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Development of digital based infographic and interactive timeline media for the daulah abbasiyahtopic at SMP IT Harapan Umat Karawang

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ABSTRACT

This study developed and evaluated a web-based learning medium combining infographics and an interactive timeline for teaching the Abbasid Caliphate (Daulah Abbasiyah) in Grade 8 Islamic Cultural History (SKI) at SMP IT Harapan Umat Karawang. Using the ADDIE research and development framework, the product was created through needs analysis, design, development, implementation, and evaluation. Feasibility was assessed through expert validation of content and media quality, followed by revisions to ensure instructional accuracy and usability. Effectiveness was examined through paired pretest–posttest measures across five parallel classes (A–E), supported by descriptive statistics, paired difference testing, and effect size reporting. Student perceptions were also captured through a questionnaire to document acceptance and perceived usefulness of the media. The findings indicate that the developed media is highly feasible and positively received by students, and overall learning outcomes improved after the intervention, although gains varied across classes. These results suggest that chronology-oriented digital media can support learning of complex historical content, but its impact depends on classroom context and how the media is orchestrated within instructional activities.

Introduction

The rapid shift toward digital learning requires schools to move beyond reliance on lengthy texts and teacher centered lecturing, especially when subject matter demands coherent and meaningful understanding. From a cognitive perspective, presenting information through a combination of words and visuals is easier to process because it helps students build more structured mental representations. Well designed visual media also reduces unnecessary cognitive load, as students are not forced to continuously translate dense text into mental imagery. Consequently, the quality of instructional design matters more than the mere presence of technology. This rationale aligns with the cognitive theory of multimedia learning, which emphasizes that visuals, text, and learning activities must be organized to support selecting, organizing, and integrating information. Therefore, developing digital learning media should be treated as an evidence based pedagogical decision rather than a passing trend (Mayer, 2024).

In history learning, the central challenge is not only memorizing facts but also grasping the sequence of events and the causal relationships that unfold over time. When chronology is not well understood, students tend to memorize fragmented information without being able to explain how

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events connect to one another (helsa et al., 2024). Interactive timeline media is relevant because it transforms the abstract concept of time into a visual pathway that students can revisit, thereby supporting coherent chronological understanding. Research on the development of timeline based e booklets indicates that a timeline format helps students understand history chronologically and contributes to measurable improvements in learning outcomes and chronological thinking. In another context, the development of Timeline JS assisted learning media was also reported to enhance learning outcomes because events were presented in a chronological, contextual, and interactive manner. Thus, strengthening chronological understanding through digital media has a solid empirical foundation for topics that are dense with events (Nalendro et al., 2025).

The Daulah Abbasiyah topic in Islamic Cultural History (SKI) is complex because it includes territorial expansion, political dynamics, scientific and intellectual contributions, and social change over an extended period. This complexity often makes it difficult for students to distinguish core events from supporting details and to construct a coherent "story map" across historical phases (Susanto, 2025). At this point, infographics serve to condense essential ideas and highlight relationships among key elements, while interactive timelines organize the sequence and transitions of events. Recent studies on digital infographic use also suggest that visualization can enhance student engagement and understanding of historical chronology because information is presented in a systematic and easily scannable form. Research on infographic development for history instruction further emphasizes that well designed infographics can strengthen students' capacity to analyze change and continuity rather than stopping at rote memorization. Therefore, integrating infographics and interactive timelines is theoretically consistent with SKI learning needs, which require both chronological understanding and conceptual meaning making (Jasanddes & Ofianto, 2025).

Several R&D studies in the past five years have examined timeline based and infographic based media and generally report that such products are valid, practical, and effective in history learning contexts. For example, the development of a timeline based e booklet confirms that presenting events in a timeline format supports chronological understanding and leads to measurable gains in learning outcomes (Helsa et al., 2024). At the university level, the development of Timeline JS media also shows improved learning outcomes, mainly because it visualizes interconnections among events in an interactive manner. Meanwhile, R&D work on infographic media for history learning reports improvements in students' ability to analyze change and continuity, as key information is condensed and presented in a focused way (Nalendro et al., 2025). However, many of these studies concentrate on general history or local history and do not specifically address the Abbasid topic within Islamic Cultural History in an integrated Islamic school context. The research gap addressed by this study lies in developing a digital product that integrates two representational forms simultaneously infographics and an interactive timeline and testing it systematically for the Abbasid topic in an SMP IT setting.

Field conditions in SMP IT Harapan Umat Karawang indicate that students tend to perceive the Abbasid topic as a disconnected list of events rather than as an interconnected historical narrative. Instruction that relies heavily on oral explanation and textbook reading can cause students to lose the sequence and struggle to summarize core ideas, particularly when a large amount of information must be processed within limited classroom time (Observation, 2025). At the same time, classroom facilities support digital learning because instruction can combine projection (teacher led display) with independent access through students' devices, yet the use of digital resources has not been structured as a coherent learning design. The most pressing need is

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not merely “attractive media,” but media that organizes content into concise, chronological, and revisitable learning resources so students have consistent scaffolding for study. Within the logic of educational product development, such needs analysis becomes the foundation for determining product specifications, features, and content organization before proceeding to design and validation. Hence, developing digital infographics and an interactive timeline is positioned as a direct response to the classroom need for chronological comprehension and conceptual condensation in the research setting (Sugiyono, 2022).

