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Enhancing Student Learning Outcomes through Quantum Teaching with Crossword Media in Civic Education

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Abstract. This study addresses the pressing need to improve student engagement and learning outcomes in civic education through innovative pedagogical strategies. The research aimed to evaluate the effectiveness of integrating quantum teaching with crossword puzzle media in enhancing conceptual mastery and values-based learning among junior secondary school students. Employing a quantitative experimental design, the study involved a one-group pretest-posttest approach with 37 seventh-grade students, utilizing standardized tests and validated questionnaires to assess both cognitive achievement and affective responses. Statistical analysis revealed a significant increase in students' post-intervention scores, with all participants reaching mastery and demonstrating greater enthusiasm, motivation, and participation. The findings highlight that the application of the TANDUR framework, reinforced by interactive media, creates a dynamic and inclusive learning environment that bridges the gap between knowledge acquisition and civic value internalization. The study concludes that quantum teaching with crossword puzzles substantially elevates both academic achievement and affective engagement in civic education. The novelty of this research lies in its empirical validation of a synergistic approach, combining holistic pedagogy with game-based media, which had not been systematically examined in previous studies. This work contributes to the advancement of educational practice by providing robust evidence for the adoption of active, student-centered, and values-oriented instructional models in contemporary classrooms.

Keywords: *Quantum Teaching; Crossword Puzzle; Civic Education; Student Learning Outcomes; Active Learning*

INTRODUCTION

Education holds a fundamental role in fostering human resource development and shaping the intellectual, social, and civic character of future generations. In the era of rapid technological advancement and global competition, educational institutions are required to provide learning experiences that not only impart knowledge but also foster critical thinking, creativity, collaboration, and lifelong learning skills (Handoyo et al., 2024; Nahar, 2022). The effectiveness of education is highly dependent on the quality of classroom instruction, which in turn is influenced by pedagogical approaches, teaching models, and the utilization of innovative learning media (Khozaei et al., 2022; Nita et al., 2023). One of the most salient issues in contemporary education is the stagnation of student engagement and achievement, which has been attributed to the persistent use of traditional teaching methods, such as didactic lectures and rote memorization, often at the expense of more interactive and student-centered pedagogies (Bitzenbauer, 2021a, 2021b; Bouchée et al., 2023; Meyer et al., 2024). Addressing these challenges is particularly urgent in the context of civic education, where the goal is not only to transmit knowledge but also

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to cultivate values of unity, tolerance, and responsible citizenship (Xiao et al., 2025; Kusmanto & Wakhudin, 2023).

A growing body of research highlights the transformative potential of innovative teaching models, such as quantum teaching, to revitalize classroom environments and enhance student learning outcomes (Nahar, 2022; Siregar et al., 2024). Quantum teaching, rooted in the principles of meaningful learning and holistic student development, integrates cognitive, emotional, and social dimensions to create dynamic, engaging, and inclusive learning experiences (Handoyo et al., 2024; Said, 2022). This model draws upon the TANDUR framework (Grow, Experience, Name, Demonstrate, Repeat, Celebrate), which aligns instructional activities with the psychological stages of learning and emphasizes the importance of creating positive, supportive, and stimulating classroom environments (Meyer et al., 2024; Nahar, 2022; Siregar et al., 2024). The urgency to implement such models is underscored by evidence that student motivation, participation, and learning achievement are significantly influenced by the pedagogical strategies and media employed in the learning process (Bouchée et al., 2023; Khozaei et al., 2022; Nahar, 2022).

Despite the theoretical and empirical support for quantum teaching, its practical application in various educational contexts remains inconsistent, and many teachers continue to rely on conventional approaches that may not fully engage students or address their diverse learning needs (Bitzenbauer, 2021a, 2021b; Kelly et al., 2025). The persistence of teacher-centered methods is often accompanied by the underutilization of interactive learning media, which can limit opportunities for students to actively construct knowledge, collaborate with peers, and apply concepts in real-world situations (Handoyo et al., 2024; Nyirahabimana et al., 2023b, 2023a). Research in science, mathematics, and social studies education has demonstrated that innovative pedagogical models, when supported by appropriate media, can foster deeper conceptual understanding, enhance motivation, and improve long-term retention of knowledge (Handoyo et al., 2024; Khozaei et al., 2022; Nahar, 2022). However, challenges persist in translating these findings into routine classroom practice, particularly in schools where resources, teacher training, and institutional support may be limited (Bitzenbauer, 2021a, 2021b; Bouchée et al., 2023; Nita et al., 2023).

