimental and control classes. Observation results complemented the quantitative test data. They indicated an increase in learners engagement during learning. Learners also showed more active participation while using the flipbook. The results of these learners activity observations are presented in Table 11.

Table 11. Learners Activity Observation Results

Observed Aspects	Number of Learners (n=30)	Percentage	Category
Attention to learning	27	90,0%	Excellent
Active participation in questioning and discussion	24	80,0%	Good
Enthusiasm for utilising the flipbook	29	96,7%	Excellent
Involvement in group work and tasks	28	93,3%	Excellent
Average	—	**90,0%**	**Excellent**

Table 11 demonstrates the results of learners activity observations during instruction utilising the (NS&SS) flipbook based on Musi Banyuasin local wisdom in the experimental class ($n=30$). A total of 27 learners (90.0%) demonstrated excellent attention to learning by attending to the teacher's explanations and the flipbook material. Active participation in questioning and discussion was exhibited by 24 learners (80.0%), classified in the 'Good' category. Learners' enthusiasm for utilising the flipbook was notably high, with 29 learners (96.7%) appearing interested and focused whilst reading. Meanwhile, involvement in group work and tasks was also classified as excellent, indicated by 28 learners (93.3%) actively contributing to group discussions. The overall mean percentage of learners activity reached 90.0%, falling within the 'Excellent' category; thus, it can be concluded that the use of the flipbook effectively enhanced active learners engagement during the learning process. Visual documentation of the observation activities is provided in Figure 6, Figure 7, Figure 8, and Figure 9.

Figure 6. Learning Activities Utilising the Flipbook

Figure 7. Learners Actively Engaging in Discussion Utilising the Flipbook

Figure 8. Learners Actively Utilising the Features Available in the Flipbook

Figure 9. Learners Actively Collaborating to Complete the Project

Visual documentation provides evidence that learners were actively engaged in discussions and the exploration of the material presented within the flipbook. Furthermore, learners demonstrated the capacity to express their ideas with greater creativity whilst completing learning tasks. The interactions observed during the instructional process reflect a marked increase in learners' participation and engagement. Collectively, these results indicate that the utilisation of the NS&SS flipbook based on local wisdom, developed via the ADDIE model, is effective in enhancing the quality of learning for fifth-year primary school learners.

DISCUSSIONS

The findings of this study indicate that the development of the interactive NS&SS flipbook based on Musi Banyuasin local wisdom, utilising the ADDIE model, has a positive impact on learners learning outcomes and creative thinking skills. In the Analysis phase, the demand from both learners and teachers for contextual and interactive learning materials was identified as substantial, with the average expressed need reaching 93% for learners and 95% for teachers. This finding is consistent with research emphasising that learning materials relevant to the local context can enhance instructional effectiveness (Autthawuttikul et al., 2022; Gold et al., 2023; Lasekan, 2020; Saro et al., 2023). Furthermore, this aligns with findings indicating that learning materials grounded in local wisdom are capable of improving learners learning motivation and critical thinking skills (Andayani et al., 2021; Misbah & Wati, 2020; Ridho et al., 2021; Rohman, 2024; Sari et al., 2023; Utari et al., 2024). Thus, the Analysis phase underscores the critical importance of developing learning media that aligns with the specific needs of learners and teachers.

In the Design and Development phases, expert validation demonstrated that the developed flipbook is highly feasible for use as a learning medium. This result concurs with studies reporting that digital flipbooks possess high validity in terms of content, language, and digital literacy (Rachim & Ambarwati, 2021; Sulaeman et al., 2025; Wulandari et al., 2023). Moreover, other research has established that interactive flipbook media are capable of effectively satisfying the feasibility indicators required for instructional media (Darmawan et al., 2024; Mahfudotin & Cintamulya, 2021; Petun et al., 2023). These validation results indicate that the design of the local wisdom-based flipbook not only meets academic standards but also possesses the necessary pedagogical suitability to support the learners learning process. These findings substantiate the working hypothesis that interactive flipbooks can serve as valid and effective learning media.

In terms of practicality, the assessment demonstrated that the flipbook was both user-friendly and appealing to learners, achieving a mean score of 91.6% and placing it within the 'Highly practical' category. This is consistent with extant research suggesting that digital flipbooks enhance classroom participation, streamline material delivery for teachers, and foster immersive learning experiences. These results indicate that the interactive flipbook effectively encourages active learners' engagement, stimulates interest in learning, and facilitates the exploration of subject matter (Elfina et al., 2024; Marwan & Yuliantri, 2023). Furthermore, observational data regarding learner activity revealed that the majority of participants displayed high levels of enthusiasm and sustained engagement during instruction. This substantiates the premise that interactive media grounded in local contexts provide a more meaningful learning experience (Dorji et al., 2021; Prayoga et al., 2022).

