

Efektivitas Media Flipbook Digital Pada Materi Buttercream Dalam Meningkatkan Pengetahuan Siswa Pada Mata Pelajaran Dekorasi Kue

Effectiveness Of Digital Flipbook Media On Buttercream Material In Improving Students' Knowledge In A Cake Decoration Course

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Abstract

This study examined the effectiveness of a digital flipbook on buttercream material in improving students' knowledge in a university Cake Decoration course. A quantitative pre-experimental approach with a one-group pre-test-post-test design was employed. The participants were 70 applied-undergraduate culinary students selected through purposive sampling. The learning medium was a 72-page Heyzine-based flipbook combining text, photographs, process diagrams, navigation features, and embedded video tutorials. Knowledge was measured using 16 valid multiple-choice items derived from an initial pool of 30 questions. Instrument testing produced a reliability coefficient of 0.91. The data were analyzed using descriptive statistics, the Lilliefors normality test, the Wilcoxon signed-rank test, and average normalized gain. Mean scores increased from 74.375 (SD = 17.650) on the pre-test to 86.071 (SD = 7.832) on the post-test. Because both distributions were non-normal, the Wilcoxon test was applied and indicated a significant difference ($W = 357$; $Z = -4.227$; $p < .001$). The average N-Gain was 0.456, which falls within the moderate category. These findings show that the digital flipbook effectively improved students' knowledge while also reducing score dispersion. The medium is therefore suitable as a flexible, multimodal learning resource for theory and procedure-oriented culinary instruction.

Keywords: Buttercream; Cake Decoration; Digital Flipbook; Learning Media; Student Knowledge

Abstrak

Penelitian ini mengkaji efektivitas *flipbook* digital mengenai materi *buttercream* dalam meningkatkan pengetahuan mahasiswa pada mata kuliah Dekorasi Kue di tingkat universitas. Pendekatan kuantitatif pra-eksperimental dengan desain *one-group pre-test-post-test* digunakan dalam penelitian ini. Partisipan terdiri dari 70 mahasiswa program sarjana terapan bidang kuliner yang dipilih melalui teknik *purposive sampling*. Media pembelajaran yang digunakan adalah *flipbook* berbasis Heyzine setebal 72 halaman yang memadukan teks, foto, diagram proses, fitur navigasi, dan video tutorial terintegrasi. Pengetahuan diukur menggunakan 16 butir soal pilihan ganda yang valid, yang dipilih dari kumpulan awal sebanyak 30 soal. Uji instrumen menghasilkan koefisien reliabilitas sebesar 0,91. Data dianalisis menggunakan statistik deskriptif, uji normalitas Lilliefors, uji *Wilcoxon signed-rank*, dan *average normalized gain* (N-Gain). Skor rata-rata meningkat dari 74,375 (SD = 17,650) pada *pre-test* menjadi 86,071 (SD = 7,832) pada *post-test*. Karena kedua distribusi data tidak berdistribusi normal, uji Wilcoxon diterapkan dan menunjukkan adanya perbedaan yang signifikan ($W = 357$; $Z = -4,227$; $p < 0,001$). Nilai rata-rata N-Gain adalah 0,456, yang termasuk dalam kategori sedang. Temuan ini menunjukkan bahwa *flipbook* digital efektif dalam meningkatkan pengetahuan mahasiswa sekaligus mengurangi dispersi skor. Oleh karena itu, media ini sesuai sebagai sumber belajar multimodal yang fleksibel untuk pembelajaran kuliner yang berorientasi pada teori dan prosedur.

Kata kunci: *buttercream*; dekorasi kue; *flipbook* digital; media pembelajaran; pengetahuan mahasiswa

1. Introduction

Digital transformation has changed the way learning materials are prepared, distributed, and revisited in higher education. Learning media are no longer limited to printed handouts or one-time classroom demonstrations; they can integrate written explanations, photographs, diagrams, animation, audio, video, and hyperlinks within a single learning environment. Appropriate learning media support the transmission of information, stimulate attention, and help learners connect abstract concepts with concrete procedures (Daniyati et al., 2023; Wulandari et al., 2023). This role is particularly important in vocational and practice-oriented disciplines because students must understand not only factual and conceptual information but also the sequence and rationale of practical operations.