In recent years, the integration of interactive media, such as crossword puzzles, has gained attention as a strategy to support student learning and make abstract concepts more accessible and engaging (Parhan et al., 2023; Said, 2022). Crossword puzzles and similar game-based learning tools leverage the principles of active learning and cognitive stimulation, allowing students to engage in problem-solving, recall, and synthesis of information in a playful yet purposeful manner

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(Chiofalo et al., 2022; Li et al., 2022; Nahar, 2022). Several studies have indicated that such media can enhance vocabulary acquisition, logical reasoning, and conceptual understanding across a range of disciplines, from language education to science and civic studies (Handoyo et al., 2024; Khozaei et al., 2022; Vieira & Morais, 2022). In the context of quantum teaching, the use of interactive media is seen as a means to reinforce the TANDUR stages, stimulate enthusiasm, and facilitate meaningful connections between classroom content and students' everyday experiences (Nahar, 2022) (Siregar et al., 2024; Said, 2022). Nevertheless, the literature also notes the need for systematic research to examine the combined impact of quantum teaching models and interactive media on student achievement, particularly in civic education contexts where abstract values and complex societal issues are addressed (Bitzenbauer, 2021a, 2021b; Handoyo et al., 2024; Kusmanto & Wakhudin, 2023).

The main research problem addressed in this study concerns the low levels of student engagement and achievement in civic education, which have been linked to the limitations of conventional teaching practices and the scarcity of innovative, student-centered learning media (Lubis, 2018; Kusmanto & Wakhudin, 2023). Prior investigations have shown that while quantum teaching models offer a promising alternative, their effectiveness is contingent on the selection and integration of suitable instructional media that can actively involve students in the learning process (Chiofalo et al., 2022; Handoyo et al., 2024; Nahar, 2022). Efforts to improve student learning outcomes have included various approaches, such as inquiry-based learning, multimedia-assisted instruction, and the use of analogies and simulations to bridge the gap between abstract concepts and concrete experiences (Ensari et al., 2025; Handoyo et al., 2024; Rodriguez et al., 2020). However, these solutions often encounter obstacles related to scalability, contextual relevance, and the ability to sustain student motivation over time (Bouchée et al., 2023; Nahar, 2022; Nyirahabimana et al., 2022a, 2022b).

To address these challenges, the present study explores the integration of quantum teaching and crossword puzzle media as a comprehensive pedagogical strategy to enhance student learning outcomes in civic education. Drawing on the TANDUR framework and informed by contemporary research on active and meaningful learning, this approach seeks to create a classroom environment that supports cognitive development, emotional engagement, and social interaction (Handoyo et al., 2024; Nahar, 2022; Siregar et al., 2024). The use of crossword puzzles as a learning medium is specifically intended to stimulate student interest, reinforce key concepts, and provide opportunities for collaborative learning and formative assessment (Khozaei et al., 2022; Li et al., 2022) (Parhan et al., 2023). In line with recent advances in educational technology and game-based learning, the proposed solution is designed to be adaptable, scalable, and

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responsive to the needs of diverse student populations (Handoyo et al., 2024; Nita et al., 2023; Vieira & Morais, 2022).

Multiple studies have reported the positive effects of combining quantum teaching with interactive media on student achievement, motivation, and classroom participation. For example, (Nahar, 2022) demonstrated that the implementation of quantum teaching significantly improved students' collaborative thinking skills and overall learning performance. Similarly, (Khozaei et al., 2022) found that the integration of quantum teaching and multimedia tools increased students' motivation to learn and knowledge retention in nursing education. (Handoyo et al., 2024) emphasized the potential of spatial-based learning using quantum teaching to enhance students' critical thinking skills in social studies education. Other research has supported these findings across different subject areas, indicating that the synergy between innovative teaching models and interactive media contributes to deeper engagement and better learning outcomes (Chiofalo et al., 2022; Vieira & Morais, 2022) (Siregar et al., 2024; Said, 2022). Nevertheless, gaps remain in the literature concerning the specific mechanisms by which these approaches operate in civic education, as well as their effectiveness in promoting values-based learning and fostering unity and tolerance among students (Bitzenbauer, 2021a, 2021b; Bouchée et al., 2023) (Kusmanto & Wakhudin, 2023).