This study aims to develop digital based infographic and interactive timeline media for the Daulah Abbasiyah topic at SMP IT Harapan Umat Karawang and to evaluate its feasibility through expert validation as well as its initial effectiveness through classroom implementation. The ultimate goal is to produce a product that is valid in content and design, practical for classroom use, and capable of improving students’ understanding of the topic. Beyond producing a learning product, the study also offers a conceptual contribution by strengthening the argument that teaching event-dense Islamic history requires dual representations, conceptual condensation through infographics and chronological structuring through interactive timelines. Another contribution lies in documenting a replicable development process so schools can adopt a similar approach for other SKI topics with comparable characteristics. Methodologically, the study follows the R&D logic that integrates product development and effectiveness testing in a unified cycle. Theoretically, it operationalizes multimedia design principles in the SKI context, framing “digital integration” as an evidence based learning design rather than a simple shift of content onto screens.

This study is grounded primarily in Cognitive Theory of Multimedia Learning**,** which explains that learning is more effective when information is presented through well designed combinations of words and visuals that help learners select, organize, and integrate content into coherent mental models (Mayer, 2024). In addition, the study draws on Cognitive Load Theory**,** emphasizing that instructional media should reduce extraneous load and optimize working memory resources, especially for content dense and chronologically complex learning materials such as the Abbasid topic (Sweller, 2020). From an instructional design perspective, the product development process follows the ADDIE model**,** ensuring a systematic pathway from needs analysis to evaluation in educational R&D (Branch, 2021). Together, these theories justify why integrating infographics (concept condensation) and an interactive timeline is pedagogically plausible and testable within a school based development study.

Method

This study employed a Research and Development (R&D) design with a quantitative approach to evaluate product feasibility and test its initial effectiveness in teaching the Abbasid Caliphate (Daulah Abbasiyah) topic in Islamic Cultural History (SKI). The development process followed the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to ensure a systematic pathway from needs analysis to product evaluation. The field trial was conducted with Grade 8 students (Classes A–E) at SMP IT Harapan Umat Karawang, involving N = 120 students for the pretest–posttest dataset and students provided responses to the student perception questionnaire (Branch, 2021). To examine initial effectiveness, the study used a one-group pretest–posttest design**,** measuring students’ learning outcomes before and after the use of the digital infographic and interactive timeline media in authentic classroom instruction. Data were collected through expert validation sheets (media and content experts) to assess feasibility, achievement tests (pretest and posttest) to capture learning gains, and a student questionnaire to document

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perceived clarity, attractiveness, usability, and learning support (Creswell, 2023). Quantitative analysis included descriptive statistics (means and score ranges), a paired samples t-test as the main inferential test, the Wilcoxon signed rank test as a non parametric confirmation, reporting of effect size to interpret practical impact, and summary of questionnaire results using mean scores and categorical interpretation by indicator (Sugiyono, 2021).

Result

This study is a development research project that produced a digital learning medium in the form of infographics and an interactive timeline**,** implemented for teaching the Daulah Abbasiyah topic. In this study, the R&D (Research and Development) framework applied was the ADDIE model**,** which guided the development process from needs identification to effectiveness evaluation. The stages of ADDIE include Analysis, Design, Development, Implementation, and Evaluation**.**

Analysis Stage

In the Analysis stage of the ADDIE based R&D model, the researcher identified instructional problems and learning needs through a field-based approach within the context of SKI instruction on the Abbasid topic for Grade 8 classes (A–E) at the research site. Based on preliminary classroom observations during instruction (Observation, 2025), the Abbasid topic demanded students' understanding of event chronology, connections among key figures, and dense cause effect chains; however, instruction dominated by oral explanation and reading materials made it difficult for some students to organize information into a coherent narrative. Classroom conditions also indicated a need for media that could "break down" complex information into key points and connect them visually, enabling students to grasp the core content more easily and remember the sequence of events more accurately. These observational findings were further strengthened through an interview with the SKI teacher (Interview, 2025), which confirmed that more visual and interactive media were needed to support comprehension while also increasing students' interest and active engagement during learning. Therefore, the learning need formulated at the Analysis stage was not merely "the need for digital media," but rather the need for media that pedagogically structures chronology, condenses key concepts, and facilitates repetition so that students' understanding of the Abbasid topic becomes more organized.

