



Enhancing Students' Cognitive Learning Outcomes through the Demonstration Method Assisted by Interactive PowerPoint in Islamic Religious Education and Character Education

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ABSTRACT

This study examined the effectiveness of the demonstration method assisted by Interactive PowerPoint in improving students' cognitive learning outcomes in Islamic Religious Education and Character Education at SMKN 13 Bandung. Guided by Piaget's Cognitive Development Theory and Mayer's Cognitive Theory of Multimedia Learning, the study employed a quantitative approach using a quasi-experimental non-equivalent control group design. The participants were 64 Grade XI Chemical Analysis students assigned to experimental and control groups. Data were collected through achievement tests, questionnaires, observations, interviews, and documentation, and analyzed using descriptive statistics, N-Gain, and independent-samples t-tests. The results showed that the Interactive PowerPoint-assisted demonstration method achieved higher instructional implementation (90–94%) than conventional instruction (80–87%). The experimental group demonstrated significantly greater improvement in cognitive achievement (84.38–97.03; N-Gain = 0.76) than the control group (78.44–86.72; N-Gain = 0.38), with a significant difference ($p < 0.001$). Students also reported more positive learning experiences, indicating that the approach effectively enhanced both cognitive achievement and classroom engagement.

ABSTRAK

Penelitian ini bertujuan menganalisis efektivitas metode demonstrasi berbantu media PowerPoint interaktif dalam meningkatkan hasil belajar kognitif siswa pada mata pelajaran Pendidikan Agama Islam dan Budi Pekerti di SMKN 13 Bandung. Penelitian menggunakan pendekatan kuantitatif dengan desain quasi-experimental tipe non-equivalent control group design yang melibatkan 64 siswa kelas XI Analisis Kimia sebagai kelas eksperimen dan kelas kontrol. Data dikumpulkan melalui tes, angket, observasi, wawancara, dan dokumentasi, kemudian dianalisis menggunakan statistik deskriptif, uji normalitas, homogenitas, N-Gain, dan independent samples t-test. Hasil penelitian menunjukkan bahwa penerapan metode demonstrasi berbantu PowerPoint interaktif terlaksana dengan sangat baik (90–94%) dibandingkan metode konvensional (80–87%). Hasil belajar kognitif kelas eksperimen meningkat dari 84,38 menjadi 97,03 dengan N-Gain 0,76 (kategori tinggi), sedangkan kelas kontrol meningkat dari 78,44 menjadi 86,72 dengan N-Gain 0,38 (kategori sedang). Uji hipotesis menunjukkan perbedaan yang signifikan ($p < 0,001$). Selain itu, respons siswa terhadap pembelajaran juga lebih positif. Temuan ini menunjukkan bahwa metode demonstrasi berbantu PowerPoint interaktif efektif meningkatkan hasil belajar kognitif dan keterlibatan siswa dalam pembelajaran Pendidikan Agama Islam dan Budi Pekerti.

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Introduction

Education plays a crucial role in developing quality human resources by fostering intellectual, moral, social, and practical competencies. Within the Indonesian educational context, Islamic Religious Education and Character Education (Pendidikan Agama Islam dan Budi Pekerti, hereafter PAI) has a strategic position because its objectives extend beyond the acquisition of religious knowledge to the development of religious attitudes, moral character, and responsible behavior. Recent scholarship emphasizes that PAI in the digital era must respond simultaneously to changes in students' learning characteristics and to the increasingly complex environment in which religious values are interpreted and practiced. Digitalization creates opportunities to enrich PAI through diverse learning resources and interactive media, but its educational value depends substantially on teachers' digital competence and their ability to integrate technology pedagogically rather than merely technologically (Lisyawati et al., 2023; Mintasih et al., 2024; Susanti et al., 2024). Thus, contemporary PAI instruction requires approaches that connect religious knowledge with students' lived experiences while encouraging active, contextual, and reflective learning.

This need has become increasingly important as technological development, changing patterns of social interaction, and the extensive circulation of digital information influence how students acquire, evaluate, and respond to religious and moral knowledge. Evidence from Indonesian PAI contexts indicates that digital literacy can contribute to the effectiveness of Islamic character education, particularly when students are guided to use digital resources critically and ethically (Yudi & Maryam, 2023). At the same time, research has identified substantial variation in teachers' readiness, infrastructure, curriculum integration, and learning strategies for implementing digital PAI. Lisyawati et al. (2023), for example, found that digital literacy initiatives in PAI can be implemented through web-based learning and social media, but their sustainability depends on institutional support, teacher capacity, and systematic monitoring. Similarly, Mintasih et al. (2024) demonstrated that technology integration in secondary-school PAI is closely related to teachers' digital competence and the availability of appropriate implementation models. These findings suggest that technological innovation alone does not automatically resolve pedagogical problems. Rather, the central issue is how digital resources are designed and integrated into learning activities that promote meaningful cognitive engagement.

The broader educational literature provides a similar conclusion. Technology-enhanced learning can produce positive learning outcomes, but its effects are strongly dependent on how technology changes students' learning activities. A systematic review and second-order meta-analysis of 28 meta-analyses found that simply substituting digital technology for conventional instruction did not necessarily produce substantial improvements in cognitive outcomes; stronger effects emerged when technology provided specific support for active and cognitively demanding learning activities (Schneider et al., 2024). Likewise, Wu (2024), in a meta-analysis of digital technology and deep learning, reported generally positive relationships between digital technology and deeper learning while emphasizing the importance of instructional design and contextual conditions. These findings challenge a technology-deterministic assumption that the presence of digital media itself improves achievement. Instead, they support a pedagogical perspective in which technology becomes effective when it facilitates meaningful observation, interaction, cognitive processing, feedback, and knowledge construction. Consequently, improving PAI instruction requires not simply increasing the use of digital media but identifying combinations of instructional methods and

technologies that correspond to the characteristics of the learning content and the cognitive processes expected from students.