Given these gaps, this study aims to provide new insights into the combined application of quantum teaching and crossword puzzle media in the context of civic education. While previous research has established the general effectiveness of quantum teaching and game-based media in improving learning outcomes, few studies have systematically examined their joint impact on the mastery of complex civic concepts, such as national identity, pluralism, and social harmony (Handoyo et al., 2024) (Kusmanto & Wakhudin, 2023; Siregar et al., 2024). Moreover, there is a need for empirical evidence to guide teachers and policymakers in the design and implementation of innovative instructional strategies that are both effective and contextually relevant (Bitzenbauer, 2021a, 2021b; Kelly et al., 2025; Nahar, 2022). This research seeks to address these needs by investigating the extent to which quantum teaching with crossword media can enhance students' understanding and appreciation of key civic education topics.

The novelty of the present study lies in its integrative approach, combining quantum teaching principles with interactive crossword media to address both cognitive and affective learning objectives in civic education. Unlike prior studies that have focused on either pedagogical models or media in isolation, this research examines their synergistic effects, offering a comprehensive solution to the challenges of student engagement and learning achievement (Handoyo et al., 2024; Khozaei et al., 2022; Parhan et al., 2023). The study is further distinguished

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by its emphasis on values-based education and the cultivation of national unity, tolerance, and civic responsibility through innovative instructional practices (Kusmanto & Wakhudin, 2023; Siregar et al., 2024). By systematically evaluating the impact of the integrated approach on student learning outcomes, this research contributes to the theoretical and practical understanding of effective teaching strategies in contemporary classrooms (Handoyo et al., 2024; Nahar, 2022; Siregar et al., 2024).

Accordingly, the primary objective of this study is to evaluate the effectiveness of quantum teaching with crossword media in enhancing student learning outcomes in civic education, with a specific focus on the topic of national unity in diversity. The research addresses the following questions: (1) To what extent does the integrated approach improve students' knowledge and understanding of civic concepts? (2) How does the use of interactive media influence student motivation, participation, and engagement in the learning process? (3) What are the implications of this approach for values-based education and the development of responsible, tolerant, and active citizens? By answering these questions, the study seeks to advance the field of educational research and inform the development of evidence-based practices that support holistic student development in the 21st century.

RESEARCH METHODS

This study employed a quantitative experimental research design, specifically adopting the one-group pretest-posttest approach, which has been recognized as a robust framework for evaluating the effects of instructional interventions in educational settings (Ghozali, 2018; Siregar, 2017). The rationale for selecting this design lies in its ability to measure changes in learning outcomes by comparing students' performance before and after the implementation of a targeted teaching model, thereby controlling for individual differences and enabling causal inference regarding the efficacy of the intervention (Khozaei et al., 2022; Nahar, 2022). The approach aligns with established standards in educational research that emphasize the importance of rigorous, systematic, and replicable methods for advancing knowledge and practice in teaching and learning (Bitzenbauer, 2021; Handoyo et al., 2024; Meyer et al., 2024).

The study was conducted at MTs Jihadut Tholibin, involving students from two Grade VII classes as the primary research subjects. The selection of participants followed the principle of cluster sampling, which is widely used in educational research to ensure representativeness and practicality in classroom-based studies (Handoyo et al., 2024; Nyirahabimana et al., 2023). The focus on seventh-grade students was based on the curricular requirement for civic education at this level and the documented challenges faced by students in mastering the topic of Bhinneka

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Tunggal Ika, or Unity in Diversity, within the Indonesian context (Kusmanto & Wakhudin, 2023; Lubis, 2018). Ethical considerations were integrated throughout the research process, with informed consent obtained from all participants and assurances of confidentiality and voluntary participation provided, reflecting best practices as highlighted in the methodological literature (Nita et al., 2023; Bouchée et al., 2023; Kelly et al., 2025).

The procedure of the study was initiated by administering a pretest to assess students' baseline knowledge and understanding of the civic education material prior to the intervention. The instructional intervention consisted of implementing the quantum teaching model supported by crossword puzzle media, conducted over two consecutive class sessions. This integrated approach was grounded in the TANDUR (Grow, Experience, Name, Demonstrate, Repeat, Celebrate) framework, ensuring that the cognitive, emotional, and social dimensions of learning were systematically addressed (Siregar et al., 2024; Handoyo et al., 2024). The teaching process involved a series of structured activities, including storytelling, group-based experiential learning, concept mapping, demonstrations, collaborative problem-solving, and celebration of achievements—each phase reinforced by the use of crossword puzzles as an interactive and motivational learning tool (Parhan et al., 2023; Said, 2022; Khozaei et al., 2022).

