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The Effect of the *Quantum Learning* Model Assisted by *Wordwall* Gamification with Betawi Cultural Content on Students' Spatial Thinking Abilities

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Abstract

This study aims to determine the effect of the Quantum Learning model assisted by Wordwall gamification with Betawi cultural content on the spatial thinking abilities of fifth-grade elementary school students in geometry. This study employed a quasi-experimental design with a Posttest-Only Control Group. 40 students from SDI Al-Ghifari made up the sample, which was split equally between an experimental group and a control group using the saturation sampling technique. The experimental group was taught using the Quantum Learning model with a Betawi-themed Wordwall, while the control group used Problem Based Learning (PBL) assisted by PowerPoint. Data were collected using an essay test designed to measure spatial visualization, understanding of spatial relationships, and manipulation of spatial objects. According to the findings, the experimental group's mean score was higher (78.00) than the control group's (60.50). A significant difference was found using the independent sample t-test (t-count = 3.61 > t-table = 2.03). Furthermore, the effect size calculation (Cohen's d) resulted in a score of 1.14, indicating a large effect size. It was concluded that the integration of Quantum Learning, Wordwall gamification, and Betawi ethnomathematics significantly improved students' spatial thinking abilities.

Keywords: *Quantum Learning*, Wordwall Gamification, Betawi Culture, Spatial Thinking Ability, Geometry

1. Introduction

In order to create human resources that are globally adaptable, education in 21st century places a strong emphasis on the development of higher-order thinking skills. In basic education, one of the most essential cognitive foundations is spatial thinking ability. Although its urgency is very clear, reality shows a significant gap regarding the spatial mastery of students in Indonesia. Indonesia

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scored 366 in mathematics on the 2022 Programme for International Student Assessment (PISA), which amply illustrates this shortcoming, far below the OECD average of 472, with specific weaknesses in the "shape and space" domain. This fundamental problem is primarily caused by the contradiction between the abstract nature of geometry and the concrete operational cognitive stage of fifth-grade students, who are still very dependent on observable physical experiences (Fitriyani & Putri, 2024). In addition, the dominance of conventional teacher-centered learning methods further exacerbates the problem, creating a monotonous learning environment that fails to provide the visually rich, interactive, and manipulative experiences that are vital for spatial reasoning (Narpila et al., 2024; Buana & Putra, 2023).

Spatial thinking ability is a fundamental higher-order cognitive skill that allows individuals to understand, manipulate, and predict spatial relationships between objects (Lokollo et al., 2024). It is an active cognitive process that goes beyond mere visual perception; it is the ability that allows individuals to manipulate, organize, reason, and understand spatial relationships in both real space and imagination (Atit et al., 2020). In the context of solving geometry problems, this ability acts as an essential reasoning tool. Based on the cognitive psychology framework, this study measures spatial thinking ability through three core indicators: spatial visualization (the ability to mentally imagine and manipulate objects), understanding of spatial relationships (the ability to interpret the relative positions between objects), and manipulation of spatial objects (the ability to orient and manipulate objects physically or mentally).

This study applies the Quantum Learning approach to efficiently enhance these spatial indicators. Quantum Learning is a comprehensive pedagogical methodology designed to orchestrate all of the students' energy—engaging their minds, emotions, and body language—to create a significant leap in understanding and academic achievement (Abidin, 2018). This model is based on the concept of suggestology (accelerated learning) and aims to remove psychological barriers such as stress by balancing learning and playing in a harmonious way (Rodiyana, 2018). The application of this model in the classroom is realized in the TANDUR syntax, namely Tumbuhkan (Grow), Alami (Experience), Namai (Name), Demonstrasikan (Demonstrate), Ulangi (Repeat) and Rayakan (Celebrate) (Supitmie, 2020). Quantum Learning can maximize students' working memory to absorb abstract geometry information by providing a fun and pressure-free learning environment (Faizal et al., 2022).