This Analysis stage provided the rationale for selecting infographics and an interactive timeline as the product, since both align closely with the topic's chronological and information-dense characteristics and are relevant to real classroom conditions at the research site. The Design stage was reflected in planning the product format (infographics and interactive timeline), mapping the content delivery flow, and developing standardized evaluation instruments (expert validation sheets, pretest–posttest, and student questionnaires) so that product quality and learning impact could be measured objectively. The Development stage involved producing the media, followed by validation from content and media experts using a 1–4 scale and revising the product based on validators' feedback; the overall feasibility mean was approximately 3.92 out of 4**,** and the media expert rating reached the maximum score, indicating that the product was suitable for use with minor refinements.

Product Design and Development Stage

In the Design stage, the researcher translated the needs analysis of SKI instruction on the Daulah Abbasiyah topic at SMPIT Harapan Umat Karawang into a product plan that was clear, measurable, and aligned with Grade 8 learning competencies. The design process began by mapping learning objectives and core content, after which the material was broken down into concise units so it could be presented effectively in an infographic format and connected within a

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chronological flow through an interactive timeline**.** In this way, students were not only exposed to information but were also supported in understanding the links among key figures, events, and their impacts in an orderly manner. Next, the researcher designed the interface and navigation system (page flow, menus, buttons, and user guidance) with attention to readability and ease of access through both a projector and students' mobile devices, as classroom conditions allowed these two modes to be used simultaneously (Interview, 2025). The main output of this stage was a structured media blueprint and storyboard/screen framework that served as the foundation for production in the subsequent phase.

Table 1. Product Contents: Media Aspects, Media Contents, and Supporting Evidence

Aspect	Media Content	Evidence/Reference
Content: scope of material	The material focuses on the Abbasid Caliphate (Daulah Abbasiyah) with emphasis on scientific advancement, educational ecosystems, and historical context.	Screenshots of the Home/Infographics pages (title/topic) and the content summary displayed via projector.
Content: event chronology	The timeline presents a chronological flow (period/year → event title → brief summary), enabling students to see sequence and interconnections in a structured way.	Screenshots of the Timeline page (at least two different period segments) and exploration buttons/links (e.g., "Read more").
Content: key concept summaries	Infographics provide concise key points (keywords, core concepts, figures, institutions, and impacts) as a quick content map.	Screenshots of the Infographics page (one full page plus a cropped section showing a subheading/section).
Components: navigation and pages	The media is a learning website with separated menus/pages (e.g., Home, Timeline, Infographics, Figures, Quiz, Ranking, About).	Screenshots of the header navigation/menu (navbar) and the list of available pages.
Components: Figures feature	The Figures page contains brief profiles of key actors (caliphs/scholars) in card format (name plus concise contribution) to facilitate information grouping.	Screenshots of the Figures page (the "Caliphs" section and the "Scholars" section).
Components: interactive quiz/assessment	The Quiz menu supports formative assessment to check understanding after exploring the content (e.g.,	Screenshots of the Quiz page (item display/activity view and progress indicator, if available).

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	interactive items or practice questions).	
Development process: content development	Content was developed through: mapping the topic → selecting core concepts → writing concise summaries → structuring a chronological timeline → composing thematic infographics.	Process documentation (draft content, outlines, or screenshots of early versions prior to finalization).
Development process: web design and implementation	The product was implemented as a digital system: page layout design, navigation integration, visual placement, and access testing via projector and students' devices.	Final screenshots of each page plus documentation of classroom access tests (projector display and students accessing via devices).
Development process: validation and revision	The product was revised based on feedback from content and media experts before the classroom trial to improve content quality and usability.	Expert validation sheets, revision notes, and before–after comparisons of revised sections.

In the Development stage, the design blueprint was transformed into a web-based digital product consisting of an infographic and an interactive timeline for the Abbasid topic. The product was developed with a menu structure that enabled step by step exploration (e.g., Home, Timeline, Infographics, Figures, Quiz, Ranking, and About), allowing students to progress from a summary to deeper learning without losing direction. After the initial version was completed, the researcher conducted internal checks to ensure content accuracy, visual consistency, smooth navigation, and platform stability when displayed via projector and when accessed through students' devices with varying screen sizes. This phase produced an initial version that was ready for testing, but it was not considered fully feasible until it passed expert review.

