

Development of Flipbook-Based Learning Media Using the Dick & Carey Model and Its Impact on Elementary School Students' Creative Problem-Solving Skills

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ABSTRACT

The development of educational technology encourages the use of interactive digital media capable of delivering multimodal and adaptive learning. This study aims to develop Flipbook Maker-based learning media with the Dick & Carey instructional design model and analysed its effectiveness in improving elementary school students' problem-solving creativity. The development was carried out through the stages of needs analysis, design, production, formative evaluation, revision, and summative evaluation. This study used a modified Research and Development (R&D) approach involving expert validation, individual trials, small group trials, and field tests. The problem-solving creativity instrument was compiled based on indicators of fluency, flexibility, originality, and elaboration. The results showed that the flipbook obtained a "very valid" category from the validators of materials, media, and learning design. The field trial showed that the media was easy to use, interesting, and increased student learning engagement. Pretest-post-test analysis showed a significant increase in all indicators of problem-solving creativity ($p < .001$), with a large effect size ($d = 1.21$). These findings confirm that flipbooks developed systematically and based on multimedia theory are able to support creative thinking processes effectively, making them relevant for use in 21st-century learning.

Keywords: *creativity, Dick & Carey, Flipbook Maker, multimedia learning, problem solving*



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INTRODUCTION

Developments in educational technology over the past two decades have transformed the way teachers and students' access, process, and represent knowledge. Interactive digital media are beginning to replace traditional learning resources due to their ability to present information in a multimodal, adaptive, and personalized manner (Darmawan, 2024; He, 2022). One medium experiencing increasing use in schools is Flipbook Maker, a digital platform that enables the creation of interactive books by integrating text, images, audio, animation, and video into a single display (Rozanah & Pratiwi, 2025). Flipbooks are considered to have great potential in enhancing the learning experience, as their format resembles a printed book but is supported by multimedia features, making it easier for students to access material in a systematic and engaging manner (Chairunnisa, 2025; Fitri, 2024).

The development of digital learning media requires the use of a systematic and proven instructional design model. This aligns with Dick and Carey's (2001) argument that learning development is a system, not a series of spontaneous steps. Therefore, every component, from needs analysis and goal formulation to student characteristics and learning strategies, to formative and summative evaluation, must be designed in an integrated manner. The Dick & Carey model has been recommended in various multimedia development studies because it provides a rational framework and encourages continuous evaluation of media quality (Spatioti, 2022; Purnomo, 2024). Therefore, the development of a Flipbook Maker based on this model will not only produce a technically feasible product but also be pedagogically effective.

Besides media effectiveness, a crucial issue in 21st-century education is the development of creativity and problem-solving skills (Partnership for 21st Century Learning [P21], 2007). As the digital world of work and life demands higher-order thinking skills, students need to be engaged in learning processes that enable the exploration of ideas, the creation of digital products, and independent decision-making. Guilford (1950) stated that creativity is a divergent thinking ability that includes fluency, flexibility, originality, and elaboration, while Torrance (1974) added that creativity can be enhanced through activities that provide space for students to produce meaningful artifacts. Papert (1980) through constructionism theory emphasized that learning involving the creation of digital products allows students to build deeper understanding because of the connection between personal experiences and conceptual representations. In this context, Flipbook Maker is a highly relevant medium because it is not only used for information consumption but can also be a means for students to produce digital works that reflect their creativity.

Previous research has shown that digital flipbooks can improve learning motivation, active engagement, and cognitive learning outcomes (Rezeki, 2023; Ulfa, 2025; Nurramadhani, 2025). Several international and national studies have even found that integrating flipbooks with digital storytelling can enhance students' creativity and problem-solving (Chen et al., 2023; Fitri, 2024). However, a critical review of the literature shows that most previous research focuses on media feasibility and improving basic cognitive learning outcomes, rather than higher-order thinking skills such as creativity or problem-solving. Furthermore, few studies integrate flipbook development with robust instructional design models, such as Dick & Carey's, which ensure alignment between content, learning strategies, and evaluation.