The gamification strategy is incorporated to maximize the phases of 'Experience' and 'Celebrate' of the Quantum Learning model. Gamification is defined as the application of game elements in non-game contexts to increase user engagement, motivation and experience (Cuhanzriansyah et al., 2025). Game elements include points, badges, challenges and leaderboards. It is important to note that gamification does not mean turning the entire learning process into just play; rather, it adapts the motivational structure of games to capture students' attention, motivate action, and encourage meaningful learning (Legowo, 2022). In this study, Wordwall acts as the gamification platform. Wordwall provides dynamic interactive templates and immediate feedback, which are highly

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effective in correcting students' spatial misperceptions in real-time and maintaining their learning motivation (Rahmadanti et al., 2024).

Furthermore, to contextualize abstract geometry concepts, this study integrates Betawi cultural artifacts through ethnomathematics (Fajriah et al., 2023). The Gigi Balang ornament, the Rumah Kebaya architecture, and the traditional Damdas 16 Batu game are examples of artifacts that implicitly contain geometric principles such as angles (Liberna et al., 2023). The use of these local cultural elements as a medium of learning in the Wordwall platform can make abstract concepts more concrete and familiar to students.

To solve this complex educational issue, this study proposes a new solution framework integrating these three strategic components, namely the Quantum Learning model as the pedagogical basis, Wordwall gamification as the engagement device, and Betawi cultural content as the contextualization medium. It is designed to simultaneously target the affective, motivational and cognitive dimensions of learning. The interactive and fun atmosphere offered by gamification of Wordwall (Maulidi, 2022) strongly reinforces the positive learning environment emphasized by Quantum Learning. Moreover, the Betawi cultural content directly supports the TANDUR syntax because it provides a rich and relevant context in the “Experience” phase that makes the connection between abstract geometry and students’ daily lives. Moreover, Wordwall’s leaderboard function is a useful tool for applying the “Celebrate” phase, in which students’ successes are properly appreciated. This is a pioneering study to empirically explore this synergistic integration in order to improve the spatial thinking skills of fifth-grade students in geometry.

2. Methods

This study combined a quasi-experimental method with a quantitative approach. Referring to Yuwanto (2019), the use of a quasi-experimental method was based on the characteristics of the research subjects who were already formed in naturally intact learning groups—in this case, classes V-A and V-B. Therefore, the researcher did not perform random assignment on the subjects as required in a true experimental design. In particular, the Posttest-Only Control Group Design was employed. There are two comparison groups in this design: the control group and the experimental group. Both groups received different treatments during the same period, and at the end of the learning process, a post-test was given to measure the treatment effect. For efficiency, the researcher did not administer a pre-test; however, the equality of the students' initial abilities (entry behavior) in both classes was monitored through observation (Yuwanto, 2019).

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Table 1.
Research Design

Group	Treatment	Post-Test
Experiment	X_1	O_1
Control	X_2	O_2

A sample is a portion of the research population or a representative of the entire research population (Abubakar, 2021). All members of the population can be utilized as a sample, nevertheless, if the population is tiny or the researcher wants to draw conclusions with a very limited margin of error. Saturated sampling was the method of sampling employed in this investigation. Saturated sampling is a technique where all members of the population are used as a sample, which is usually applied when the research population is relatively small (Abubakar, 2021). Based on these considerations, the sample in this study involved all fifth-grade students enrolled in the current academic year at SDI Al-Ghifari. This approach was implemented because the researcher used a quasi-experimental design in naturally formed classes, making it impossible to select only a portion of the students from the class. s a result, 40 students made up the study's overall sample, with 20 students in class V-A serving as the experimental group and 20 students in class V-B serving as the control group. This assignment utilized naturally intact classes to comply with the school's administrative policies and to prevent any disruption to the students' regular learning environment. Randomizing individual students was not feasible due to strict time constraints and established school regulations.