Figure 1. Product Development

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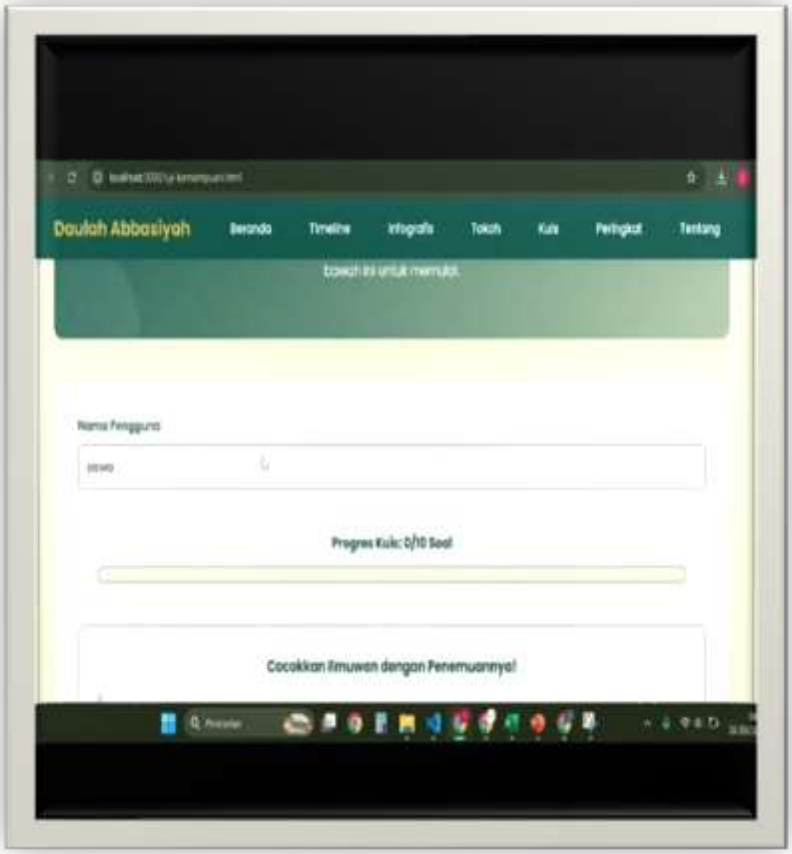

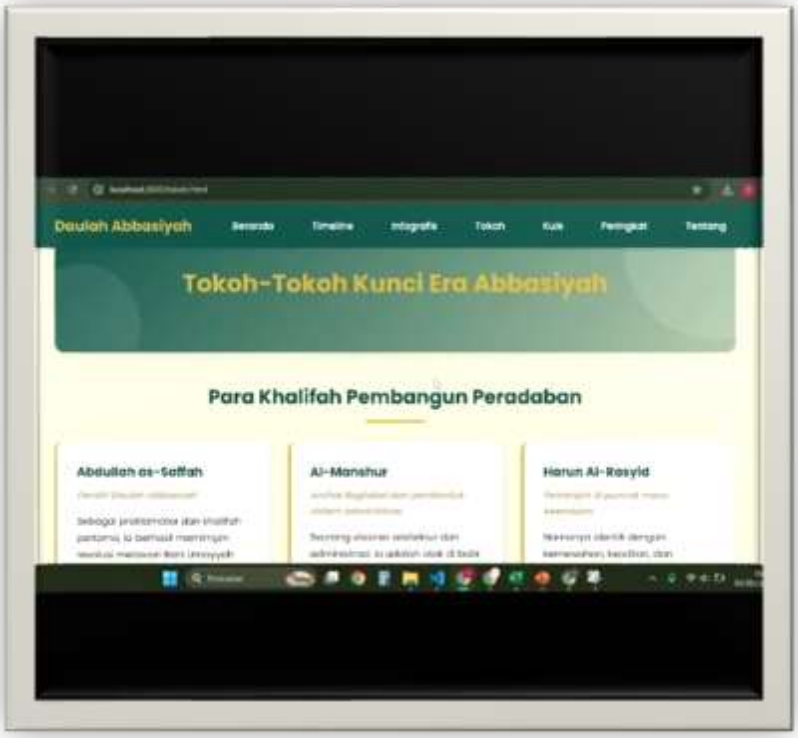

Next, the product underwent expert validation (content expert and media expert) using a 1–4 validation scale so that feasibility could be assessed objectively and systematically. The researcher sent the validation instruments along with the media link so validators could directly evaluate

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content aspects (accuracy, completeness, and alignment with learning objectives) and media aspects (visual design, readability, navigation, and technical quality). The validation results indicated a very high feasibility mean of approximately 3.92 out of 4**,** with the media expert rating reaching 4.00 and the content expert ratings reported as 4.00; 4.00; and 3.67**,** indicating that the product was suitable for use with minor improvements based on experts' recommendations. These scores also confirm that the product met feasibility standards in both content and visual presentation for Grade 8 instruction. The final step within the development phase was product revision**,** namely refinements based on expert feedback to ensure that the version implemented in the classroom was a quality controlled product. Revisions were directed toward strengthening content and presentation (sharpening connections across concepts and events, and refining concise narrative explanations) as well as improving technical aspects (font and layout consistency, clearer navigation buttons, user instructions, and re testing access stability).

Implementation Stage

The Implementation phase was carried out across all Grade 8 classes (A–E) at SMP IT Harapan Umat Karawang with a structured schedule to ensure consistent procedures across classes.