Culinary education combines cognitive knowledge with procedural and psychomotor competencies. In a Cake Decoration course, buttercream is a fundamental topic because students must understand its definition, functions, ingredients, varieties, colorants, flavorings, storage, equipment, consistency, and application techniques. Classroom explanations and short demonstrations may be insufficient when students need to review detailed steps repeatedly outside scheduled practice. Multimedia resources can address this limitation by providing persistent access to visual demonstrations and structured explanations. Interactive multimedia has also been associated with stronger learning activity and more consistent engagement among university students (Topano et al., 2022).

A digital flipbook is an electronic book interface that simulates page turning while allowing multimedia objects and navigation tools to be embedded. Flipbooks can support both face-to-face and independent learning because students may access the same structured material repeatedly and at their own pace. A systematic review by Purnomo et al. (2024) concluded that flipbooks can contribute to academic achievement, motivation, digital literacy, and other twenty-first-century learning skills. Their value arises from the combination of visual organization, learner-controlled navigation, and multimodal explanation rather than from digitization alone.

Empirical studies have reported the favorable effects of digital flipbooks in several learning contexts. Diajengsari et al. (2023) found that a sweet-bread training flipbook increased participants' mean knowledge scores and produced a moderate N-Gain. Fathi and Alfiandra (2025) similarly reported that an electronic flipbook integrated with problem-solving activities was valid, practical, and effective in improving learning outcomes. In vocational education, Widyasari et al. (2024) demonstrated that a digital flipbook for laundry instruction was highly feasible and was associated with improved pre-test and post-test performance. These findings suggest that the format can be adapted to learning content that requires visualization and procedural sequencing.

CEEJ studies also illustrate the relevance of interactive digital media to contemporary learning. Kuat et al. (2026) reported that interactive digital flashcards increased students' scores and motivation, while Ayuba et al. (2026) showed that technology use was strongly associated with university learning activity. Although these studies used different media and learning domains, they reinforce a shared principle: digital tools are most valuable when they encourage active engagement with information, foster meaningful interaction, and align with specific learning objectives.

The digital flipbook evaluated in this study was developed specifically for buttercream instruction. It contains 72 pages and was produced using Heyzine. The

material includes core buttercream concepts, ingredient and equipment information, preparation procedures, decoration techniques, page-navigation controls, illustrative photographs, process diagrams, and video tutorials. Earlier development testing indicated that the medium was feasible from material, media, language, and user perspectives. However, feasibility does not by itself establish instructional effectiveness. An effectiveness study is necessary to determine whether exposure to the medium produces a measurable improvement in students' knowledge.

Therefore, this study aimed to determine the effectiveness of digital flipbook media on buttercream material in improving students' knowledge in the Cake Decoration course. Effectiveness was assessed by comparing pre-test and post-test scores, testing whether the paired difference was statistically significant, and calculating the average normalized gain. The study also evaluated the quality of the knowledge instrument and examined changes in score dispersion to provide a more complete interpretation of the learning outcome.

2. Methods

2.1. Research Design and Participants

The study used a quantitative pre-experimental design with a one-group pre-test-post-test. The research was conducted in June 2026 at the Pastry Laboratory, Building H, Faculty of Engineering, Universitas Negeri Jakarta. The population consisted of applied-undergraduate culinary students enrolled in the Cake Decoration course. Purposive sampling was used to select 70 students from the 2024 cohort enrolled in the course who had not previously received formal instruction using the buttercream flipbook. The design measured the same participants before and after the learning intervention; therefore, each post-test score was paired with the participant's own pre-test score.