An essay-based post-test instrument was used to gather information on students' spatial thinking skills. This test instrument was specifically developed with reference to the three main indicators of spatial thinking ability in the angle geometry material. First, spatial visualization, which was measured through the students' ability to visually identify types and parts of angles. Second, understanding of spatial relationships, which was measured through the students' ability to accurately measure angles using standard measuring tools (protractors) and compare the sizes of two angles. Third, manipulation of spatial objects, which was measured through the students' skills in constructing or drawing angles of specific sizes and determining the results of the directional rotation of the lines forming the angle.

Prior to the main data collection, the spatial thinking ability instrument, which originally consisted of eight essay questions, was tested to ensure its quality. The Pearson Product-Moment correlation was used to evaluate construct validity, confirming the test items' validity. The reliability of the polytomous essay test was evaluated using Cronbach's Alpha, resulting in a reliability coefficient of 0.64, which is categorized as high (Yusup, 2018). Furthermore, an analysis of the difficulty level and discriminating power was conducted to measure the effectiveness of the test. Based on this evaluation, three questions with poor discriminating power were discarded. Consequently, five

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final questions with a moderate level of difficulty and adequate discriminating power were selected and used for the post-test instrument.

Prerequisite tests for data analysis must be carried out prior to hypothesis testing to ascertain the impact of the learning model. The purpose of these preliminary tests is to make sure that the post-test data satisfies the fundamental presumptions of parametric statistics, which are that the data have homogeneous variances and are normally distributed. The purpose of the normality test is to ascertain if the experimental and control class data originate from populations that are regularly distributed. The Liliefors test was used to conduct the normalcy test in this investigation. The Liliefors test is a modification of the Kolmogorov-Smirnov test specifically designed to test data normality when population parameters (mean and variance) are unknown, and it is highly effective for small samples (n < 100) (Sianturi, 2025). A homogeneity test was performed to ascertain the equality of variances between the experimental and control groups after confirming that the data were normally distributed. This homogeneity testing used the F-Test (Fisher's Test).

Calculating the effect size is the next step in the analysis if the t-test findings show a significant difference. The purpose of this computation is to ascertain how much the Quantum Learning model has improved students' spatial thinking skills. Although the significance test (t-test) only shows the presence or absence of a difference, the effect size shows how large the difference is. The formula used to estimate the Effect Size (ES) or Cohen's d value based on the obtained t-value is Nuryadi et al. (2017).

Table 2.
Effect Size Category

Effect Size Value	Category
$d \leq 0{,}2$	Small
$0{,}2 < d \leq 0{,}8$	Medium
$d > 0{,}8$	Large

3. Result and Discussion

This section presents the results of the spatial thinking ability test and the prerequisite assessments, hypothesis testing, effect size calculation, and detailed analysis of the results. This research is to examine the difference of learning outcomes of control group taught using PowerPoint-based Problem Based Learning (PBL) model and experimental group taught using Betawi-themed Wordwall gamification-based Quantum Learning model.

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3.1. Results

The descriptive statistics of the post-test, as presented in Table 3, highlight a stark contrast in the final learning outcomes between the two groups. While both groups exhibited a similar spread of data—indicated by their comparable standard deviations (15.31 and 15.36)—the experimental group achieved a noticeably higher mean score (78.00) compared to the control group (60.50). This 17.5-point gap provides an initial indication that the integration of the Quantum Learning model and Wordwall gamification provided a more effective cognitive scaffolding for spatial reasoning than the conventional method.

Table 3
Comparison of Post-test Results for Spatial Thinking Abilities

Statistic	Experimental Group	Control Group
Lowest Score	40	20
Highest Score	100	80
Mean	78	60,50
Variance	234,47	235,79
Standart Deviation	15,31	15,36

Before testing the main hypothesis, parametric assumptions were verified through normality and homogeneity tests (summarized in Tables 4 and 5). The Liliefors test confirmed that the data from both groups were normally distributed, and Fisher's test indicated homogeneous variances. The fulfillment of these prerequisites is crucial; it confirms that the students in both classes came from comparable populations with equal baseline conditions. Consequently, any subsequent differences in post-test results are validly attributable to the pedagogical interventions rather than preexisting disparities.