This study is situated within vocational secondary education, specifically among Grade XI Chemical Analysis students at SMKN 13 Bandung. Vocational education presents a distinctive instructional context because students are expected to develop academic understanding while simultaneously strengthening practical, procedural, and professional competencies. Students in such programs frequently encounter learning activities in which abstract explanations need to be connected with observable processes, visual representations, and practical applications. This characteristic is relevant to PAI because some religious concepts—including moral conduct, worship practices, social responsibility, and prohibited behaviors—can become difficult to understand when presented predominantly through verbal explanations. The pedagogical challenge is therefore not merely to transmit correct religious information but to provide learning experiences through which students can observe, interpret, discuss, and connect religious concepts with concrete situations. Recent studies in PAI provide preliminary support for this orientation. Demonstration-based instruction has been reported to improve learning outcomes in Islamic education by allowing students to observe concepts and practices more directly (Hertati et al., 2024; Mansyuarna et al., 2023). In Fiqh learning, for instance, Wulandari and Karman (2023) found that demonstration was useful for making abstract and complex material more understandable through visualization and practical simulation. However, much of this evidence comes from classroom action research and elementary or junior-secondary settings, leaving the effectiveness of demonstration-based PAI instruction in vocational secondary education less clearly established.

Against this background, the present study focuses on the integration of the demonstration method assisted by Interactive PowerPoint. Demonstration-based instruction provides opportunities for teachers to represent concepts, procedures, examples, and situations through observable illustrations and guided explanation. Its pedagogical value lies in reducing the distance between abstract verbal information and concrete representation. Evidence from PAI research consistently points in this direction. Mansyuarna et al. (2023) reported improvements in PAI learning outcomes following the implementation of demonstration instruction, while Hertati et al. (2024) similarly documented improvements among elementary students following demonstration-based Islamic education. Wulandari and Karman (2023) further showed the relevance of demonstration for Fiqh material that requires visualization and practical simulation. Nevertheless, these findings should be interpreted cautiously because the existing studies are predominantly small-scale classroom action research. Their findings establish the pedagogical plausibility of demonstration but provide less evidence concerning comparative effectiveness under a quasi-experimental design, particularly among vocational high-school students.

Interactive PowerPoint can potentially strengthen the demonstration method by providing visual and interactive representations within a single instructional environment. Unlike static presentations, interactive PowerPoint can incorporate images, diagrams, animations, videos, hyperlinks, navigation structures, questions, and quizzes. Such affordances are consistent with the principles of multimedia learning, which emphasize how learners process information presented through verbal and visual representations. Mayer (2024) argues that multimedia learning should be understood through the cognitive processes involved in selecting, organizing, and integrating information rather than through the mere presence of multiple media formats. Recent meta-analytic evidence likewise indicates that the effects of multimedia learning vary according to design characteristics and contextual conditions, suggesting that multimedia

principles should not be treated as universally effective independently of instructional context (Cromley & Chen, 2025). Accordingly, Interactive PowerPoint is pedagogically meaningful when its visual and interactive elements support the intended cognitive activity rather than simply increase the amount of information displayed.

Empirical research on interactive multimedia generally supports this position but also reveals differences in the strength and consistency of effects. Akbar and Usmeldi (2024), in a meta-analysis of 15 studies across educational levels, reported a large overall effect of interactive multimedia on student learning outcomes. Similarly, Rahman and Yunus (2024) found that Project-Based Learning supported by Interactive PowerPoint produced a medium level of learning improvement among vocational students in mechanical engineering. More recent quasi-experimental evidence has also indicated that Interactive PowerPoint can produce higher post-test achievement when incorporated into an appropriate student-centered instructional model (Febriani & Zahara, 2026). These findings are relevant to the present study because they demonstrate that Interactive PowerPoint can function as more than a presentation tool when its features are incorporated into an instructional strategy. However, the evidence also suggests that the effectiveness of the medium cannot be separated from the pedagogical model with which it is combined. Indeed, Schneider et al. (2024) found that technology had stronger cognitive effects when it facilitated specific learning activities, while Hooshyar et al. (2024) similarly reported positive effects of technology-enhanced learning when instructional strategies were appropriately combined.

The relevance of this integration is particularly strong for PAI, where learning objectives often involve movement from conceptual understanding toward interpretation and application of religious values. Recent Indonesian scholarship has increasingly examined digital media as a means of making PAI more contextual, interactive, and responsive to students' digital environments. Susanti et al. (2024) identified digital and social-media-based resources as important forms of innovation in contemporary PAI learning, while Suparmun et al. (2024) emphasized the potential of digital PAI media to support religious character, responsibility, honesty, discipline, moderation, and tolerance when digital literacy is deliberately integrated into instruction. Nevertheless, these studies also imply an unresolved issue: evidence concerning digital PAI frequently focuses on descriptive implementation, teacher competence, digital literacy, or character formation rather than experimentally testing whether a particular technology-pedagogy combination improves measurable cognitive achievement. The distinction is important because successful implementation and positive student perceptions do not necessarily demonstrate causal effects on learning outcomes.

Accordingly, the literature establishes three important points. First, PAI requires instructional approaches that respond to students' increasingly digital and interactive learning environments (Lisyawati et al., 2023; Mintasih et al., 2024; Susanti et al., 2024). Second, both demonstration-based instruction and multimedia-supported learning have demonstrated potential to improve students' understanding, particularly when learning requires visualization, observation, and active cognitive processing (Akbar & Usmeldi, 2024; Hertati et al., 2024; Wulandari & Karman, 2023). Third, recent meta-analytic evidence cautions that technology does not improve learning simply because it replaces conventional instruction; its effectiveness depends on whether the technology supports meaningful learning activities and is integrated with an appropriate pedagogical strategy (Schneider et al., 2024). What remains insufficiently resolved is whether combining demonstration-based instruction with Interactive PowerPoint produces measurable advantages in PAI cognitive learning outcomes among vocational high-school students. Existing studies tend to examine demonstration or digital media separately, use

classroom action research, focus on non-vocational populations, or investigate subjects other than PAI. The present study therefore addresses this gap by examining the effectiveness of an integrated demonstration–Interactive PowerPoint strategy among Grade XI Chemical Analysis students at SMKN 13 Bandung. Its contribution lies not simply in introducing another digital medium, but in empirically testing whether the deliberate alignment of a concrete instructional method with interactive multimedia can improve students' cognitive achievement in PAI within a vocational secondary-school context.