Table 2. Class treatment schedule

Class	Activity	Day	Date (2025)	Periods	Time
B	Pretest & application orientation	Monday	Nov 24, 2025	2–4	08:00–10:00
A	Pretest & application orientation	Tuesday	Nov 25, 2025	8–10	13:00–15:00
E	Pretest & application orientation	Wednesday	Nov 26, 2025	8–10	13:00–15:00
C	Pretest & application orientation	Thursday	Nov 27, 2025	2–4	08:00–10:00
D	Pretest & application orientation	Friday	Nov 28, 2025	2–4	08:00–10:00
B	Posttest & application trial	Monday	Dec 1, 2025	2–4	08:00–10:00
A	Posttest & application trial	Tuesday	Dec 2, 2025	8–10	13:00–15:00
E	Posttest & application trial	Wednesday	Dec 3, 2025	8–10	13:00–15:00
C	Posttest & application trial	Thursday	Dec 4, 2025	2–4	08:00–10:00
D	Posttest & application trial	Friday	Dec 5, 2025	2–4	08:00–10:00

In practice, the researcher coordinated with the SKI teacher to ensure classroom readiness, projector availability, and student device access so that the media could be used optimally without disrupting the flow of instruction. During the first meeting in each class, activities began with a pretest as a baseline measurement of students' initial understanding at the individual level. The pretest was administered at the beginning of the lesson with uniform instructions, completed independently, and managed so that scores reflected students' knowledge prior to exposure to the developed media. After the pretest, the teacher or researcher provided a brief orientation to the lesson objectives and clarified that the media was intended to support both conceptual understanding and chronological structuring of the Abbasid topic (Observation, 2025). The session

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then continued with an application introduction**,** including how to access the link, how to navigate menus, and how to use the infographic and interactive timeline components effectively. This step was essential because the implementation aimed not merely to "use media," but to embed media use as a core part of a controlled and purposeful instructional design.

The core treatment was delivered through instruction that integrated the media with a consistent learning flow across classes. The lesson began with exploration of the infographic to capture key concepts and essential points, followed by guided use of the interactive timeline to organize events, key figures, and causal links in chronological order. Throughout instruction, the teacher facilitated structured discussion, posed guiding questions, asked students to explain relationships among events based on timeline nodes, and corrected misconceptions that emerged as students interpreted historical sequences. Students were also encouraged to explore specific sections independently using their devices and then share findings or respond to questions by citing information directly from the media. To prevent passive learning, the treatment included reinforcement activities such as short exercises or quizzes based on infographic points and timeline chronology, accompanied by immediate feedback to strengthen comprehension.

In the final meeting (the following week) in each class, students completed a posttest after the media supported instruction was concluded, so the final measurement reflected learning outcomes after the treatment. The posttest followed standardized administration procedures (time allocation, instructions, and supervision) to ensure fair comparability between pretest and posttest at both the individual and class levels. In addition to measuring learning outcomes, the application trial at this stage also served to confirm the media's operational feasibility under real classroom conditions, whether projected for whole class instruction or accessed through student devices. In this way, the implementation produced two complementary evaluation outputs evidence of learning gains (pretest–posttest) and evidence of practical feasibility in classroom use.

Evaluation Stage

The evaluation stage consisted of a series of activities to analyze the outcomes of the treatment and students' responses to the developed media. The analysis was conducted in stages: (1) descriptive statistics to describe score tendencies and distributions; (2) paired difference testing to examine whether a meaningful improvement occurred after the media was used; and (3) effect size reporting to interpret the practical magnitude of the impact. Overall, the test results indicated significant improvement in most classes, while one class showed a relatively small increase and therefore weaker evidence of improvement compared to the others. This pattern is consistent with Figure 2**,** which shows that Class B had the smallest gain.

Descriptive findings indicate an increase in learning achievement after instruction using the media. At the pooled level across Classes A–E, the mean pretest score of 84.41 increased to a mean posttest score of 93.25**,** yielding an average gain of 8.84**.** However, the magnitude of improvement varied across classes, Class A demonstrated the largest increase, whereas Class B demonstrated the smallest. This variation is important because the effectiveness of the media in real classroom settings may be influenced by initial class conditions, instructional dynamics, and the intensity of student engagement during media use. Descriptively, all classes showed higher scores from pretest to posttest, yet the size of the increase differed across classes. Class A exhibited the highest gain, while Class B showed the lowest gain. This variation suggests that the impact of the media in classroom practice may depend on baseline class characteristics and the dynamics of how the instruction was implemented.

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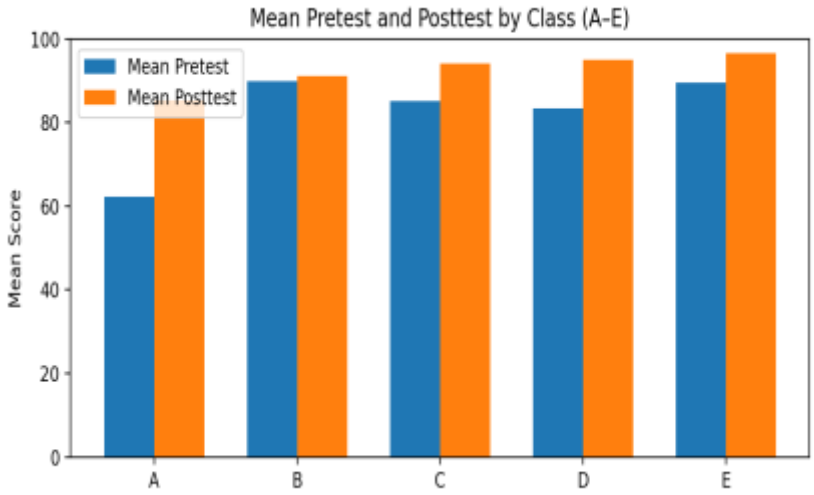
Table 3. Mean pretest, posttest, and gain by class (A–E)