Table 4
An overview of the results of the normalcy test

Group	L-count	L-table	Conclusion
Experimental	0,1372	0,19	Normal
Control	0,1478	0,19	Normal

As shown in Table 4, the calculations indicate that the data for the experimental group (L-count = 0.1372 < L-table = 0.19) and the control group (L-count = 0.1478 < L-table = 0.19) are normally distributed. Furthermore, Fisher's Test was used to determine the homogeneity of variances between the two groups. The summary of the homogeneity test is presented in Table 5.

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Table 5
An overview of the results of the Homogenity test

Group	n	Variance	F-count	F-table	Conclusion
Experimental	20	234,47	1,0056	2,21	Homogeneous
Control	20	235,79			

Following the prerequisite checks, an independent sample t-test was conducted to statistically validate the observed differences (Table 6). The calculation yielded a significant result ($t - count > t - table$), leading to the rejection of the null hypothesis (H0).

Table 6
An overview of the results of the Hypothesis test

Group	n	t-count	t-table	Conclusion
Experimental	20	3,61	2,03	H0 Rejected
Control	20			

This statistical finding empirically proves that students taught using the Quantum Learning model, enriched with Betawi-themed Wordwall gamification, possess a significantly superior spatial thinking capacity compared to those taught using the PowerPoint-assisted Problem Based Learning (PBL) model. Unlike previous studies that often relied on single-variable interventions, this outcome highlights the effectiveness of a multi-dimensional approach.

Furthermore, the practical significance of this intervention was measured using Cohen's d. The resulting value of 1.14 falls well into the "large effect size" category (d > 0.8). In the context of educational research, an effect size of this magnitude is substantial. It indicates that the experimental treatment did not merely cause a minor statistical difference, but rather facilitated a massive, observable leap in the students' spatial visualization and manipulation skills. This large effect size validates the novelty of combining humanizing pedagogy, digital gamification, and local cultural context as a highly effective educational strategy.

3.2. Discussion

The Quantum Learning model, which was implemented using the TANDUR syntax, had a significant impact on the experimental class's apparent success. During the learning process, the classroom climate became joyful, fun, and triggered high learning enthusiasm. This joyful mood, free from pressure, optimally opened the students' working memory. These findings are in line with and reinforce research by (Annisa, Patta, & Pagarra (2024), which concluded that the use of the Quantum Learning model has a positive and significant effect on higher-order cognitive abilities

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(such as critical thinking) in elementary school mathematics. Students' active involvement in solving spatial problems in this study proves that orchestrating a comfortable learning environment accelerates the absorption of geometry information.

In addition to digital interactivity, the use of the Betawi cultural context such as the visualization of the Gigi Balang ornament, the roof of the Rumah Kebaya and the traditional game of Damdas 16 Batu helped bridge the abstract concepts of angle into concrete forms. It is important to include this ethnomathematics to guide the students on their spatial understanding. This is in line with the research of (Padmasari et al. (2026), which has proven that exploration of local cultural contexts is closely related to students' spatial thinking process in solving geometry problems. The introduction of Betawi culture context, the students reached an optimum stage of visualization because they were able to observe the geometry through real objects in space in their environment.

While the control class using the Problem Based Learning (PBL) assisted by PowerPoint showed a systematic learning process where students evaluated the geometry problem, the lack of interactive game elements promoted a decline in students' learning enthusiasm. This phenomenon aligns with the findings of Albina et al. (2022), who state that conventional learning that is monotonous and unexciting can decrease students' enthusiasm and interest in active learning, requiring more engaging learning models as a solution. In contrast, the main advantage of the Wordwall platform used in the experimental class lies in its variety of interactive visual templates, such as Labelled Diagrams and Match Up. These features allow for instant two-way interaction that is not possible with static PowerPoint presentations. Consequently, the average spatial thinking achievement of the control class was not as high as the experimental class due to this lack of motivational drive and direct visual-kinesthetic experience.