The growing integration of digital technology into Islamic education has encouraged educators to reconsider conventional approaches to PAI instruction. Technology-supported learning provides opportunities to contextualize religious knowledge, present authentic examples, and accommodate students' increasingly visual and digitally oriented learning experiences. Previous studies have generally indicated that interactive multimedia can enhance students' motivation, engagement, conceptual understanding, and academic achievement. Visual and audiovisual elements may make complex or abstract materials more accessible by presenting information through multiple forms of representation. Similarly, demonstration-based instruction can strengthen comprehension by allowing students to observe how theoretical concepts are expressed through concrete examples, procedures, or behaviors. However, technology-enhanced PAI also faces several challenges, including differences in teachers' digital competence, unequal technological infrastructure, and the persistence of lecture-centered instructional practices. Furthermore, the presence of digital media alone does not guarantee improved learning outcomes. Poorly designed multimedia may overwhelm students, distract attention, or promote passive rather than active learning. Therefore, technology should function as a pedagogical tool integrated with appropriate teaching strategies rather than as an independent solution. Effective implementation requires alignment among learning objectives, instructional methods, content, student characteristics, and media features. Despite increasing interest in educational technology, empirical research examining the combined use of demonstration methods and Interactive PowerPoint in PAI remains limited. This gap is particularly significant because PAI involves not only conceptual understanding but also value interpretation, moral reasoning, and practical application, making findings from other subject areas insufficient without contextual adaptation.

A significant unresolved issue concerns whether combining the demonstration method with Interactive PowerPoint can effectively improve students' cognitive learning outcomes in Islamic Religious Education and Character Education (PAI), particularly in vocational secondary schools. Although previous studies have examined demonstration-based learning and interactive multimedia separately, limited research has systematically investigated their combined application in religious education. Existing studies also tend to emphasize affective outcomes, including motivation, interest, enjoyment, and engagement, while cognitive achievement has received comparatively limited attention in technology-enhanced PAI research. This gap is important because cognitive mastery provides an essential foundation for students to internalize and apply Islamic values in meaningful contexts. Preliminary observations and interviews at SMKN 13 Bandung indicated that PAI instruction was predominantly delivered through lectures, textbook explanations, and written assignments, whereas Interactive PowerPoint was rarely integrated into classroom activities. Consequently, learning tended to be less varied, opportunities for active participation were limited, and some students experienced difficulties in achieving the expected minimum competency standards. The issue does not necessarily imply that conventional methods are ineffective, but rather highlights the need for greater instructional variation and stronger integration of methods and media to

accommodate diverse learning needs. Limited use of visual, interactive, and demonstrative resources may hinder students' ability to visualize abstract religious concepts, sustain attention, and connect theoretical knowledge with concrete situations. Therefore, the key scholarly question is whether a carefully designed combination of demonstration and Interactive PowerPoint can provide an effective pedagogical mechanism for improving PAI cognitive outcomes in vocational education.

The principal novelty of this study lies in integrating the demonstration method with Interactive PowerPoint as a unified instructional strategy in Islamic Religious Education and Character Education (PAI) at the vocational high school level. Rather than examining demonstration and digital media as separate interventions, this research positions Interactive PowerPoint as a technological support that strengthens the visual, explanatory, and interactive dimensions of demonstration-based learning. Through this integration, teachers can present religious concepts using multiple forms of representation while enabling students to observe, interpret, respond, and construct understanding actively. Unlike previous studies that frequently emphasize motivation, engagement, or affective responses, this research places students' cognitive learning outcomes at the center of evaluation. The study therefore examines whether the integrated instructional approach produces measurable improvements in students' academic achievement. The underlying assumption is that meaningful learning can occur when students actively connect verbal explanations, visual representations, demonstrations, and prior knowledge. Interactive PowerPoint facilitates the presentation of diverse learning representations, while demonstration provides concrete experiences through which students can interpret and understand abstract religious concepts. This combination may consequently strengthen the relationship between theoretical Islamic knowledge and observable learning experiences. By testing the approach in an authentic vocational school setting, the study provides context-specific evidence that may be relevant to comparable PAI classrooms. Furthermore, using widely accessible PowerPoint technology offers a practical alternative to sophisticated digital platforms that may require greater infrastructure, technical expertise, and financial resources, making the proposed approach potentially feasible for broader implementation in Indonesian schools.

This study aims to determine the effectiveness of demonstration-based Islamic Religious Education and Character Education (PAI) assisted by Interactive PowerPoint in improving the cognitive learning outcomes of Grade XI Chemical Analysis students at SMKN 13 Bandung. Specifically, the study examines the implementation of this instructional approach and compares students' cognitive achievement before and after the learning intervention. Theoretically, the research extends discussions of multimedia-supported learning and demonstration-based pedagogy into Islamic Religious Education, a field in which empirical evidence on integrated technology-enhanced instruction remains limited. Empirically, it provides quantitative evidence regarding the effectiveness of combining demonstration methods with Interactive PowerPoint in improving students' cognitive achievement within a vocational school context. Practically, the findings may offer PAI teachers an accessible instructional model for creating more engaging, interactive, and visually supported learning without requiring sophisticated technological infrastructure. The study also highlights the importance of teachers' digital competence and their ability to integrate technology with appropriate pedagogical strategies rather than using digital media solely as presentation tools. More broadly, the research supports the development of PAI instruction that responds to contemporary students' learning characteristics while maintaining the essential objectives of religious and character education. By strengthening demonstration-based learning through

carefully designed interactive media, this study contributes to a more meaningful, participatory, and evidence-based approach to PAI. The findings may also provide a foundation for future research involving broader samples, different educational levels, diverse learning outcomes, and other technology-enhanced instructional approaches.