Class	N	Mean Pretest	Mean Posttest	Mean Gain
A	13	62.31	85.38	23.08
B	27	89.96	91.11	1.15
C	27	85.19	94.07	8.89
D	26	83.46	95.00	11.54
E	27	89.63	96.67	7.04

The descriptive results in Table 1 and the visual pattern in Figure 1 jointly indicate that learning outcomes increased from pretest to posttest across all Grade 8 classes (A–E), suggesting that the developed infographic and interactive timeline media supported students' understanding of the Abbasid topic. However, the magnitude of improvement varies substantially between classes, which is clearly visible in the different gaps between the pretest and posttest bars. In particular, Class A shows the largest improvement, whereas Class B exhibits only a very small change, implying that the media's impact may depend on class level conditions and how the learning activities were enacted. This cross class variation is important because it signals that effectiveness should be interpreted not only at the pooled level but also at the class level. To make these differences easier to compare, the next analysis presents the mean gain (posttest minus pretest) by class, followed by inferential testing to determine whether the observed increases are statistically meaningful rather than incidental.

Figure 1. Bar chart of mean pretest and posttest by class (A–E).



While Figure 1 provides a clear side by side comparison of mean pretest and posttest scores, it does not directly show the size of improvement for each class in a single, comparable metric. To address this, Figure 2 presents the mean gain (posttest minus pretest) for each class, allowing the magnitude of change to be seen more explicitly and compared more easily across classes. This gain based view highlights which classes benefited most from the intervention and which showed only limited progress. In particular, the smallest gain becomes more visible, helping to identify classes that may require stronger instructional scaffolding or more intensive learning activities during implementation. Therefore, Figure 2 functions as a bridge from the descriptive pre post comparison to the subsequent inferential tests that assess whether the observed gains are statistically meaningful.

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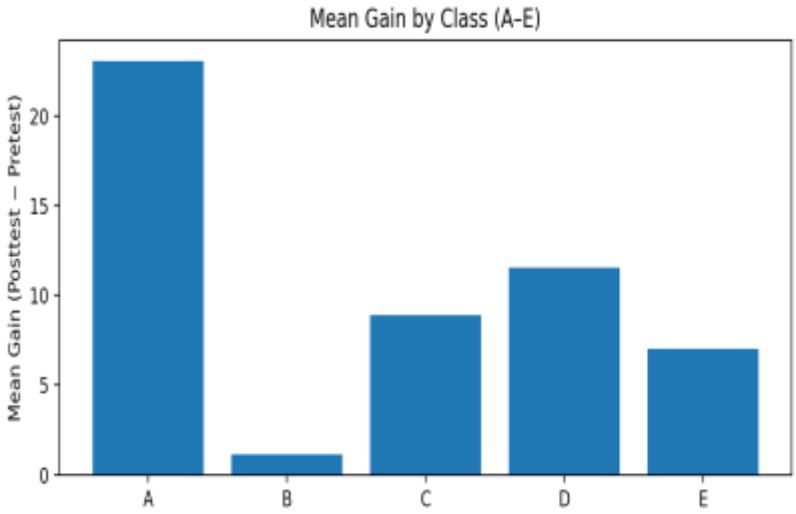
Figure 2. Bar chart of mean gain (posttest − pretest) by class (A–E).



After descriptive statistics, the analysis proceeded to paired difference testing to ensure that score increases were not due to chance. The primary test was the paired samples t-test, supported by the non-parametric Wilcoxon signed rank test as a confirmation, strengthening conclusions when parametric assumptions might be a concern. Class-level results showed significant improvements in Classes A, C, D, and E, whereas Class B was not significant in either test. At the pooled level across Classes A–E, the learning improvement was highly significant ($p < 0.001$) in both the paired t-test and Wilcoxon test. Overall, the effectiveness of the media at the Grade 8 level is supported by consistent descriptive and inferential evidence, while acknowledging meaningful variation across classes.

Table 4. Pretest–posttest significance tests by class and pooled sample.