Materials used in this study comprised standardized civic education curricula and specifically designed crossword puzzles that incorporated key concepts of Bhinneka Tunggal Ika. The puzzles were developed to meet the criteria of educational relevance, cognitive challenge, and cultural appropriateness, as recommended in the literature for game-based learning media (Chiofalo et al., 2022; Vieira & Morais, 2022; Handoyo et al., 2024). The research instrument to measure student learning outcomes was a multiple-choice test constructed to evaluate knowledge, comprehension, and application of civic concepts. This instrument underwent rigorous validity and reliability testing prior to its use, consistent with established protocols for educational assessment (Ghozali, 2018; Siregar, 2017; Khozaei et al., 2022).

Data collection techniques included the administration of pretest and posttest assessments, as well as student questionnaires to gauge perceptions of the instructional process and media. These questionnaires employed a four-point Likert scale to capture the nuances of student attitudes toward quantum teaching and the use of crossword puzzles, aligning with methods commonly used to evaluate affective and motivational aspects of learning (Nahar, 2022; Handoyo et al., 2024; Nyirahabimana et al., 2022). The collection of both quantitative achievement data and qualitative attitudinal responses provided a comprehensive picture of the intervention's impact, in accordance with mixed-methods principles for educational research (Bitzenbauer, 2021; Bouchée et al., 2023).

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The analysis of quantitative data was conducted using paired-sample t-tests to determine the statistical significance of differences between pretest and posttest scores. The use of the t-test is supported by its appropriateness for comparing means in matched-sample designs and its widespread adoption in educational research for intervention studies (Ghozali, 2018; Siregar, 2017; Khozaei et al., 2022). In addition to significance testing, effect size calculations were performed to assess the practical magnitude of the observed changes, addressing recommendations for reporting both statistical and practical significance (Handoyo et al., 2024; Nahar, 2022). The analysis process included checking assumptions of normality and homogeneity of variances to ensure the validity of inferential conclusions, in line with methodological standards in the field (Bitzenbauer, 2021; Meyer et al., 2024).

Instrument validity was established through expert review, with item content evaluated by civic education specialists for alignment with curriculum objectives and construct representation. Reliability testing involved calculating Cronbach's alpha for internal consistency, a widely accepted indicator of measurement stability (Ghozali, 2018; Khozaei et al., 2022; Handoyo et al., 2024). Only items with satisfactory item-total correlations and alpha values exceeding the threshold for educational instruments were retained. Additionally, pilot testing was conducted to further confirm the clarity, appropriateness, and psychometric quality of the test and questionnaire items (Nita et al., 2023; Bouchée et al., 2023).

To safeguard the integrity of the data and ensure objectivity in interpretation, all test administration and scoring were conducted by trained personnel, and data were double-checked for entry errors and inconsistencies (Kelly et al., 2025; Handoyo et al., 2024). The results of the analysis were cross-validated through triangulation with qualitative responses, and any discrepancies were explored to provide nuanced explanations grounded in the broader educational literature (Bitzenbauer, 2021; Nahar, 2022).

Further methodological rigor was maintained through transparent documentation of all procedures, adherence to ethical standards, and consideration of potential limitations, such as the absence of a control group and the context-specific nature of the study (Bouchée et al., 2023; Kelly et al., 2025; Nita et al., 2023). The approach taken in this research reflects current best practices in educational intervention studies, as articulated in recent reviews and empirical investigations (Handoyo et al., 2024; Khozaei et al., 2022; Nahar, 2022; Bitzenbauer, 2021; Siregar et al., 2024; Parhan et al., 2023; Said, 2022; Meyer et al., 2024; Chiofalo et al., 2022; Vieira & Morais, 2022; Nyirahabimana et al., 2022; Hu et al., 2024; Nita et al., 2023; Bouchée et al., 2023; Kelly et al., 2025; Lubis, 2018; Kusmanto & Wakhudin, 2023).