Methods

This study employed a quantitative research approach using a quasi-experimental method to investigate the effect of the demonstration method assisted by Interactive PowerPoint on students' cognitive learning outcomes in Islamic Religious Education and Character Education (PAI). A quantitative approach was selected because it enables objective measurement of causal relationships through numerical data and statistical analysis. The study adopted the Non-Equivalent Control Group Design, in which two existing classes served as the experimental and control groups without random assignment. The experimental group received demonstration-based instruction supported by Interactive PowerPoint, whereas the control group was taught using conventional lecture-based instruction. Both groups completed pre-tests and post-tests to evaluate changes in cognitive learning outcomes following the instructional intervention.

The research was conducted at SMKN 13 Bandung, a public vocational secondary school located in Bandung, West Java, Indonesia. The study focused on the Grade XI Chemical Analysis Program, where Islamic Religious Education and Character Education is a compulsory subject in the national curriculum. Preliminary classroom observations and interviews with the PAI teacher revealed that classroom instruction was still dominated by lectures and written assignments, with limited use of interactive digital learning media. This instructional context provided an appropriate setting for evaluating the effectiveness of Interactive PowerPoint-assisted demonstration instruction. The research was carried out during the 2024/2025 academic year, encompassing the preparation stage, implementation of the intervention, data collection, and statistical analysis.

The participants consisted of 64 Grade XI Chemical Analysis students, selected through purposive sampling because the existing classroom organization could not be modified for experimental purposes. Two intact classes with relatively similar academic characteristics were assigned as the experimental group (32 students) and the control group (32 students). The experimental group received instruction through the demonstration method assisted by Interactive PowerPoint, while the control group received conventional teacher-centered instruction. The unit of analysis was students' cognitive learning outcomes, measured individually through standardized achievement tests administered before and after the instructional intervention.

Multiple data collection techniques were employed to obtain comprehensive information regarding the effectiveness of the instructional intervention. The primary instrument was a cognitive achievement test, administered as a pre-test and post-test to measure students' understanding of the instructional materials. The test items were developed according to the competency standards and learning objectives of the PAI curriculum. A student questionnaire was used to assess students' responses toward the learning process and the implementation of Interactive PowerPoint. In addition, classroom observations were conducted during each learning session to monitor instructional implementation, teacher performance, and students' classroom participation. Semi-structured interviews with the PAI teacher provided contextual information regarding instructional practices and challenges in integrating digital media. Supporting documentation, including lesson plans, students' assessment records, and

classroom photographs, was also collected to strengthen the interpretation of the findings.

The collected quantitative data were analyzed using both descriptive and inferential statistical techniques. Descriptive statistics, including the mean, standard deviation, minimum score, and maximum score, were calculated to summarize students' pre-test and post-test performance. Prior to hypothesis testing, the assumptions of parametric analysis were examined using normality and homogeneity tests. The effectiveness of the instructional intervention was then evaluated using normalized gain (N-Gain) analysis, which measured the magnitude of students' cognitive improvement between the pre-test and post-test. Finally, an independent-samples *t*-test was conducted to determine whether significant differences existed between the experimental and control groups. All statistical analyses were performed using appropriate statistical software with a significance level of 0.05.

To ensure the quality of the research findings, several validation procedures were implemented. The cognitive achievement test and questionnaire were developed based on the national curriculum and reviewed by experts in Islamic Religious Education and educational assessment to establish content validity. Before the main study, the instruments were piloted with students who possessed characteristics similar to those of the research participants. The pilot data were analyzed to determine item validity and instrument reliability, with reliability coefficients calculated using Cronbach's alpha. Classroom observations were conducted systematically using structured observation sheets to maintain consistency during implementation. Furthermore, the combination of tests, questionnaires, observations, interviews, and documentation enabled methodological triangulation, thereby enhancing the credibility and trustworthiness of the research findings.

The study was conducted in accordance with established ethical principles for educational research. Permission to conduct the research was obtained from the administration of SMKN 13 Bandung before data collection commenced. The participating teacher and students were informed about the objectives, procedures, and expected outcomes of the study, and their participation was entirely voluntary. Participants were assured that the research would not influence their academic evaluation, and all collected data were treated confidentially by anonymizing participants' identities during analysis and reporting. The instructional intervention involved regular classroom learning activities supported by Interactive PowerPoint and therefore posed no physical or psychological risks to participants. These procedures ensured that participants' rights, privacy, and well-being were protected throughout the research process.

Results and Discussion

Results

Implementation of the Demonstration Method Assisted by Interactive PowerPoint

This study investigated the implementation and effectiveness of the demonstration method assisted by Interactive PowerPoint in Islamic Religious Education and Character Education (PAI) at SMKN 13 Bandung. A quasi-experimental approach was employed using two intact Grade XI Chemical Analysis classes. Class XI Chemical Analysis-2 was assigned as the experimental group, while Class XI Chemical Analysis-5 served as the control group. Both groups received instruction on the same PAI learning materials, focusing on the Islamic perspectives concerning the prohibition of student violence, alcohol consumption, and drug abuse. The learning intervention was conducted in two meetings. The experimental group received instruction through a demonstration method

supported by Interactive PowerPoint, while the control group was taught through conventional lecture-oriented instruction. The Interactive PowerPoint presentation incorporated several multimedia and interactive components, including visual illustrations, animations, videos, hyperlinks, navigation features, and interactive quizzes. These components were integrated into the demonstration activities rather than being used merely as supplementary presentation materials.

The implementation of the instructional intervention demonstrated differences in the learning experiences of the two groups. In the experimental classroom, students were provided with opportunities to observe demonstrations, examine visual representations, respond to questions, discuss contextual situations, and interact with multimedia learning materials. The teacher used the Interactive PowerPoint presentation to provide concrete illustrations of concepts that could otherwise be difficult to understand through verbal explanations alone. Videos and visual examples were used to present situations related to violence, alcohol consumption, and drug abuse, while interactive questions and quizzes were incorporated to encourage students to process the information presented. The instructional sequence allowed students to move from explanation and observation toward interpretation and response. In contrast, students in the control group primarily experienced teacher explanations, textbook-based discussion, note-taking, and written exercises. Although both groups received the same substantive learning content, the manner in which the content was presented and processed differed considerably.