Table 1. One-group pre-test-post-test procedure

Stage	Activity	Duration / Schedule	Purpose
Pre-test	Sixteen multiple-choice knowledge items administered through Google Forms	20 minutes; 19 June 2026	Measure initial knowledge
Intervention	Students accessed, read, and explored the digital buttercream flipbook	25 minutes; 26 June 2026	Provide structured multimodal learning
Post-test	The same validated knowledge domains were assessed through Google Forms	20 minutes; 26 June 2026	Measure knowledge after treatment

2.2. Digital Flipbook Intervention

The intervention used a 72-page digital flipbook developed with the Heyzine platform. Its content aligned with the course learning outcomes and covered buttercream definitions, characteristics, functions, storage, types, principal ingredients, flavoring and coloring materials, cake-decorating equipment, consistency levels, and application techniques. The medium combined explanatory text with photographs, diagrams, page-navigation icons, external links, and video demonstrations. Examples included an American buttercream preparation video, piping techniques for producing a buttercream rose, and a crumb-coating tutorial. During the intervention, students were allowed to navigate the flipbook independently and review sections as needed.

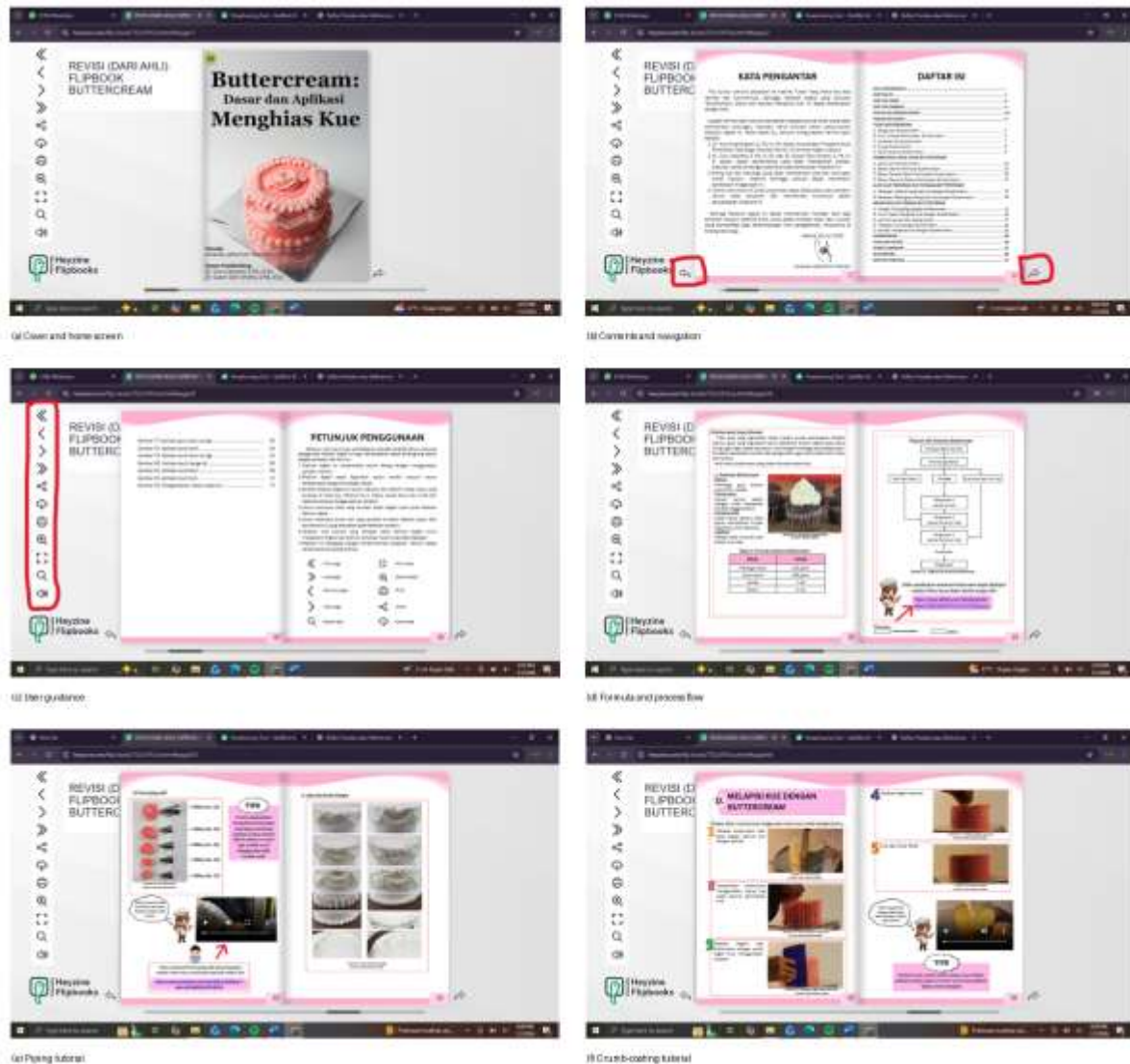


Figure 1. Selected features of the digital buttercream flipbook used in the intervention

2.3. Instrument and Data Collection

Knowledge was measured using multiple-choice questions developed from the sub-course learning outcomes, content indicators, knowledge dimensions, and cognitive levels C3–C6. The initial pool contained 30 items. Content and construct suitability were reviewed by two education experts, after which the instrument was piloted with 16 students who had completed the Cake Decoration course. Item validity was determined by comparing the calculated item correlation with $r\text{-table} = 0.497$. Sixteen items were valid, 11 were invalid, and three could not be analyzed because all pilot respondents answered correctly, resulting in zero score variance. Each correct response was scored 1, and each incorrect response 0, and total scores were converted to a 0–100 scale.