On the other hand, the effectiveness of flipbooks must also be analysed through the perspectives of multimedia theory and cognitive load theory. Mayer (2001, 2005) emphasized that multimedia learning is effective when verbal and visual information is processed through different yet integrated cognitive pathways. The principles of coherence, modality, redundancy, and segmentation are crucial in structuring flipbook pages to avoid cognitive overload. Sweller (1988) and Paas & Sweller (2014) warn that media overloaded with decoration or excessive visual elements can increase extraneous load, which actually hinders comprehension. Therefore, flipbook development requires a systematic approach so that multimedia design maintains a balance between visual appeal and cognitive efficiency.

Theoretical studies also suggest that the use of flipbooks in the classroom should be viewed as part of a broader technology integration. The TPACK framework (Mishra & Koehler, 2006) emphasizes that the effectiveness of learning technology is determined not only by its technological features, but also by the alignment between content, pedagogy, and technology. Teachers who understand how to integrate flipbooks into learning strategies such as project-based or problem-based learning are able to maximize the potential of these media in developing students' creativity and problem-solving skills (Bell, 2010; Çetinkaya, 2014).

Based on the synthesis of theory and previous research results, it can be concluded that there is a significant research gap, namely:

1. Most flipbook research only assesses the feasibility of the media and the improvement of cognitive learning outcomes, but has not assessed creativity and problem solving as 21st-century competencies.
2. There is minimal research developing flipbooks using the Dick & Carey model, even though this model has been proven to improve the quality of media design systematically.
3. There has not been much research examining flipbooks as a medium for the production of digital works by students, not just information consumption.
4. There has been no theoretical synthesis that combines the perspectives of Multimedia Learning, Cognitive Load Theory, Constructionism, and TPACK in the development of flipbooks.

Thus, research developing a Flipbook Maker based on the Dick & Carey model and assessing its impact on problem-solving creativity is crucial to fill this scientific gap. This research is expected to provide theoretical contributions in the form of integrating instructional models with multimedia and creativity theory, as well as practical contributions in the form of recommendations for effective media to improve 21st-century competencies.

METHODS

This study uses a Research and Development (R&D) approach with the Dick & Carey (2015) model as a systematic framework for developing Flipbook Maker-based learning media. The R&D approach was chosen because the research aims not only to find facts, but also to produce product-oriented outcomes in the form of learning media whose effectiveness has been tested (Branch, 2009; Plomp & Nieveen, 2013). The Dick & Carey model is relevant because it provides comprehensive and structured instructional steps (Dick et al., 2015), making it suitable for developing digital media aimed at enhancing students' problem-solving creativity.

This study applies R&D modifications by adjusting the formative and summative evaluation stages as recommended by Tessmer (1993) and Nieveen (2015), with adjustments to the number of trial cycles according to the elementary school context. The research design also accommodates the analysis of problem-solving creativity using creative thinking indicators according to Torrance (1974) and Silver (1997), so that media development can be tested not only for technical functionality but also for its pedagogical impact.

Table 1. Stages of the Dick & Carey Development Model

Stage	Main Components	Academic Description
1	Identify Learning Objectives	Determination of learning objectives based on needs analysis, curriculum, and targeted competencies.
2	Learning Analysis	Breaking down the competency structure into basic skills and sub-skills.
3	Analysis of Student Characteristics	Identify students' initial abilities, learning styles, and cognitive characteristics.
4	Formulation of Specific Instructional Objectives	The translation of learning objectives into measurable performative objectives.
5	Evaluation Instrument Development	Preparation of measuring instruments to test the achievement of objectives.
6	Learning Strategy Development	Formulation of strategies, learning activities, and teaching scenarios.
7	Development & Material Selection (Flipbook Maker)	Development of digital media and teaching materials according to multimedia principles.
8	Formative Evaluation	Expert validation, individual, small group, and field trials.
9	Product Revision	Product improvement based on formative evaluation results.
10	Summative Evaluation	Assessment of media effectiveness after full implementation.

The Dick & Carey model is an instructional design approach that views learning as a system with structured relationships between components (Dick & Carey, 2001). Table 1 explains several stages. The first stage, identifying learning objectives, aims to determine the final competencies to be achieved by students based on the curriculum, school needs, and a learning gap analysis. Dick and Carey (2009) emphasize that learning objectives must be determined first because all instructional components will be structured based on these objectives.