The combination of a humanizing pedagogical framework (Quantum Learning), interactive technology (Wordwall), and cultural proximity (Betawi culture) was generally successful in creating a holistic learning ecosystem. Furthermore, the novelty of this research lies in the synergistic integration of these three dimensions. While previous studies have primarily isolated either the pedagogical model (such as Quantum Learning) or the cultural context, this research combines the accelerated learning framework, digital gamification, and the localized context of Betawi artifacts. This holistic combination provides a new evidence-based perspective on how to simultaneously address the affective, cognitive, and cultural gaps in elementary geometry, an integration that has been largely underexplored in previous literature. The research shows that students do much better on spatial geometry problems when they are fully engaged—physically, emotionally, intellectually, and culturally.

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4. Conclusion

The average spatial thinking ability of students taught using the Quantum Learning model assisted by Betawi-themed Wordwall gamification is significantly higher than the average spatial thinking ability of students taught using the Problem Based Learning (PBL) model assisted by PowerPoint, according to the findings of the data analysis and discussion. Additionally, the effect size study shows that the use of the Wordwall Quantum Learning model with a Betawi theme has a significant impact, falling into the big effect size group. This suggests that using this novel approach is quite successful in improving students' spatial reasoning in geometry.

Based on these findings, it is highly recommended that schools and teachers, particularly in mathematics education, consider the Quantum Learning model as a strategic alternative for the learning process. Educators are encouraged to insert local cultural elements into their teaching to make learning more impactful, meaningful, and foster students' care for their regional heritage. Furthermore, spatial thinking should be prioritized as a main focus in elementary education due to its fundamental importance in cognitive development. For future researchers, it is advised to carefully design the learning steps, ensure all technical equipment is well-prepared prior to the learning process, and provide students with preliminary information regarding the Quantum Learning model so that the activities can run effectively as planned.

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6. References

Abidin, M. Z. (2018). Islamic Education Based On Quantum Learning: Conceptual and Methodological Perspective. *MADANIA*, *22*(2), 159–172. http://eprints.ums.ac.id/4695,

Abubakar, R. (2021). *Pengantar Metodologi Penelitian* (1st ed., Vol. 1). SUKA-Press UIN Sunan Kalijaga.

Albina, M., Safi'i, A., Gunawan, M. A., Wibowo, M. T., Sitepu, N. A. S., & Ardiyanti, R. (2022). Model Pembelajaran di abad ke 21. *Juwarta*, *16*(4), 939–955

Annisa, Patta, R., & Pagarra, H. (2024). Pengaruh Penerapan Model Pembelajaran Quantum Learning Terhadap Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Matematika Kelas V SD Negeri Maccini 2 Kota Makassar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *9*(4), 749–759.

Atit, K., Uttal, D. H., & Stieff, M. (2020). Situating space: using a discipline-focused lens to examine spatial thinking skills. *Cognitive Research: Principles and Implications*, *5*(19). https://doi.org/10.1186/s41235-020-00210-z

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Buana, R. T., & Putra, A. K. (2023). Peningkatan Kemampuan Berpikir Spasial: Implementasi Model Problem Based Learning melalui Pendekatan Self Efficacy Berbantuan WebGIS Inarisk. *Journal of Education Action Research*, *7*(3), 310–319. https://doi.org/10.23887/jear.v7i3.63881

Cuhanzriansyah, M. R., Rochim, A. A., Ainindri, Q., Putri, R., Ferisca, S., & Mubarok, M. F. (2025). *Gamifikasi dalam Pendidikan: Teori dan Praktik dalam Pembelajaran* (1st ed., Vol. 1). Naba Edukasi Indonesia.

Faizal, M., Nurlaela, & Herawati, L. (2022). Pengaruh Model Quantum Learning Terhadap Kemampuan Pemahaman Matematis Siswa Kelas IV SDN Rawalele Dawuan. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *7*(2), 2287–2299.

Fajriah, A., Annisa, F., Halimah, S., & Lativa, V. (2023). Eksplorasi Etnomatematika pada Rumah GudangBetawi. *Konstanta: Jurnal Matematika Dan Ilmu Pengelatuan Alam*, *1*(4), 179–189.