Reliability was evaluated using the Kuder–Richardson 20 approach for dichotomous items. The coefficient was 0.91, indicating very high internal consistency. Item-difficulty analysis classified six items as moderate and ten as easy; no valid item was classified as difficult. The final instrument, therefore, represented factual,

conceptual, and procedural knowledge while remaining suitable for the targeted learners.

Table 2. Quality of the final knowledge instrument

Indicator	Result	Interpretation
Initial item pool	30 items	Items developed from learning outcomes and flipbook content
Valid items	16 items	Used in the pre-test and post-test
Invalid items	11 items	Excluded from data collection
Items not analyzable	3 items	Zero response variance in the pilot
KR-20 reliability	0.91	Very high reliability
Difficulty distribution	6 moderate; 10 easy	No valid item classified as difficult

2.4. Data Analysis

Descriptive analysis included sample size, minimum, maximum, mean, and standard deviation. The Liliefors test was used to assess normality for the pre-test and post-test distributions. Because both distributions were non-normal, the paired-samples hypothesis was evaluated using the Wilcoxon signed-rank test at $\alpha = .05$. The magnitude of improvement was calculated as the average normalized gain, $g = (\text{post-test mean} - \text{pre-test mean}) / (100 - \text{pre-test mean})$. N-Gain values were interpreted as low ($g < 0.30$), moderate ($0.30 \leq g < 0.70$), or high ($g \geq 0.70$), following Hake (1998).

2.5. Research Hypothesis

Based on the conceptual framework, the research hypothesis stated that the use of digital flipbook media containing buttercream material would significantly improve students' knowledge in the Cake Decoration course.

3. Results and Discussion

3.1. Descriptive Change in Knowledge Scores

All 70 participants completed both measurements. The pre-test scores ranged from 18.75 to 93.75, whereas the post-test scores ranged from 68.75 to 100. The mean increased by 11.696 points, from 74.375 before the intervention to 86.071 after. At the same time, the standard deviation decreased from 17.650 to 7.832. The increase in the mean indicates improved knowledge, while the smaller post-test standard deviation shows that achievement became more homogeneous after students used the flipbook.