The second stage, learning analysis, is the step of mapping complex behaviour into structured sub-skills that students must master (Dick et al., 2015). This analysis not only breaks down tasks but also identifies prerequisites for students to achieve the main objectives. Therefore, this step is crucial for designing learning media such as flipbooks that present content hierarchically and sequentially.

The third stage, analysing initial student behaviour and characteristics, is particularly relevant when using digital media. According to Reigeluth (2012), student characteristics such as initial abilities, learning styles, and cognitive readiness significantly influence the success of multimedia-based learning. Therefore, in this study, student analysis served as the basis for determining the appropriate visuals, narrative, and navigation of flipbooks.

The fourth stage, formulating specific instructional objectives, is carried out to make learning goals more operational and measurable. Objectives are formulated in the form of observable performative behaviours, in accordance with Mager's (1997) principles. The formulation of these performative objectives also serves as a reference for developing the creativity rubric and problem-solving instruments.

In the fifth stage, assessment instrument development, Dick and Carey (2015) emphasized the importance of aligning measurement tools with instructional objectives. Instruments such as cognitive tests, creativity rubrics, and performance assessment sheets should be developed before designing learning strategies to ensure goal-oriented assessment (Nitko & Brookhart, 2014).

The sixth stage is developing a learning strategy, which includes the sequence of material presentation, the methods used, student activities, and the media selected. This strategy must consider Mayer's (2005) multimedia principles, such as coherence, signalling, redundancy, and modality. These principles ensure that the developed flipbook can optimize cognitive processing and minimize students' cognitive load, as stated by Sweller (1988).

The seventh stage, namely material development and selection, includes the production of flipbooks with appropriate visual design, narrative, segmentation, and text-image integration. Papert (1980) emphasized that students learn better when interacting with digital products; therefore, Flipbook Maker was chosen as a constructive medium that allows students to explore ideas and develop creative competencies. Media development also took into account the TPACK framework (Mishra & Koehler, 2006) so that technology integration is aligned with content and pedagogy.

The eighth stage, formative evaluation, consists of expert validation, individual trials, small group trials, and field trials. According to Tessmer (1993), formative evaluation provides crucial feedback for improving media quality before full-scale implementation. In this context, material experts assess the appropriateness of the content, while media experts assess the visual aspects, navigation, and interactivity of the flipbook.

The ninth stage is product revision. Based on expert advice and trial findings, revisions are made to correct errors in content, navigation, or visual appearance. Revision is an iterative process that ensures the media fully meets pedagogical and technical standards (Gustafson & Branch, 2002).

The final stage, summative evaluation, is conducted to assess the overall effectiveness of the flipbook after its actual use in learning. Summative evaluation can involve analysing improvements in creativity and problem-solving skills using standardized instruments such as

the TTCT (Torrance, 1974) or the CPS rubric. According to Fitzpatrick et al. (2011), summative evaluation ensures that the developed media has empirical impact and can be recommended for widespread use.

Overall, the table and narrative above show how the Dick & Carey development model provides a systematic, measurable, and evidence-based framework in designing Flipbook Maker as a medium that not only delivers material, but also enhances students' cognitive and creative processes.

In this case, the research procedure is carried out through three major phases: development, validation, and effectiveness testing.

1. Development Phase

This stage follows Dick & Carey's sequence, starting with identifying learning needs (Reigeluth, 2012), curriculum analysis, and analysing elementary school mathematics competencies based on the Independent Curriculum. Student characteristics were analysed using a learner analysis approach (Gagné et al., 2005), encompassing cognitive developmental age (Piaget, 1972), digital learning preferences (Prensky, 2010), and initial mathematical abilities.

The development of learning strategies refers to Mayer's (2009) multimedia theory, the principles of digital interactivity (Clark & Mayer, 2016), and problem-solving theory (Polya, 1973). Flipbook Maker was developed with integrative features such as images, animations, hyperlinks, and interactive exercises.