The difference in instructional experiences was reflected in the descriptive statistics of students' cognitive learning outcomes. Before the intervention, the experimental group obtained a mean pre-test score of 84.38, whereas the control group obtained a lower mean score of 78.44. Following two instructional meetings, the experimental group achieved a mean post-test score of 97.03, while the control group achieved a mean post-test score of 86.72. Thus, both groups demonstrated improvement following instruction, but the magnitude of improvement was substantially greater in the experimental group. The experimental group increased by 12.65 points, whereas the control group increased by 8.28 points. These findings indicate that both instructional approaches contributed to learning, but the demonstration method assisted by Interactive PowerPoint produced greater improvement in students' cognitive achievement.

The descriptive results were further examined using normalized gain (N-Gain) analysis. The experimental group achieved an N-Gain score of approximately 0.76, categorized as high, whereas the control group obtained an N-Gain of approximately 0.38, categorized as moderate. The substantially higher normalized gain in the experimental group indicates that the improvement was not merely attributable to students' initial level of achievement. Rather, students who experienced demonstration-based instruction supported by Interactive PowerPoint demonstrated a considerably greater proportion of possible learning improvement than students who experienced conventional instruction. The difference in N-Gain provides additional evidence that the integrated instructional approach generated stronger learning progress during the intervention.

To determine whether the observed difference between the two groups was statistically significant, an independent-samples t-test was conducted. The analysis produced a t value of -6.980 with a significance value below 0.001. Because the significance value was lower than the predetermined 0.05 criterion, the null hypothesis was rejected. The statistical finding indicates that there was a significant difference in cognitive learning outcomes between students who received demonstration-based instruction assisted by Interactive PowerPoint and those who received conventional instruction. The magnitude of the difference in mean post-test achievement, together with

the N-Gain results, further indicates that the difference was educationally meaningful rather than merely statistically detectable.

Table 1. The comparative results are summarized

Group	Pre-test Mean	Post-test Mean	Mean Increase	N-Gain	Category
Experimental	84.38	97.03	12.65	0.76	High
Control	78.44	86.72	8.28	0.38	Moderate

The results demonstrate that the experimental group consistently outperformed the control group after the instructional intervention. Although the experimental group began with a higher pre-test mean, the subsequent increase in achievement was also greater than that observed in the control group. The experimental group's post-test mean approached the maximum possible achievement level, suggesting that most students were able to demonstrate strong mastery of the learning material following the intervention. By comparison, the control group showed improvement but remained considerably below the achievement level reached by the experimental group.

Differences in Students' Cognitive Learning Outcomes

Before the hypothesis test was conducted, the comparability of the two groups was examined through homogeneity testing. Levene's Test of Homogeneity of Variance produced a significance value greater than 0.05, indicating that the variance of the experimental and control groups could be considered homogeneous. This result satisfied the homogeneity assumption required for the independent-samples t-test. The finding also supported the interpretation that the two groups were sufficiently comparable for statistical comparison following the instructional intervention.

The hypothesis-testing results provided clear evidence of differences between the two instructional groups. The independent-samples t-test generated a t value of -6.980 and a significance value of $p < 0.001$. Because the probability value was substantially below 0.05, the difference between the groups was statistically significant. Therefore, the hypothesis stating that there was a difference in cognitive learning outcomes between students taught through Interactive PowerPoint-assisted demonstrations and those taught conventionally was supported.

The descriptive and inferential results should be considered together. The experimental group demonstrated an increase from 84.38 to 97.03, while the control group increased from 78.44 to 86.72. The difference in post-test means was 10.31 points in favor of the experimental group. More importantly, the N-Gain analysis showed a high category for the experimental group and a moderate category for the control group. The results therefore indicate consistency across several analytical procedures: descriptive statistics demonstrated higher achievement, N-Gain demonstrated greater learning improvement, and inferential testing confirmed that the difference between groups was statistically significant.

Students' Responses to the Instructional Intervention

In addition to cognitive achievement, the study examined students' responses to the demonstration method assisted by Interactive PowerPoint. Students' perceptions were measured using a 15-item questionnaire based on a five-point Likert scale. The questionnaire was developed around four dimensions of Keller's ARCS Motivation Model: Attention, Relevance, Confidence, and Satisfaction. The instrument was tested before being used for data collection. The validity analysis indicated that all questionnaire items

met the required validity criterion, with correlation coefficients exceeding 0.344. The reliability analysis produced a Cronbach's Alpha coefficient of 0.854, indicating high internal consistency. The instrument was therefore considered appropriate for measuring students' responses to the instructional intervention.

The questionnaire results indicated a substantial improvement in students' perceptions of the learning process. Before the intervention, the mean response score was 3.45. After students experienced the demonstration method assisted by Interactive PowerPoint, the mean increased to 4.32. The increase of 0.87 points indicates a considerable positive change in students' perceptions. The initial score represented a fairly good level of response, whereas the post-intervention score reached a very good category.

The improvement was particularly evident in students' perceptions of attention and relevance. The multimedia features incorporated into the Interactive PowerPoint presentation helped attract students' attention and maintain their involvement during classroom activities. Animations, videos, visual illustrations, hyperlinks, and interactive quizzes provided variation in the presentation of learning materials. Rather than continuously listening to teacher explanations, students encountered multiple opportunities to observe, respond, and interact with the instructional content.

The relevance dimension was also strengthened because the demonstrations and multimedia representations were connected to situations familiar to students. The learning materials concerning violence, alcohol, and drug abuse were presented through contextual examples that enabled students to relate Islamic teachings to contemporary issues affecting adolescents. Students were consequently encouraged to interpret the religious content not simply as theoretical information but as knowledge applicable to their everyday lives.

Students also demonstrated increased participation during the intervention. Classroom activities involved asking and answering questions, discussing presented situations, responding to interactive quizzes, and interpreting the visual and audiovisual materials. These activities provided opportunities for students to demonstrate understanding while receiving immediate feedback. The increased participation was consistent with the improvement in students' questionnaire responses and cognitive learning outcomes.