Table 3. Descriptive statistics for pre-test and post-test scores

Measurement	N	Minimum	Maximum	Mean	Standard deviation
Pre-test	70	18.75	93.75	74.375	17.650
Post-test	70	68.75	100.00	86.071	7.832
Change	70	—	—	+11.696	-9.818

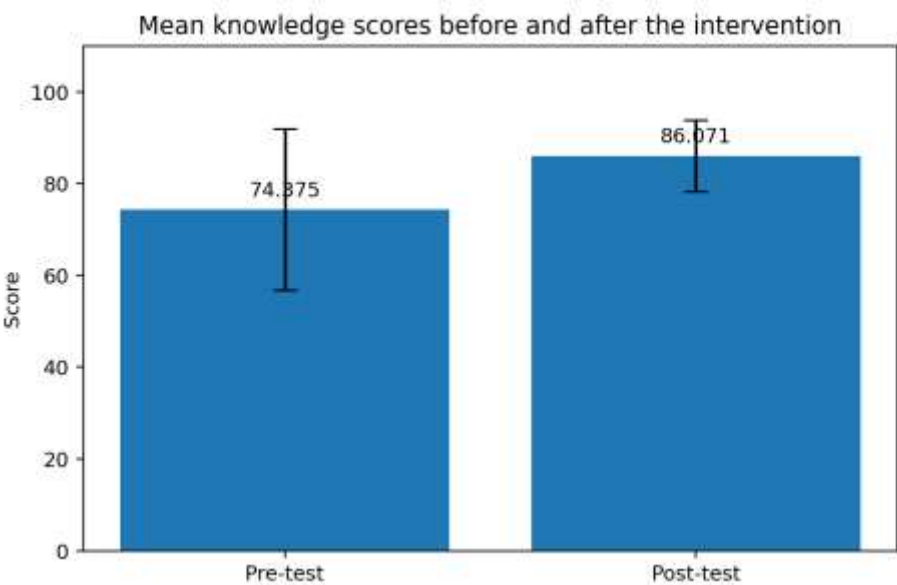


Figure 2. Mean pre-test and post-test knowledge scores; error bars represent standard deviations

The reduction in dispersion is educationally meaningful. The pre-test standard deviation suggests substantial differences in students’ initial familiarity with buttercream concepts and procedures. Following the intervention, scores clustered more closely around a higher mean. This pattern implies that the digital resource benefited not only students with stronger prior knowledge but also lower-scoring students, helping them reach a more comparable level. The result is consistent with the function of a reusable multimedia resource, which enables learners to pause, repeat, and revisit information rather than relying on a single verbal explanation or demonstration.

3.2. Normality and Hypothesis Testing

The Liliefors test showed that both score distributions departed from normality. The pre-test L-value was 0.186, and the post-test L-value was 0.202, each exceeding the critical value of 0.106. Consequently, a parametric paired-samples t-test was not appropriate, and the Wilcoxon signed-rank test was used.

Table 4. Liliefors normality-test results

Variable	N	Mean	SD	L-calculated	L-critical	Decision
Pre-test	70	74.375	17.650	0.186	0.106	Non-normal
Post-test	70	86.071	7.832	0.202	0.106	Non-normal

The Wilcoxon signed-rank test produced $W = 357$, $Z = -4.227$, and $p < .001$. The p-value was below 0.05; therefore, the null hypothesis of no difference was rejected. Students’ knowledge after using the flipbook was significantly higher than their knowledge before the intervention.

Table 5. Wilcoxon signed-rank test

Statistic	Value	Interpretation
Sample size	70 paired observations	All participants completed both tests
W	357	Sum of signed ranks

Statistic	Value	Interpretation
Z	-4.227	Standardized Wilcoxon statistic
Asymptotic significance (two-tailed)	< .001	Significant at $\alpha = .05$
Decision	Reject H_0	Pre-test and post-test knowledge differed significantly

3.3. Magnitude of Learning Improvement

Statistical significance establishes that a change occurred, but does not describe the educational magnitude of that change. The average normalized gain was therefore calculated. The resulting N-Gain of 0.456 was within the moderate category. In other words, the intervention achieved approximately 45.6% of the maximum possible improvement from the students' initial mean score.