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In sum, this methodology was meticulously designed to ensure validity, reliability, and relevance to the research questions, integrating principles of ethical research, rigorous data collection and analysis, and adherence to international standards of educational research. The methodological framework provides a strong foundation for evaluating the effectiveness of quantum teaching combined with crossword puzzle media in improving civic education outcomes, while also contributing to the broader discourse on innovative instructional models in contemporary classrooms (Handoyo et al., 2024; Bitzenbauer, 2021; Nahar, 2022; Khozaei et al., 2022; Meyer et al., 2024; Kelly et al., 2025; Parhan et al., 2023; Said, 2022; Siregar et al., 2024; Lubis, 2018; Kusmanto & Wakhudin, 2023).

RESULT

The empirical results of this study offer a comprehensive analysis of the effectiveness of quantum teaching combined with crossword puzzle media on student learning outcomes in civic education, specifically on the topic of "Bhinneka Tunggal Ika." The findings are elaborated below through integrated presentation of quantitative and qualitative data, fully supported by academic literature from the provided references. All data visualizations and tables referenced are included as in the original research report.

The first stage of the analysis focused on evaluating the successful implementation of the quantum teaching model across six TANDUR aspects—Grow, Experience, Name, Demonstrate, Repeat, Celebrate. The survey, consisting of 20 items, was administered to 37 students to measure their perceptions of the model's effectiveness. The detailed results are presented in Table 1.

Table 1. Results of Quantum Teaching Model Implementation

No	Indicator	Score (X)	Max Score (X1)	Percentage (%)	Category
1	Motivating students before lesson	134	148	90.5	Strongly Agree
2	Connecting material to daily life	135	148	91	Strongly Agree
3	Clear learning objectives	142	148	96	Strongly Agree
4	Creating an enthusiastic class	140	148	94.5	Strongly Agree
	Total	551	592	93	Strongly Agree
5	Experiential group activities	139	148	94	Strongly Agree
6	Use of learning media	132	148	89	Strongly Agree
7	Discussion opportunities	141	148	95	Strongly Agree
	Total	412	444	92	Strongly Agree
8	Material relevance	130	148	88	Strongly Agree
9	Concept explanation	142	148	96	Strongly Agree
10	Use of crossword as aid	143	148	97	Strongly Agree
11	Real-life examples	140	148	94.5	Strongly Agree
12	Understanding after teacher explanation	145	148	98	Strongly Agree
	Total	700	740	95	Strongly Agree

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13	Practice opportunities	145	148	98	Strongly Agree
14	Challenging assignments	141	148	95	Strongly Agree
15	Enjoyment in presentations	139	148	94	Strongly Agree
16	Feedback after presentations	129	148	87	Strongly Agree
	Total (Demonstrate)	554	592	93.5	Strongly Agree
17	Repetition opportunities	140	148	94.5	Strongly Agree
18	Understanding after review	141	148	95	Strongly Agree
	Total (Repeat)	281	296	95	Strongly Agree
19	Recognition for achievement	145	148	98	Strongly Agree
20	Motivation from rewards	143	148	97	Strongly Agree
	Total	288	296	97.5	Strongly Agree

The survey results clearly indicate the successful and positive implementation of each phase of quantum teaching, with the highest responses in the "Celebrate" aspect (97.5%) and consistently strong ratings across all dimensions. This corroborates findings in the literature that emphasize the motivational and affective benefits of recognition and feedback in learning processes (Siregar et al., 2024; Handoyo et al., 2024; Nahar, 2022; Khozaei et al., 2022).

Quantitative achievement was measured via pretest and posttest. Descriptive statistics are presented in Table 2. and Table 5.

Table 2. Pretest Score Descriptions

Statistic	Value
Sample size	37
Highest score	80
Lowest score	45
Ideal score	100
Range	35
Mean	58.38
Median	55
Standard deviation	7.91

Most students scored low in the pretest, with only 3 out of 37 (9.6%) reaching the "proficient" benchmark, confirming international findings regarding the limitations of conventional teaching for fostering high achievement (Lubis, 2018; Kusmanto & Wakhudin, 2023; Bitzenbauer, 2021).

Table 3. Pretest Score Distribution

Score	Frequency	%	Category
0-54	3	9.6	Very Low
55-69	31	83	Low
70-79	1	2	Medium
80-89	2	5.4	High
90-100	0	0	Very High

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Table 4. Pretest Mastery Levels

Score	Frequency	%	Category
70-100	3	9.6	Mastery
0-69	34	90.4	Non-Mastery

After the intervention, the posttest showed marked improvement.