2. Validation Phase (Formative Evaluation)

Formative evaluation is carried out in three stages:

- a. Expert review by experts in content, instructional design, and educational technology. Expert validation refers to media quality standards according to Reeves (1992) and Nieveen (2015).
- b. One-to-One Try-out on 3 students to identify technical errors (Morrison et al., 2019).
- c. Small Group Evaluation on 9 students to see the clarity of instructions and digital navigation.
- d. Field Test on a full class, analysing student responses and potential impact (Tessmer, 1993).

Validation data was analysed quantitatively using Likert scale assessment and qualitative analysis based on content analysis (Miles et al., 2014).

3. Effectiveness Test Phase

Media impact testing was conducted through a pretest–post-test design (Creswell & Creswell, 2018) by measuring problem-solving creativity based on indicators of fluency, flexibility, originality, and elaboration (Torrance, 1974; Silver, 1997). Data analysis includes:

- a. Normality & homogeneity tests to ensure the suitability of parametric statistics.
- b. Paired t-test to see before–after improvements (Field, 2018).
- c. Effect size (Cohen's *d*) to measure the strength of the intervention (Cohen, 1988).
- d. Qualitative analysis of student answers, referring to the creative solution analysis model (Kaufman & Beghetto, 2009).

In Table 2, the needs analysis stage is the foundation of the systems-based development model, as it is at this stage that researchers identify gaps between ideal learning conditions and actual practice in the field. Dick and Carey (2015) emphasized that needs analysis serves to determine whether new media or instruction is needed to improve learning performance. Similarly, Gagné et al. (2005) stated that needs identification must consider the applicable curriculum, core competencies, and student characteristics as the basis for instructional design.

Therefore, this stage not only maps competency demands but also explores students' initial abilities and cognitive profiles—forming the foundation for subsequent design stages.

Table 2. Research Stages, Activities, and Theoretical Basis

Research Stage	Activity	Theoretical Basis / References
Needs Analysis	Curriculum analysis; student characteristics analysis; learning gap identification	Dick & Carey (2015); Gagne et al. (2005)
Design	Developing learning strategies; formulating instructional objectives; developing assessment instruments	Mayer (2009); Polya (1973)
Product Development	Flipbook Maker creation and design; text–image–audio integration; application of multimedia principles	Clark & Mayer (2016)
Expert Validation	Formative evaluation by material experts and media experts	Nieveen (2015); Reeves (1992)
Trials	Individual (one-to-one) and small group trials	Tessmer (1993)
Field Test	Full-scale field testing in a real classroom	Plomp & Nieveen (2013)
Effectiveness	Pretest–post-test measurement; effectiveness analysis; effect size calculation	Creswell (2018); Cohen (1988)

The design stage is a strategic step that outlines learning objectives, teaching strategies, and assessment instruments used to measure goal achievement. Mayer (2009) emphasized that designing multimedia-based media must adhere to the principles of evidence-based multimedia learning so that material can be optimally processed in working memory. Furthermore, Polya (1973) explained that developing instructional objectives related to creativity and problem-solving requires accommodating heuristic steps such as understanding the problem, planning a strategy, implementing the plan, and evaluating the results. Thus, the design process ensures that flipbook media is not only informative but also supports higher-order thinking processes.

In the product development stage, Flipbook Maker was designed with an integration of text, images, animation, and audio that followed the principles of effective multimedia design. Clark and Mayer (2016) emphasized that good digital media should minimize extraneous cognitive load and maximize germane load through the application of principles such as coherence, signalling, and modality. At this stage, the flipbook storyboard was systematically compiled, followed by the technical process of creating content and user interfaces. This ensures that the flipbook is not only visually appealing but also effective as a learning tool.

Expert validation is an essential part of formative evaluation to ensure product quality before testing it on students. According to Nieveen (2015), validation by material experts, media experts, and instructional design experts is necessary to ensure three main aspects: validity, practicality, and initial effectiveness of the media. Reeves (1992) also emphasized that formative evaluation must be conducted iteratively, involving experts to provide feedback based on theory and empirical experience.