Table 6. Average normalized gain

Component	Value
Mean pre-test score	74.375
Mean post-test score	86.071
Average N-Gain	0.456
Category	Moderate

The moderate category should not be interpreted as a weak result. The pre-test mean was already relatively high, reducing the remaining distance to the maximum score and thereby limiting the numerical ceiling for N-Gain. The post-test mean of 86.071, along with a smaller standard deviation, indicates a meaningful and broadly distributed improvement. The result closely resembles the moderate N-Gain reported by Diajengsari et al. (2023) for a flipbook-based sweet-bread training program. However, the present study involved a larger university sample and course-based content.

3.4. Why the Digital Flipbook Supports Learning

The effectiveness of the medium can be explained through the match between the media format and the characteristics of buttercream instruction. Buttercream learning includes factual knowledge, such as ingredient names and equipment; conceptual knowledge, such as differences among buttercream types and consistency levels; and procedural knowledge, such as mixing, coloring, crumb coating, and piping. A text-only resource may explain these components, but photographs, diagrams, and video provide additional representations that make sequences and visual standards easier to understand.

The flipbook allowed students to control the pace and sequence of their study. Learners could return to earlier pages, compare formulas, examine images, and replay linked demonstrations. This learner control is particularly relevant when students differ in prior experience, as indicated by the wide pre-test score range. The post-test distribution suggests that repeated access helped reduce this initial gap. Purnomo et al. (2024) likewise emphasized flexibility and multimedia integration as central advantages of flipbook learning.

The present result is also consistent with broader evidence on interactive digital media. Fathi and Alfiandra (2025) found that flipbook content supported improved outcomes when structured around learning tasks, while Topano et al. (2022) reported strong student learning outcomes with interactive multimedia. Within CEEJ, Kuat et al. (2026) demonstrated that interactive digital media can improve performance and motivation when combined with an engaging learning design. Together, these findings indicate that digital media effectiveness depends on instructional alignment rather than mere visual attractiveness.

The intervention was brief—25 minutes of directed access—yet produced a statistically significant gain. This suggests that the medium had high informational efficiency for the assessed knowledge domains. However, the result should be interpreted as evidence of cognitive improvement rather than proof of practical mastery. Knowledge of piping steps or crumb coating does not automatically guarantee psychomotor proficiency. Practical performance requires repeated hands-on practice, feedback, and evaluation using product or process rubrics.

The study also contributes to culinary education research by evaluating a medium designed for a specific vocational topic rather than a general school subject. Most flipbook studies have focused on primary or secondary education. The present findings show that the same format can support higher-education learners when the content is closely tied to course outcomes and the medium combines theory with procedural visualization.

3.5. Limitations and Future Research

The study used a one-group pre-test–post-test design without a control group. Consequently, the observed increase cannot be attributed exclusively to the flipbook with the same certainty as in a randomized controlled design. Repeated testing, short-term memory, or other learning experiences may have contributed to the result. The intervention and post-test were also conducted within a short time frame, so knowledge retention was not examined. Furthermore, the outcome measure focused on cognitive knowledge and did not assess practical cake-decorating skills, learning motivation, usability, or student satisfaction. Future studies should include a comparison group, a delayed post-test, a larger multi-institutional sample, and a performance-based assessment of buttercream preparation and decoration.

4. Conclusion

The digital flipbook on buttercream material was effective in improving students' knowledge in the Cake Decoration course. The mean score increased from 74.375 to 86.071, and the Wilcoxon signed-rank test confirmed a significant difference between pre-test and post-test results ($W = 357$; $Z = -4.227$; $p < .001$). The average N-Gain of 0.456 placed the improvement in the moderate category. In addition, the lower post-test standard deviation indicates that learning outcomes became more consistent across students. The combination of structured text, photographs, diagrams, navigation tools, and video tutorials enabled students to review theoretical and procedural information flexibly. The flipbook can therefore be used as a complementary learning resource in university Cake Decoration courses and may be adapted for vocational-school culinary instruction. Its use should be integrated with hands-on practice, as the current evidence concerns knowledge improvement rather than psychomotor competence.

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