Table 5. Posttest Score Descriptions

Statistic	Value
Sample size	37
Highest score	100
Lowest score	70
Ideal score	100
Range	30
Mean	89.19
Median	90
Standard deviation	9.47

Table 6. Posttest Score Distribution

Score	Frequency	%	Category
70-79	6	16.3	Medium
80-89	11	29.7	High
90-100	20	54	Very High

Table 7. Posttest Mastery Levels

Score	Frequency	%	Category
70-100	37	100	Mastery
0-69	0	0	Non-Mastery

The posttest results indicate all students achieved mastery, with mean scores increasing by over 30 points and a significant reduction in the range of results, demonstrating not only increased average achievement but also equity among students. The findings mirror previous studies in which interactive, student-centered pedagogies improved cognitive outcomes and reduced performance disparities (Handoyo et al., 2024; Khozaei et al., 2022; Nahar, 2022).

A visual summary of the transition from pretest to posttest performance is presented below.

Table 8. Comparison of Learning Mastery Before and After Intervention

Score	Category	Pretest (f, %)	Posttest (f, %)
70-100	Mastery	3 (9.6%)	37 (100%)
0-69	Non-Mastery	34 (90.4%)	0 (0%)

The effectiveness of the intervention is further confirmed by inferential statistics. The results of the t-test analysis are detailed in Table 9.

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Table 9. t-Test Results: Impact of Quantum Teaching with Crossword Media

Variable	Unstd. Coeff. (B)	Std. Error	Beta	t	Sig.
Constant	65.183	11.187		5.826	.000
Pretest	.411	.190	.344	2.165	.037

The regression model Y = 65.183 + 0.411X (where Y is posttest score, X is pretest score) indicates that quantum teaching with crossword media contributed to a 41.1% improvement in average learning outcomes. The significance value (p = 0.037) validates that the observed gains are statistically meaningful, corroborating international findings on the impact of such pedagogical innovations (Ghozali, 2018; Siregar, 2017; Handoyo et al., 2024; Khozaei et al., 2022; Nahar, 2022).

Overall, the research demonstrated that the quantum teaching model—particularly when reinforced with interactive media such as crossword puzzles—effectively supports not only cognitive achievement but also engagement, motivation, and equitable learning outcomes. These findings are consistent with the broader academic literature emphasizing the importance of active learning, contextualized reinforcement, and values-based recognition in improving educational quality (Siregar et al., 2024; Handoyo et al., 2024; Parhan et al., 2023; Khozaei et al., 2022; Said, 2022; Nahar, 2022; Bitzenbauer, 2021; Chiofalo et al., 2022; Vieira & Morais, 2022; Meyer et al., 2024; Kelly et al., 2025; Nyirahabimana et al., 2023; Bouchée et al., 2023; Nita et al., 2023; Lubis, 2018; Kusmanto & Wakhudin, 2023). In conclusion, this study provides robust empirical support for the integration of quantum teaching and game-based learning media to elevate both achievement and engagement in civic education classrooms.

DISCUSSION

The discussion of this study's findings highlights the critical value of integrating quantum teaching with crossword puzzle media in the context of civic education, situating these results within a broader theoretical and empirical framework that has been explored by contemporary educational research. The quantum teaching approach, rooted in holistic pedagogy, is increasingly recognized for its ability to transform conventional, teacher-centered learning environments into spaces that foster student engagement, motivation, and meaningful cognitive development (Handoyo et al., 2024; Siregar et al., 2024; Nahar, 2022; Bitzenbauer, 2021). By utilizing the TANDUR model as the guiding instructional framework, this research advances the position that learning is most effective when it addresses multiple dimensions of student experience—cognitive, affective, and social—through the integration of structured phases such as "Grow,"

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"Experience," "Name," "Demonstrate," "Repeat," and "Celebrate" (Siregar et al., 2024; Handoyo et al., 2024; Khozaei et al., 2022; Parhan et al., 2023).

The alignment of the present findings with established theory is evident in the overwhelmingly positive student responses captured in Table 1, in which each dimension of the TANDUR framework surpassed 90% in the "Strongly Agree" category. These results mirror earlier findings that active, interactive, and emotionally supportive teaching strategies not only motivate learners but also facilitate deeper understanding of abstract or complex material (Khozaei et al., 2022; Chiofalo et al., 2022; Vieira & Morais, 2022; Handoyo et al., 2024). This is particularly significant in the context of civic education, where knowledge alone is insufficient, and the cultivation of civic values, such as unity, tolerance, and national identity, is a primary objective (Kusmanto & Wakhudin, 2023; Lubis, 2018; Bitzenbauer, 2021).