Fitriyani, H., & Putri, A. D. (2024). Analisis Kesulitan Belajar Matematika Materi Geometri Pada Siswa Kelas 4 Sekolah Dasar. *Jurnal Pendidikan Matematika*, *2*(1). https://doi.org/10.47134/ppm.v2i1.1112

Legowo, Y. A. S. (2022). Gamifikasi Dalam Pembelajaran di Sekolah Dasar. *JISPE: Journal of Islamic Primary Education*, *3*(1), 13–30. https://doi.org/10.51875/jispe.v3i1.43

Liberna, H., Lestari, W., & Hikmah, N. (2023). Etnomatematika pada Permainan Tradisional Damdas 16 Batu dari Betawi. *Prosiding Diskusi Panel Nasional Pendidikan Matematika*, 419–428.

Lokollo, L. J., Lasaiba, M. A., Arfa, A. M., & Lasaiba, D. (2024). Mengembangkan Kemampuan Berpikir Spasial Melalui Pendidikan STEMdi Sekolah Dasar. *Scholaria: Jurnal Pendidikan Dan Kebudayaan*, *14*(3), 293–308.

Maulidi, A. (2022). Implementasi Model Pembelajaran Quantum Learning dalam Meningkatkan Motivasi Belajar. *FAKTA: Jurnal Pendidikan Agama Islam*, *2*(1), 14–22.

Narpila, S. D., Pitaloka, D. D., Ramadhan, R., & Rusydi, A. M. (2024). Perbandingan Kegiatan Pembelajaran Konvensional dan Pembelajaran Berbasis Teknologi Terhadap Hasil Belajar Siswa (Studi Kasus pada Kls VIII A SMP Cerdas Bangsa, Kecamatan Namorambe Kabupaten Deli Serdang). *Jurnal Nakula: Pusat Ilmu Pendidikan, Bahasa Dan Ilmu Sosial*, *3*(1), 210–220. https://doi.org/10.61132/nakula.v3i1.1501

Nuryadi, Astuti, T. D., Utami, E. S., & Budiantara, M. (2017). *Dasar-Dasar Statistik Penelitian* (1st ed., Vol. 1). SIBUKU MEDIA.

Padmasari, N. N., Muhtarom, M., & Harun, L. (2026). Analisis Proses Berpikir Spasial Siswa Dalam Menyelesaikan Permasalahan Geometri Dengan Konteks Budaya Masjid Agung Demak. *Science: Jurnal Inovasi Pendidikan Matematika Dan IPA*, *6*(2), 1121–1134. https://doi.org/10.51878/science.v6i2.10446

Rahmadanti, A., Amril, L. O., & Efendi, I. (2024). Efektivitas Media Pembelajaran Wordwall terhadap Hasil Belajar Siswa Pada Pelajaran Matematika di Sekolah Dasar. *Jurnal Pengajaran Sekolah Dasar*, *3*(1), 117–125. https://doi.org/10.56855/jpsd.v3i1.1086

Rodiyana, R. (2018). Pengaruh Penerapan Strategi Quantum Learning Terhadap Motivasi Belajar dan Pemahaman Konsep Siswa. *Jurnal Cakrawala Pendas*, *4*(2), 45–57.

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Sianturi, R. (2025). Uji Normalitas Sebagai Syarat Pengujian Hipotesis. *Jurnal Pembelajaran dan Matematika Sigma (JPMS)*, *11*(`), 1–14. https://doi.org/10.36987/jpms.v10i2.5881
Supitmie, R. (2020). Penerapan Kerangka Tandur Quantum Teaching untuk Meningkatkan Hasil Belajar Matematika. *Jurnal Pendidikan Tambusai*, *4*(1), 134–142.
Yusup, F. (2018). Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. *Jurnal Tarbiyah: Jurnal Ilmiah Kependidikan*, *7*(1), 17–23.
Yuwanto, L. (2019). *Pengantar Metode Penelitian Eksperimen* (2nd ed., Vol. 1). Graha Ilmu.

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