Group	N	Paired t-test	Wilcoxon	Decision (α = 0.05)
A	13	t = 4.89; p = 0.00037	p = 0.004	Significant
B	27	t = 0.45; p = 0.658	p = 0.311	Not significant
C	27	t = 4.74; p < 0.001	p < 0.001	Significant
D	26	t = 4.81; p < 0.001	p < 0.001	Significant
E	27	t = 4.21; p < 0.001	p < 0.001	Significant
Pooled (A–E)	120	t(119) = 7.33; p < 0.001	p < 0.001	Significant

Statistical significance should be complemented by effect size to interpret how strong the impact is in practical terms. The effect size used was Cohen's d_z for paired data. The pooled effect size across Classes A–E was 0.67 (a medium effect), while several classes showed large effects (e.g., Classes A, C, D, and E) and Class B showed a small effect. In addition, the distribution of score changes reinforces this interpretation: in the pooled sample, 64.2% of students improved, 25.8% remained unchanged, and 10.0% declined, indicating that gains occurred for the majority rather than a small subset. However, Class B had a lower proportion of improvement and a higher proportion of decline compared with other classes, which helps explain why its significance tests were weak. Overall, combining effect size with change proportions indicates that the media effectively improved learning outcomes at the Grade 8 population level, although effects were not perfectly uniform across classes.

Beyond achievement outcomes, the study also examined student acceptance of the media using a Google Forms questionnaire. A total of 111 student responses were recorded and analyzed,

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collected through self-administration on students' devices to support honest reporting. The questionnaire used a four point agreement scale and included negatively worded items that were reverse-coded to keep score interpretation consistent. The grand mean score was 3.25 (good), indicating that students responded positively and perceived the media as supportive for learning. At the indicator level, "Attractiveness and learning motivation" and "Interaction and recommendation" were rated very good, while the remaining indicators were rated good, suggesting that future refinement should prioritize features that foster learner autonomy and sustained reuse intentions.

Table 5. Mean student responses by indicator.

Indicator	Items	Mean	Category
Understanding and clarity of material	6	3.25	Good
Attractiveness and learning motivation	6	3.29	Very good
Autonomy and intention to reuse	4	3.13	Good
Interaction and recommendation	2	3.35	Very good

Empirically, the main finding indicates that the infographic and interactive timeline media improved learning outcomes at the pooled Grade 8 level, evidenced by increases in mean scores, consistent statistical significance across two tests, and a medium pooled effect size. Nevertheless, the variation across classes suggests that effectiveness in classroom practice depends strongly on contextual factors, including baseline class conditions and the pattern of student engagement during implementation. Class B is particularly important to note because its mean gain was small and not statistically significant, with a higher proportion of score declines than other classes, implying that the media did not function as a strong lever in that class. From an implementation standpoint, the generally positive student acceptance (good to very good) implies that the main barrier is not whether the media is accepted, but rather the supporting activity design, consistency of use, and potential differences in how teachers orchestrate the media supported instruction across classes. Accordingly, an important scholarly contribution is that a media product that is expert-validated (feasible) and positively received by students does not automatically produce uniform effects; effectiveness should be read as the joint result of media quality, activity design, and real classroom context.

The findings further show that the infographic and interactive timeline support Islamic history learning by condensing information, strengthening event chronology, and helping students connect concepts and figures to temporal sequences. However, the variation in gains underscores that media effectiveness is not self sustaining, it depends on teacher orchestration, device readiness, and the intensity of accompanying learning activities (practice, quizzes, and feedback). The class with the smallest gain signals the need to strengthen activity design, for example by increasing timeline based exercises, assigning short infographic based tasks, and facilitating more structured discussion. The novelty of this study lies in three aspects: first, the tested product is not a static visual medium but an integration of infographics and an interactive timeline that foregrounds chronological structure as the core of understanding. Second, the trial involved the full Grade 8 population across five classes, providing a nuanced picture of impact variation within one school. Third, effectiveness is interpreted not only through overall score improvement but also through class-level pre–post and gain visualizations, which help identify classes that require strengthened implementation. In this way, the study offers a chronology oriented media development model that can be replicated and provides practical guidance for implementation strategies to achieve more even impacts.

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Discussion

The implementation documented in this study aligns well with the core logic of the ADDIE model, because the product was developed through a sequential flow from needs diagnosis to classroom evaluation. The Analysis stage was grounded in classroom observation and teacher interviews, which is consistent with ADDIE's requirement to define instructional problems and learner needs before designing solutions (Molenda, 2020). The Design stage translated those needs into a structured blueprint (content mapping, storyboard, navigation plan), while the Development stage produced a working web based product and subjected it to expert validation and revision, reflecting standard instructional design practice within ADDIE (Branch, 2021). The Implementation stage followed a controlled schedule across multiple classes, enabling systematic exposure of learners to the media. Finally, the Evaluation stage combined learning outcome analysis and student response data, reflecting ADDIE's emphasis on evidence based refinement. A key strength of applying ADDIE in the field is its traceability**,** as each stage provides a rationale for the next and reduces the risk of producing media that looks attractive but lacks instructional purpose.