Overall, the results indicate that the demonstration method assisted by Interactive PowerPoint produced positive outcomes across both cognitive and perceptual dimensions. The experimental group achieved higher cognitive learning gains than the control group, while students also reported substantially more positive experiences following the intervention. The combination of statistical achievement data and questionnaire responses provides converging evidence that the integrated instructional strategy was effective in creating a more engaging learning environment and improving students' understanding of PAI content.

Discussion

Effectiveness of Demonstration-Based Instruction Assisted by Interactive PowerPoint

The findings demonstrate that the integration of the demonstration method with Interactive PowerPoint was more effective than conventional lecture-based instruction in improving students' cognitive learning outcomes in Islamic Religious Education and Character Education (PAI). The experimental group increased its mean score from 84.38 on the pre-test to 97.03 on the post-test, while the control group increased from 78.44 to

86.72. The N-Gain analysis reinforces this difference, with the experimental group achieving a high gain of approximately 0.76 compared with approximately 0.38 in the control group. Furthermore, the independent-samples t-test produced a statistically significant difference ($t = -6.980, p < 0.001$). Taken together, these findings indicate that the instructional intervention was associated with substantially greater cognitive improvement than conventional instruction.

The results can first be understood through the principles of cognitive development and active knowledge construction. Learning does not occur simply because students receive information; rather, students need to actively process, interpret, organize, and connect new information with existing cognitive structures. The demonstration method provides an important mechanism for this process because it transforms concepts into observable examples and situations. In the context of PAI, this is particularly relevant because some religious concepts involve moral principles and behavioral consequences that may remain abstract when communicated solely through verbal explanation. Demonstrating situations associated with violence, alcohol consumption, and drug abuse allows students to move from abstract statements toward concrete representations of how these behaviors manifest themselves and why Islamic teachings prohibit them.

The integration of Interactive PowerPoint strengthens this process by adding multiple forms of representation to the demonstration. Instead of relying exclusively on teacher explanation, students encounter images, animations, videos, hyperlinks, and interactive questions. These features provide additional cognitive cues that help students identify important information and establish relationships among concepts. For example, a teacher can explain the Islamic prohibition of alcohol while simultaneously displaying relevant visual information, presenting a short contextual video, and asking students to identify the consequences of alcohol consumption. Such integration creates a learning sequence in which students receive information, observe representations, process the information, and formulate responses. This sequence is pedagogically different from a lecture in which students may primarily listen and record information.

The findings are also consistent with the Cognitive Theory of Multimedia Learning. According to this perspective, learners process information through verbal and visual channels, and meaningful learning can occur when these representations are appropriately coordinated. The Interactive PowerPoint presentation used in the experimental class enabled the teacher to combine verbal explanations with visual and audiovisual information. However, the effectiveness of the multimedia presentation should not be attributed simply to the number of media elements used. Its value lies in the pedagogical organization of those elements around the learning objectives. Visual materials were used to clarify concepts, videos provided contextual examples, and interactive quizzes encouraged students to retrieve and apply information. Thus, the multimedia components functioned as cognitive supports rather than decorative additions.

The high N-Gain achieved by the experimental group suggests that this integrated approach was effective in facilitating meaningful learning. Students did not merely improve their scores by recalling isolated facts; the learning activities required them to interpret examples, recognize problematic behaviors, understand their consequences, and relate them to Islamic teachings. Such activities can strengthen conceptual connections and improve students' ability to apply religious knowledge to contextual situations. In PAI, this is particularly important because successful learning should extend beyond memorization toward understanding and appropriate application.

The results also illustrate the importance of instructional sequencing. Demonstration-based learning provides an opportunity for teachers to introduce a

concept, provide an example, demonstrate its application, and then invite students to respond. Interactive PowerPoint can organize these stages into a coherent visual structure. This organization may reduce confusion by providing students with a clear progression from explanation to illustration and from observation to response. In conventional instruction, students may receive the same information but without sufficient visual or interactive support. Consequently, the difference between the two groups may reflect not merely the use of technology but the more structured learning experience created through the integration of technology and pedagogy.

Demonstration, Multimedia, and Meaningful Learning in PAI

The effectiveness of the intervention can also be interpreted from a constructivist perspective. Constructivist learning emphasizes that students actively construct knowledge through interaction with information, learning environments, teachers, peers, and prior experiences. The experimental learning activities provided several opportunities for this construction process. Students were not limited to listening to explanations; they observed demonstrations, interpreted visual information, answered questions, discussed situations, and participated in interactive quizzes. Such activities encouraged students to become active participants in the learning process.

This active participation is particularly valuable in PAI because religious learning frequently involves questions that require interpretation and judgment. The topic of student violence, for instance, is not adequately understood simply by memorizing that violence is prohibited. Students need to recognize forms of violence, understand its moral and social consequences, and evaluate how Islamic principles should guide their responses to conflict. Similarly, understanding the prohibition of alcohol and drugs requires students to connect religious teachings with physical, psychological, social, and moral consequences. Interactive demonstrations can create opportunities for such connections to be made explicit.

The results therefore suggest that Interactive PowerPoint was most effective when used as part of a broader instructional strategy. If PowerPoint had merely replaced a chalkboard or textbook without changing classroom interaction, its pedagogical impact might have been limited. In this study, however, the digital medium was combined with demonstration, questioning, discussion, and contextualization. The technology therefore supported a shift from information transmission toward guided learning. This distinction is important for interpreting the findings because it demonstrates that educational technology should not be viewed as an automatic solution to learning difficulties.

The findings also support the principle that multimedia should be designed according to students' cognitive needs. Excessive visual information, unnecessary animation, long videos, or unrelated hyperlinks could potentially distract students and increase extraneous cognitive processing. The positive outcomes observed in the experimental group indicate that the multimedia elements were sufficiently aligned with the instructional content to support rather than interfere with learning. The results therefore provide practical evidence that Interactive PowerPoint can be effective when teachers carefully select and organize multimedia components according to specific learning objectives.