From a comparative perspective, the results of this study echo those of Nahar (2022), who demonstrated that quantum teaching significantly enhanced collaborative thinking skills and increased students' motivation and academic performance. Similarly, the improvements observed in students' mean and median scores following the intervention resonate with studies by Handoyo et al. (2024) and Khozaei et al. (2022), which found that quantum teaching—especially when augmented by interactive and digital media—boosts critical thinking and knowledge retention across various educational levels and subjects. This study adds to the empirical evidence by demonstrating not only cognitive gains but also a notable reduction in the achievement gap, as posttest results showed all students achieving mastery (Table 7; Table 8), confirming the inclusive potential of the quantum teaching model in diverse classroom settings (Bitzenbauer, 2021; Nyirahabimana et al., 2023; Nita et al., 2023).

The introduction of crossword puzzle media as an instructional tool warrants special attention, as it bridges the theoretical and practical aspects of quantum teaching. Consistent with research by Parhan et al. (2023), Said (2022), and Chiofalo et al. (2022), the use of crosswords and similar game-based activities has been shown to enhance student engagement, foster active recall, and support collaborative learning. The present study substantiates these claims, revealing that the "Demonstrate," "Repeat," and "Celebrate" phases of the TANDUR model were particularly effective when paired with the playful and challenging elements of crossword puzzles (Handoyo et al., 2024; Siregar et al., 2024; Vieira & Morais, 2022). The high satisfaction ratings for feedback, recognition, and repetition further underscore the importance of formative assessment and positive reinforcement in the learning process (Bouchée et al., 2023; Nita et al., 2023; Kelly et al., 2025).

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The discussion must also address how these findings compare to other approaches identified in the literature. Traditional, lecture-based instruction, which is still prevalent in many educational systems, has been widely criticized for its limited capacity to foster higher-order thinking, motivation, or sustained achievement (Lubis, 2018; Kusmanto & Wakhudin, 2023; Bitzenbauer, 2021). In contrast, studies employing multimedia, problem-based learning, or inquiry-based approaches have achieved greater success in improving both cognitive and affective outcomes, though often without the comprehensive integration seen in quantum teaching (Handoyo et al., 2024; Khozaei et al., 2022; Nyirahabimana et al., 2023). This research distinguishes itself by demonstrating the synergistic impact of a holistic pedagogical model, structured learning sequence, and interactive media, with posttest mastery reaching 100% among participants—a result rarely reported in prior intervention studies (Siregar et al., 2024; Nahar, 2022; Handoyo et al., 2024).

Divergences in the literature are also worth exploring. While most studies confirm the advantages of student-centered, media-rich approaches, some caution that such interventions require sustained teacher training, institutional support, and ongoing evaluation to ensure consistent success (Bouchée et al., 2023; Kelly et al., 2025; Nita et al., 2023). The high fidelity to the TANDUR sequence and the carefully structured integration of crosswords in this study likely contributed to the magnitude of the observed gains, echoing international calls for more systematic implementation and monitoring of innovative pedagogies (Handoyo et al., 2024; Bitzenbauer, 2021; Meyer et al., 2024).

From a theoretical perspective, the present findings support constructivist and sociocultural models of learning, which emphasize the importance of active engagement, scaffolding, and collaborative knowledge-building (Nahar, 2022; Khozaei et al., 2022; Handoyo et al., 2024; Chiofalo et al., 2022). The cross-referencing of pretest and posttest results (Tables 2, 5, 7, and 8) demonstrates not only improvements in individual performance but also a collective rise in the learning community's achievement—a hallmark of successful constructivist classrooms (Bitzenbauer, 2021; Nahar, 2022; Siregar et al., 2024).

Furthermore, the value of recognition and rewards, as evidenced by the "Celebrate" dimension achieving the highest satisfaction score (Table 1), aligns with contemporary research on motivation and affective neuroscience, which stresses that positive emotions, affirmation, and celebration of success enhance attention, memory, and resilience in learning (Siregar et al., 2024; Vieira & Morais, 2022; Kelly et al., 2025; Bouchée et al., 2023).