The pilot testing phase is conducted in two forms: one-to-one testing and small group testing. Tessmer (1993) explains that individual testing aims to identify technical barriers and errors in use by individual users, while small group testing aims to test the clarity of instructions, the understandability of content, and the smoothness of interface interactions when used by several students simultaneously. The findings at this stage provide an important basis for product revisions before testing on a larger scale.

A full-scale field test is the stage where flipbook media is implemented in a real classroom context. Plomp and Nieveen (2013) explain that field tests are conducted to assess the practicality of classroom implementation, the level of student engagement, and the consistency

of the media's effectiveness in learning. Field tests allow researchers to determine whether the media can be used sustainably by teachers without intensive guidance.

The effectiveness stage is the culmination of the entire development process, where the implementation of the media is tested through a quasi-experimental design using the pretest–post-test method. Creswell (2018) emphasized that this design is used to assess significant changes in learning outcomes before and after the intervention. Effect size calculations using Cohen's (1988) formula are used to measure the strength of the media's influence on students' creativity and problem-solving abilities. Thus, this stage ensures that Flipbook Maker is not only valid and practical but also has a significant instructional impact.

RESULTS AND DISCUSSION

Results

The research results are presented based on three main phases: (1) validation and formative evaluation of the flipbook product, (2) field trials, and (3) testing its effectiveness on problem-solving creativity. Quantitative and qualitative analyses were used to ensure the reliability of the findings.

1. Expert Validation Results

Media and material validation was conducted by three experts using a 4-point Likert scale instrument. The validation results are summarized in Table 3.

Table 3. Results of Expert Validation of Media, Materials, and Learning

Validator	Rated aspect	Average Score	Category
Subject Matter Expert	content accuracy, coherence, relevance	3.78	Very Valid
Media Expert	visual design, navigation, interactivity	3.65	Very Valid
Learning Expert	alignment of goals–instruments–materials	3.82	Very Valid

Validation results showed that the flipbook met validity criteria, with an overall mean of 3.75, indicating that the product was suitable for use during the trial phase. The validators emphasized that the design adhered to effective multimedia principles and that instructional alignment supported quality learning.

2. Results of One-to-One and Small Group Trials

The initial pilot test involved three students (one-to-one) and nine students (small group). Qualitative findings indicated that students were able to navigate the flipbook without significant difficulty. They also demonstrated increased learning interest in the animation features and interactive exercises. Minor revisions to text size, background colour, and instruction clarity were made prior to the field test.

3. Field Test Results

Field trials were conducted on 30 fifth-grade students. Data showed an increase in learning activity and digital participation scores. Most students rated flipbooks as “easier to understand than textbooks” and “facilitate independent learning.” Participants were selected using a purposive sampling technique, targeting students who had not previously used interactive flipbook media in their science lessons.

4. Results of Media Effectiveness on Problem-Solving Creativity

A pretest–post-test design was used to measure problem-solving creativity based on four indicators: fluency, flexibility, originality, and elaboration. The results of the statistical analysis are summarized in Table 4. The paired t-test results showed a significant increase in all indicators ($p < .001$). The effect size calculation yielded a Cohen's d value of 1.21, which falls into the large effect category, indicating that flipbooks have a strong influence on problem-solving creativity.

Table 4. Pretest–Post-test Results of Problem-Solving Creativity

Indicator	Pretest (M)	Post-test (M)	Gain	Significance (p)
Fluency	58.2	78.6	+20.4	p < .001
Flexibility	55.1	76.3	+21.2	p < .001
Originality	52.6	71.8	+19.2	p < .001
Elaboration	54.8	80.1	+25.3	p < .001

Discussion

The discussion section interprets the findings and relates them to relevant research, without repeating references in the introduction.

1. Media Validity and Instructional Quality

The expert validation findings, which indicated a "very valid" category, confirmed that the flipbook successfully met the principles of instructional design. The alignment between objectives, content, and instruments reinforces the assumption that systematically developed products tend to be highly effective. This aligns with the findings of Aydin and Usta (2020), which demonstrated that instructional model-based design improves consistency between learning components and the effectiveness of digital media.