Another important factor is contextual relevance. Students may find religious material more meaningful when concepts are connected to situations they encounter in their social environment. The experimental instruction addressed violence, alcohol, and drug abuse—issues that are highly relevant to adolescent life. By presenting these topics through visual demonstrations and contextual examples, students were able to see the

practical significance of Islamic teachings. Relevance can strengthen motivation because students perceive that what they are learning has implications beyond the classroom. This interpretation is consistent with the improvement in students' responses reported after the intervention.

Differences in Cognitive Learning Outcomes

The statistically significant difference between the experimental and control groups provides strong evidence supporting the effectiveness of the integrated instructional approach. The independent-samples t-test produced a t value of -6.980 and a probability value below 0.001 . Because this value is substantially lower than the 0.05 significance criterion, the difference cannot reasonably be attributed to random sampling variation within the assumptions of the analysis. The finding is further strengthened by the N-Gain results, which show that the experimental group achieved a high level of improvement while the control group achieved only a moderate level.

The difference in post-test achievement is also educationally meaningful. The experimental group reached a mean score of 97.03 , compared with 86.72 in the control group. This difference of more than ten points suggests that the instructional approach had a substantial practical effect on students' achievement. Importantly, the experimental group did not simply obtain a higher post-test score because it began with a higher pre-test score. The experimental group also demonstrated a greater increase in achievement. This pattern indicates that the intervention was associated with enhanced learning progress during the instructional period.

The findings can be interpreted through the interaction between cognitive engagement and instructional representation. When information is presented verbally alone, students must construct mental representations from linguistic explanations. For some learners, particularly when concepts are abstract or unfamiliar, this process may be difficult. Visual representations and demonstrations provide additional external representations that can make relationships more explicit. When appropriately combined with verbal explanation, these representations may reduce the effort required to construct an initial mental model and allow students to devote more cognitive resources to understanding and applying the concept.

The results therefore reinforce the argument that learning media should be selected according to the nature of the content. PAI is sometimes mistakenly treated as a subject that can be effectively taught primarily through verbal explanation because its content concerns religious texts, concepts, and values. However, many PAI topics involve behavioral situations, social interactions, moral dilemmas, and practical applications. Such content can benefit from visualization and demonstration. Interactive PowerPoint offers a relatively accessible means of creating these representations without requiring sophisticated technological infrastructure.

The findings are also relevant to vocational education. Students in vocational schools are accustomed to learning within an educational environment that emphasizes practical competence. Consequently, instructional strategies that connect theoretical concepts with observable situations may be particularly appropriate. Although PAI is not a vocational subject, its learning can still benefit from practical and contextual approaches. Demonstration allows religious knowledge to be connected to situations that students may encounter in their social and professional lives. This may strengthen the perceived usefulness of PAI and support the development of responsible behavior.

Students' Responses and Learning Motivation

The increase in students' questionnaire scores from 3.45 to 4.32 provides additional evidence concerning the effectiveness of the intervention. Students responded more positively after experiencing the Interactive PowerPoint-assisted demonstration approach. This finding is important because students' perceptions of learning can influence their willingness to participate, sustain attention, and invest cognitive effort in classroom activities.

The findings can be interpreted through Keller's ARCS Motivation Model, which emphasizes Attention, Relevance, Confidence, and Satisfaction. First, the interactive multimedia elements were capable of attracting students' attention through visual variation, animations, videos, and interactive activities. Attention is particularly important in classroom learning because sustained cognitive engagement requires students to focus on relevant information. Conventional lecture-based learning may become monotonous when students receive information through a single mode for an extended period. Interactive demonstrations introduce variation and provide multiple points of engagement.

Second, the learning materials were relevant to students' experiences. Issues concerning violence, alcohol, and drug abuse are not merely theoretical religious topics; they represent social and behavioral problems that adolescents may encounter directly or indirectly. Presenting these issues through contextual demonstrations allowed students to connect Islamic teachings with real-world situations. This contextualization may explain why the relevance dimension demonstrated a notable improvement.

Third, Interactive PowerPoint-assisted activities may strengthen students' confidence by providing opportunities for successful participation. Interactive quizzes, questions, and discussions enable students to test their understanding and receive feedback. When students can successfully answer questions or explain their interpretations, they may develop greater confidence in their ability to understand the material. Confidence is particularly important in PAI because students may sometimes hesitate to express interpretations of religious issues when they are uncertain about their answers.

Fourth, satisfaction can arise when students perceive the learning process as enjoyable, meaningful, and productive. The improvement in cognitive achievement may itself reinforce satisfaction because students can recognize that their participation has contributed to successful learning. Thus, the positive response score of 4.32 should not be interpreted merely as students liking the technology. It may indicate that the instructional environment created through the integration of demonstration and multimedia was perceived as more engaging and useful.

The relationship between motivation and cognitive achievement is particularly important. Although motivation and achievement are distinct constructs, they can reinforce one another. Students who are interested and attentive are more likely to engage with instructional content, while successful learning can increase confidence and satisfaction. The present findings illustrate this relationship because the experimental group simultaneously demonstrated improved cognitive achievement and more positive learning responses.

Theoretical and Practical Implications

The findings contribute to the theoretical discussion of technology-enhanced Islamic education by demonstrating the relevance of multimedia learning principles to PAI. Much of the established discussion of multimedia instruction has emerged from subjects in which visual representations are commonly used, including science, mathematics, and language learning. The present study extends this perspective to religious education and

demonstrates that Islamic concepts related to moral behavior and social problems can also benefit from carefully designed visual and interactive representations.

The study also reinforces the importance of methodological integration. Demonstration and Interactive PowerPoint should not be regarded as competing instructional approaches. Instead, they can function synergistically. Demonstration provides the pedagogical structure for showing and explaining concepts, while Interactive PowerPoint provides the technological means to enrich those demonstrations. This relationship represents an important contribution because it shifts the focus from technology adoption toward technology-pedagogy integration.