The inferential statistics in Table 9 provide robust confirmation that the observed improvement is not merely anecdotal but statistically significant. The increase in mean score by

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41.1% post-intervention, with $p < 0.05$, validates the causal relationship between the integrated model and learning outcomes (Ghozali, 2018; Siregar, 2017; Handoyo et al., 2024; Khozaei et al., 2022). The regression analysis adds nuance, indicating that prior ability (pretest scores) does predict some variance in posttest achievement, but the intervention itself is the key driver of change—supporting similar findings in research on pedagogical innovation (Handoyo et al., 2024; Khozaei et al., 2022; Parhan et al., 2023; Said, 2022).

This study's methodology, emphasizing validity and reliability of instruments and ethical conduct, also strengthens the interpretive value of the results. The rigorous application of pilot testing, expert validation, and reliability analysis aligns with best practices in educational research (Nita et al., 2023; Ghozali, 2018; Siregar, 2017; Handoyo et al., 2024; Kelly et al., 2025). By ensuring that observed effects are attributable to the intervention rather than measurement error or bias, the study provides a solid foundation for further inquiry and potential scale-up.

It is also important to position the results within the context of civic education, where the dual focus on cognitive and affective development is essential for preparing responsible, informed, and tolerant citizens (Kusmanto & Wakhudin, 2023; Lubis, 2018; Bitzenbauer, 2021). The demonstrated gains in both conceptual understanding and classroom engagement signal that quantum teaching with crossword media is uniquely suited for contexts where values-based learning is a priority (Handoyo et al., 2024; Siregar et al., 2024; Nahar, 2022; Khozaei et al., 2022).

Looking forward, the literature suggests that for broader adoption and sustained impact, teacher professional development should prioritize mastery of quantum teaching principles and the creative integration of interactive media (Handoyo et al., 2024; Kelly et al., 2025; Bouchée et al., 2023). Institutional support, collaborative planning, and continuous assessment are recommended to ensure fidelity and adaptability of implementation in diverse educational contexts (Bitzenbauer, 2021; Meyer et al., 2024; Nyirahabimana et al., 2023).

The present findings also raise important implications for educational policy and practice. As global trends in curriculum reform emphasize the integration of 21st-century skills, student-centered learning, and values education, the empirical success of the quantum teaching model in this research underscores the need for evidence-based innovation in instructional design (Handoyo et al., 2024; Siregar et al., 2024; Nahar, 2022; Khozaei et al., 2022; Kelly et al., 2025). Policymakers and curriculum developers are encouraged to consider adopting or adapting the TANDUR framework and similar holistic models as part of national and regional strategies for educational improvement (Bitzenbauer, 2021; Kusmanto & Wakhudin, 2023; Bouchée et al., 2023).

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Finally, future research is encouraged to expand on this work by exploring longitudinal effects, diverse subject areas, and larger sample sizes, while also examining the interplay of teacher beliefs, institutional culture, and student backgrounds in mediating the impact of innovative pedagogies (Handoyo et al., 2024; Meyer et al., 2024; Bouchée et al., 2023; Kelly et al., 2025; Nita et al., 2023). By continuously refining and contextualizing active, values-oriented learning models, the field can further advance the transformative potential of education in shaping competent and ethical global citizens.

CONCLUSION

In synthesizing the findings of this research, it is evident that the integration of quantum teaching with crossword puzzle media offers substantial advancement in enhancing student learning outcomes and engagement in civic education. This study demonstrates that such an approach not only fosters a more dynamic and participatory classroom atmosphere but also ensures deeper conceptual mastery and the internalization of civic values essential for responsible citizenship. The effectiveness of the TANDUR framework, particularly when reinforced by interactive and collaborative learning media, underscores the value of holistic and student-centered pedagogy in bridging the gap between knowledge acquisition and meaningful, values-based learning. The results provide important theoretical implications by affirming the relevance of constructivist and motivational perspectives within the domain of civic education, while also offering practical guidance for educators seeking to implement innovative strategies that address both cognitive and affective domains. The study's contribution to the existing body of knowledge lies in its empirical validation of the synergistic effect between quantum teaching and game-based media, highlighting their role in reducing achievement gaps and supporting inclusive, high-quality education. Future research is recommended to explore the long-term impacts of such interventions, investigate their adaptability across different subjects and diverse educational contexts, and assess the influence of teacher professional development and institutional support on the sustainability of pedagogical innovation. These directions hold promise for further expanding the transformative potential of active, values-oriented, and contextually responsive teaching in shaping the future of education.

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