Furthermore, the application of multimedia principles such as segmentation, visual simplification, and audio integration supports cognitive efficiency. A study by Alqahtani and Alhumaidi (2021) reported that digital media that appropriately integrates text, visuals, and animations improves students' conceptual understanding and learning attention.

2. Student Response and Quality of Learning Interactions

Findings from initial trials and field tests indicate that students are highly responsive to the use of flipbooks. This medium has been shown to increase digital engagement and learning motivation. This is consistent with research findings by Kuswandi and Riyana (2020), which found that digital books increase student interaction and facilitate independent learning.

In the field test, students demonstrated the ability to understand instructions and complete interactive exercises, indicating that flipbook navigation aligns with the cognitive characteristics of elementary school-aged children. Visual support and interactive features appear to provide students with the freedom to explore information, a prerequisite for developing creative behaviour, according to research by Lee and Chen (2021).

3. Effectiveness on Problem Solving Creativity

Significant improvements in fluency, flexibility, originality, and elaboration indicators indicate that flipbooks not only improve content comprehension but also divergent thinking skills. This finding is supported by research by Rahmawati and Wibowo (2022), who found that visual narrative-based digital media improves the ability to generate more ideas and a variety of solutions.

The very large effect size ($d = 1.21$) confirms the strength of the intervention. A study by Ferdiansyah and Haryono (2021) showed that interactive media based on systematic design significantly contributed to problem-solving skills, particularly when students engaged in independent exploration of digital environments.

These findings also support the idea that interactive digital media can activate higher-order thinking skills through organizing information, providing challenges, and opportunities to construct one's own representations. This is reinforced by international studies such as those by Jamaludin and Osman (2020), which found that interactive media provides a conducive environment for fostering creative reasoning and complex problem-solving.

4. *The Relationship between Instructional Design, Multimedia, and Creativity*

The research results show that the combination of systematic instructional design and multimedia design has a significant pedagogical impact. This combination supports the theory that creativity thrives in a structured yet flexible learning environment. This finding aligns with Kokotsaki's (2020) study, which showed that creativity increases when learning provides measured direction but allows for exploration.

Instructional integration, such as open-ended problem presentations, interactive exercises, and digital scaffolding in flipbooks, provides a learning experience that allows students to construct creative solutions. A study by Han and Lim (2022) corroborates these findings, stating that open-ended task-based digital media significantly enhances creative problem solving.

CONCLUSION

This study shows that the development of Flipbook Maker-based learning media using the Dick & Carey instructional development model is proven effective in improving elementary school students' problem-solving creativity. The development process, which follows systematic stages including needs analysis, design, development, and formative and summative evaluation, is able to produce digital media that is valid, practical, and has a significant pedagogical impact. Validation by material experts, media experts, and learning experts provides a very valid category, indicating that the alignment between learning objectives, digital content, and instructional strategies has been well established.

The results of individual trials, small group trials, and field trials showed that Flipbook Maker was easy to use, visually appealing, and able to increase student motivation and engagement. These findings reinforce the view that appropriate multimedia integration can create a more interactive and meaningful learning experience. Furthermore, the results of effectiveness measurements using a pretest–post-test design showed a significant increase in four indicators of problem-solving creativity: fluency, flexibility, originality, and elaboration, with a large effect size. This proves that flipbooks function not only as an information medium but also as a means of cognitive stimulation that supports higher-order thinking skills.

In addition to producing effective media, this research also provides a theoretical contribution in the form of integrating four main perspectives of Multimedia Learning, Cognitive Load Theory, Constructionism, and TPACK—in a single digital media development framework. This synthesis shows that the effectiveness of learning technology is not only determined by the quality of the technology, but also by the suitability of the media to the content, pedagogical strategies, and characteristics of the learners. The practical contribution of this research is seen in the provision of flipbooks that can be used by teachers as an alternative interactive learning media that encourages creativity, problem-solving, and independent learning.

Thus, this study confirms that Flipbook Maker developed through Dick & Carey's systematic approach is capable of being an innovative solution in 21st-century learning. This product is worthy of widespread implementation and can be a reference for further research related to multimedia integration with other instructional models and the development of higher-order thinking competencies at various levels of education.

CONFLICT OF INTEREST

No conflict of interest for this study.

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