From a practical perspective, the findings suggest that PAI teachers can use accessible technologies to improve classroom learning without necessarily relying on complex digital platforms. PowerPoint is widely available and familiar to many teachers, making it a realistic medium for technology integration. However, effective implementation requires teachers to develop the capacity to design interactive rather than purely linear presentations. Teachers need to identify appropriate visual materials, organize information clearly, develop meaningful questions, incorporate relevant videos, and connect multimedia activities with learning objectives.

The findings also have implications for teacher professional development. Digital competence should not be understood solely as the ability to operate software. Teachers need pedagogical competence to determine when, why, and how digital media should be used. Professional development programs should therefore integrate technological knowledge with instructional design, multimedia learning principles, assessment strategies, and classroom management. Such integration would enable teachers to move beyond the use of PowerPoint as a simple presentation device toward its use as an interactive learning environment.

Schools also have a role in supporting sustainable implementation. Although Interactive PowerPoint requires relatively modest technological resources, effective use still depends on access to computers, projectors or displays, audio equipment, and reliable digital content. Schools should therefore provide adequate infrastructure while also creating opportunities for teachers to share instructional materials and good practices. Collaborative development of multimedia resources may reduce individual teachers' workload and improve the quality of instructional media.

Nevertheless, the findings should be interpreted within the boundaries of the research context. The study involved two intact classes from one vocational high school and focused on a specific PAI topic. Therefore, the findings should not automatically be generalized to all educational levels, school types, or PAI topics. Differences in student characteristics, teacher competence, technological infrastructure, and learning content may influence the effectiveness of the intervention. Future studies could address these limitations by involving larger and more diverse samples, multiple schools, and different educational levels.

Future research could also extend the investigation beyond cognitive learning outcomes. Because PAI seeks to develop religious understanding, character, attitudes, and responsible behavior, subsequent studies could examine critical thinking, moral reasoning, religious attitudes, character development, and students' ability to apply Islamic values in authentic situations. Longitudinal studies would also be valuable for determining whether improvements in cognitive achievement are maintained over time and whether enhanced understanding eventually contributes to behavioral change.

Further comparative research could examine Interactive PowerPoint alongside other emerging technologies, such as gamification, augmented reality, virtual reality, learning management systems, and artificial intelligence-assisted learning. Such studies could

determine whether the effectiveness observed in the present research is specific to Interactive PowerPoint or reflects a broader principle concerning interactive multimedia-supported instruction. Experimental studies involving larger samples and stronger controls could also provide more robust evidence concerning causal mechanisms.

Overall, the findings indicate that the demonstration method assisted by Interactive PowerPoint represents a promising instructional strategy for PAI. Its effectiveness appears to derive not from technology alone but from the integration of concrete demonstration, multimedia representation, contextualization, interaction, and feedback. The experimental group's high N-Gain, significantly higher post-test achievement, and more positive learning responses collectively demonstrate the potential of this approach to improve both the cognitive and experiential dimensions of PAI learning. The study therefore supports a broader movement toward technology-enhanced Islamic Religious Education that remains pedagogically grounded, contextually relevant, and oriented toward meaningful student learning.

Conclusion

This study investigated the effectiveness of the demonstration method assisted by Interactive PowerPoint in improving students' cognitive learning outcomes in Islamic Religious Education and Character Education (PAI) among Grade XI Chemical Analysis students at SMKN 13 Bandung. The findings demonstrate that integrating demonstration-based instruction with Interactive PowerPoint is significantly more effective than conventional lecture-based teaching. The instructional intervention was implemented successfully, with higher instructional fidelity in the experimental class (84–97%) than in the control class (80–87%). Students who participated in the Interactive PowerPoint-assisted learning achieved substantially higher cognitive learning outcomes, as confirmed by the independent-samples *t*-test ($p < 0.05$). Moreover, the experimental group demonstrated a high level of learning improvement (N-Gain = 0.76) and expressed more positive perceptions of the learning process than the control group. These findings indicate that combining demonstration activities with interactive multimedia not only enhances students' cognitive achievement but also promotes greater engagement, participation, and motivation during classroom learning.

The study contributes both theoretically and practically to the development of Islamic Religious Education. The findings provide empirical support for Piaget's Cognitive Development Theory and Mayer's Cognitive Theory of Multimedia Learning, demonstrating that multimedia-supported demonstrations facilitate active knowledge construction through the integration of visual and verbal information. Unlike previous studies that have predominantly focused on science or mathematics education, this research extends the application of Interactive PowerPoint to Islamic Religious Education, where students are expected to master conceptual understanding alongside moral and practical competencies. The results also highlight the importance of adopting technology-enhanced, student-centered instructional strategies to improve learning quality. Therefore, teachers are encouraged to integrate interactive multimedia into classroom instruction, while schools should strengthen digital infrastructure and provide continuous professional development to improve teachers' technological and pedagogical competencies.

Despite these contributions, this study has several limitations. The research was conducted in a single vocational high school involving only two classes, which may limit the generalizability of the findings. In addition, the intervention focused on a single instructional topic and measured only cognitive learning outcomes and students' responses, without examining long-term knowledge retention, character development, or

behavioral change. Future research should involve larger and more diverse samples across different educational settings, investigate a wider range of Islamic Religious Education topics, and employ longitudinal or mixed-methods approaches to evaluate the sustained effects of technology-assisted instruction. Further studies are also encouraged to compare Interactive PowerPoint with emerging educational technologies, such as gamification, virtual reality, augmented reality, and artificial intelligence-based learning systems, to identify innovative strategies for enhancing both cognitive achievement and character formation in Islamic Religious Education.

AI Disclosure

The authors used ChatGPT (OpenAI) for language editing and grammar improvement. The authors reviewed and edited the output and take full responsibility for the content of the publication.

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Author 1 : correcting technical aspects and writing conventions such as formatting, grammar, and manuscript neatness;

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Author 3 : director of the article's core content and substantive elements, such as theory, methodology, and data analysis results;

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Disclosure Statement / Conflict of Interest

The authors declare that there is no potential conflict of interest related to this article.

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