With respect to effectiveness, the learning test results demonstrated a significant improvement in the experimental class relative to the control class. The mean pre-test score rose from 49.3 to 86.6, yielding an N-Gain of 0.73 (classified as 'high'). In contrast, the control class score increased only marginally from 45.5 to 53.2, resulting in an N-Gain of 0.14 ('low'). The t-test results confirmed a statistically significant difference (Sig. 2-tailed = 0.000). These findings corroborate research indicating that the utilisation of digital flipbooks enhances learners learning outcomes, motivation, and conceptual understanding (Arsita & Astawan, 2022; Juita et al., 2025; Sebayang et al., 2023; Susanti et al., 2022). This substantiates the working hypothesis that the NS&SS flipbook, based on local wisdom, exerts a positive influence on the learning outcomes of primary school learners.

A review of wider literature indicates that interactive flipbooks also support 21st-century skills, including digital literacy, creative thinking, and collaboration (Manalu & Wilujeng, 2025; Yanuarto et al., 2025). This is because interactive flipbooks require learners to operate digital media independently, complete creative tasks, collaborate in group activities, and design and carry out small projects that demand problem-solving skills, thereby directly fostering these competencies in authentic learning contexts. These findings are consistent with previous studies showing that the use of interactive media in NS&SS education can enhance learners' motivation, critical thinking, collaboration skills, as well as their ability to complete projects and solve problems (Kousloglou et al., 2023; Rusevska et al., 2024; Singh et al., 2024). Further research confirms that the utilisation of interactive flipbooks is capable of enhancing learners' engagement and learning motivation within the context of digital science education (Hidayati et al., 2023; Setianingrum et al., 2023). Moreover, several studies highlight the pedagogical characteristics of flipbooks that support reading comprehension as well as the independent exploration of learning materials (Marisda et al., 2024). Thus, the interactive NS&SS flipbook is not only academically effective but also instrumental in cultivating learners' 21st-century competencies.

This study yielded positive results, but it has a limitation: testing was conducted in only one school. Future research could involve multiple schools across different grade levels and regions. The development of flipbooks could also be improved by adding interactive multimedia elements, such as narrative audio, local videos, or virtual simulations. These enhancements would enrich the learning experience and deepen learners' conceptual understanding. Overall, the findings of this study support the importance of developing valid, practical, and effective local wisdom-based teaching materials. The developed interactive flipbook for science and natural sciences has been proven to improve learners learning outcomes. This medium also contributes to improving creative thinking skills, learners' engagement, and the development of cultural awareness and local identity. Thus, this flipbook offers a strategic solution for integrating local wisdom into elementary school learning while simultaneously promoting 21st-century competencies and has the potential for broader application in formal education contexts in the future.

CONCLUSION

This study presented a novel approach to the development of digital learning materials through the integration of an NS&SS flipbook grounded in the local wisdom of Musi Banyuasin. This tool is explicitly designed to strengthen the nexus between curricular content and the local cultural context. A significant contribution of this research lies in the provision of interactive, contextual, and culturally relevant learning resources that have been demonstrated to enhance the quality of the pedagogical process and learners' engagement among Grade V primary school pupils. In contrast to previous studies, which have frequently overlooked local contexts, this study posits that the incorporation of elements of local wisdom into learning materials can deepen conceptual understanding in NS&SS and bolster learner motivation and active participation. This study is subject to specific limitations, primarily concerning the small sample size, which comprised only two classes with a total of 61 learners. Consequently, the statistical power and external validity of the findings are constrained. The research was conducted at a single primary school in the Musi Banyuasin Regency; thus, the results cannot be fully generalised to other schools with differing characteristics. Furthermore, the relatively brief duration of the implementation does not capture long-term learning dynamics. Therefore, the sustained impact of flipbook utilisation on the enhancement of creative thinking skills and the comprehensive understanding of the material necessitates further investigation. Consequently, it is

recommended that future studies include a larger number of schools from diverse regions and extend the implementation period to obtain a more comprehensive and representative assessment of the effectiveness of local wisdom-based flipbooks. The findings of this research hold significant implications for educational practice and curriculum development. The integration of elements of local wisdom into learning materials not only enhances the quality of the learning process but also reinforces local identity and fosters more meaningful learning experiences. This approach enables learners to better understand and appreciate the instructional material. Future research should also account for variations in teachers' instructional styles and learners' prior experience with digital learning media, as these factors may influence learning outcomes. By addressing these variables, the effectiveness of local wisdom-based digital media can be assessed more accurately, thereby maximizing its positive impact on education.

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