This study's workflow shows that the product choice (infographics plus interactive timeline) was logically derived from the content's chronological and information-dense nature, which is in line with the principle that media design should be driven by learning needs rather than novelty. Another advantage is quality control**,** because expert validation acts as a gatekeeping mechanism prior to classroom testing, a common standard in educational R&D to strengthen feasibility claims (Richey & Klein, 2020). The structured implementation schedule also improves internal consistency across classes, which matters when interpreting heterogeneous effects. However, a limitation typical of ADDIE in school settings is that the process can become overly linear**,** potentially underutilizing iterative micro cycles of rapid prototyping during implementation (Molenda, 2020).

From a practical perspective, one weakness of the field application is that the Implementation stage may not fully standardize instructional orchestration across classes. Even when the same media is used, variation in facilitation, device readiness, and student engagement can meaningfully influence learning outcomes, a point repeatedly emphasized in technology-integration research (Bond et al.,, 2021). In ADDIE terms, this suggests the need for stronger implementation protocols such as scripted activity sequences, minimum practice requirements, and consistent feedback routines to improve fidelity. Another limitation is that evaluation tends to focus on immediate posttest outcomes, whereas digital learning interventions often show more stable benefits when longer exposure and repeated access are captured (Tamim et al., 2020). Thus, the evaluation could be extended using delayed posttests and indicators of actual reuse outside class to better reflect sustained learning mechanisms.

Theoretically, the product design is aligned with learning principles relevant to procedural and chronological content, because infographics and timelines support information chunking and sequence structuring (Mayer, 2021). The interactive timeline operationalizes the idea that historical understanding depends not only on recalling facts but also on organizing events into a coherent temporal and causal chain, consistent with multimedia learning principles that emphasize reducing cognitive overload through structured representation. At the same time, contemporary digital learning theory increasingly emphasizes learning design over media format, meaning that tasks such as retrieval practice and feedback embedded around the media matter as much as the visuals (Fiorella & Mayer, 2021). In this sense, the study's interpretation that media feasibility and acceptance do not guarantee uniform effects is theoretically well grounded, because learning gains

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are mediated by how learners interact with information and practice it. A sharper theoretical contribution is a conditional claim: the media becomes a stronger lever when activities require students to repeatedly navigate, explain, and apply timeline relations rather than passively view content.

When compared with prior educational R&D studies, this work is consistent in its use of expert validation and classroom trials to establish feasibility and effectiveness (Richey & Klein, 2020). Many R&D studies report high validity scores and positive learner perceptions, but fewer present class-by-class variability that reveals how context shapes impact, even though heterogeneity is a known issue in classroom-based interventions. The present findings add nuance by showing that a product can be rated highly by experts and welcomed by students, yet still yield uneven learning gains across parallel classes. This addresses a common gap where evaluation results are reported only at the pooled level, potentially masking meaningful differences in enactment. In addition, the integration of infographics with an interactive timeline provides a more targeted solution for chronology-heavy content than studies relying solely on static visuals, which aligns with recommendations to match representational forms to content structure.

In terms of novelty, the study contributes by combining (i) a product that foregrounds chronological structure as the core of understanding, (ii) implementation across five parallel classes to capture within school variability, and (iii) evaluation that integrates descriptive patterns, inferential testing, and student response indicators. This combination helps fill a gap where interactive chronology-oriented media is often discussed but less frequently tested across multiple classes with comparable procedures and transparent reporting of heterogeneity (Richey & Klein, 2020). The class level evidence also supports a practical implication that is underemphasized in earlier R&D reports: “effectiveness” should be read as an interaction between media quality and implementation fidelity. Conceptually, this is compatible with recent calls to treat digital integration as a pedagogical design problem rather than a simple media addition strategy (Bond et al., 2021). Therefore, the study strengthens both the empirical and theoretical case for chronology oriented digital media while pointing to future work on longer exposure, facilitation protocols, and measurement of out-of-class use (Tamim et al, 2020).

Conclusion

The study concludes that the digital learning media combining infographics and an interactive timeline for the Abbasid Caliphate topic is feasible and pedagogically relevant for Grade 8 SKI instruction at SMP IT Harapan Umat Karawang. Expert validation results indicate that the product meets high standards in both content accuracy and media quality, suggesting that the design and development procedures within the ADDIE framework successfully produced a well structured and usable learning resource. Student responses also reflect positive acceptance, showing that the media is perceived as clear, engaging, and supportive for learning. Taken together, these findings confirm that the developed product is appropriate for classroom use and aligns with the instructional needs identified during the analysis stage.

In terms of effectiveness, the evaluation results show that learning outcomes improved from pretest to posttest at the pooled Grade 8 level, supported by consistent evidence from descriptive patterns and inferential tests. However, the magnitude of learning gains varied across classes, indicating that the impact of the media is not uniformly distributed and may depend on classroom conditions, implementation fidelity, and the intensity of accompanying learning activities. This variation implies that digital media alone does not automatically guarantee equal benefits for all groups of learners, even when the product is valid and well received. Therefore, the study

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contributes to both practice and theory by emphasizing that effectiveness should be interpreted as an interaction between media quality, instructional orchestration, and real classroom context, rather than as a standalone effect of technology.

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