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# Technology Acceptance of a Low-Device Gamified Learning Approach in Primary Mathematics: Perceptions, Attitudes, and Achievement Differences in Wayground Paper Mode

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**Abstract.** This study investigates Year 6 pupils' perceptions of and attitudes toward mathematics learning achievement through Wayground Paper Mode. The study addresses the problem of limited access to individual digital devices in primary classrooms, which restricts the implementation of technology-enhanced learning activities. A quantitative research design employing a survey method was used, involving 162 Year 6 pupils from a primary school in Kuala Lumpur. The research instrument was a questionnaire constructed based on the Technology Acceptance Model (TAM), measuring perceived ease of use, perceived usefulness, and pupils' attitudes toward Wayground Paper Mode. Descriptive statistical analysis indicated that pupils reported high levels of perception (M = 4.03, SD = 0.60) and attitude (M = 4.07, SD = 0.62), with most participants agreeing that the approach was easy to use, enjoyable, and supportive of mathematics learning. Inferential analysis using the Kruskal–Wallis H test revealed statistically significant differences in perceptions and attitudes across mathematics achievement levels. Specifically, high-achieving pupils demonstrated significantly more positive perceptions and attitudes compared to their moderate- and low-achieving peers. The findings suggest that Wayground Paper Mode can support positive learning experiences in primary mathematics classrooms. However, differences across achievement groups indicate the need for differentiated instructional support to ensure that pupils of varying academic abilities can benefit effectively from gamified learning activities. This study contributes to the understanding of how gamified, low-tech instructional approaches can support student engagement in mathematics education. Future research is recommended to explore long-term effects of such approaches on student motivation and learning outcomes.

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## 1. Introduction

In 21st-century education, the integration of technology into teaching and learning (T&L) has become a central requirement for enhancing student engagement and improving learning outcomes (Mahmud & Law, 2022). This transformation is particularly significant in mathematics education, where technology-enhanced and gamified approaches have been shown to influence students' perceptions and foster greater engagement in learning processes. In alignment with the demands of the Industrial Revolution (IR) 4.0, the Malaysia Education Blueprint (2013–2025) similarly emphasises the integration of digital technologies to strengthen the quality and effectiveness of education (Ministry of Education, 2013).

Despite these policy aspirations, the implementation of technology-based learning in mathematics remains uneven due to persistent infrastructural and resource constraints in schools. In many contexts, limited access to digital devices and insufficient technological infrastructure hinder the effective implementation of continuous practice-based and feedback-oriented mathematics instruction. This challenge is further compounded by national evidence indicating that approximately 900,000 students in Malaysia lack access to personal digital devices for learning purposes (Hasin et al., 2022), with disproportionate effects observed among low-income households (Saipudin et al., 2022). In addition, initiatives such as Bring Your Own Device (BYOD) have faced implementation barriers, particularly due to inconsistent internet connectivity and limited school infrastructure readiness (Othman et al., 2020).

These constraints highlight the need for alternative instructional approaches that enable meaningful technology-supported learning without requiring individual device ownership. In this regard, the Wayground platform (formerly Quizizz) has introduced the Paper Mode feature as a low-device gamified learning solution. This mode allows gamification principles to be implemented in offline or low-tech classroom settings while maintaining interactive learning structures (Cahyani & Putranto, 2024). Specifically, Wayground Paper Mode enables synchronous response sharing, allowing all pupils to participate simultaneously rather than sequentially. It also provides immediate feedback after each item and generates performance reports upon completion of learning activities (Quizizz Inc., 2024).

While the platform has been rebranded as Wayground, its pedagogical functionality remains consistent with its earlier iteration as Quizizz (Quizizz Inc., 2025). Consequently, empirical findings from studies on Quizizz remain relevant in informing the present investigation. Prior research has consistently reported positive learner perceptions and attitudes toward Quizizz-based learning, attributed to its interactive design, gamified structure, and capacity to enhance engagement (Supriyatin, 2024). In mathematics education specifically, these attributes are particularly valuable, as mathematics is often perceived by students as abstract and challenging, thereby affecting motivation and learning

engagement (Hasrin & Maat, 2022). Such gamification features are especially relevant for elementary school pupils, whose learning is often enhanced through interactive, visually stimulating, and reward-based activities. Elements such as immediate feedback, points, and rewards may help maintain attention and encourage active participation in mathematics learning. As motivation and engagement are important factors associated with learning outcomes, the integration of gamified learning platforms such as Wayground may provide meaningful support for mathematics achievement among young learners.

Gamification-based instructional strategies have been shown to improve motivation and learning effectiveness in mathematics contexts (Ahmad & Maat, 2023; Matlan & Maat, 2021). However, existing research has predominantly focused on online implementations of Quizizz (Mohd Noordin et al., 2023; Rivas-García & Magadán-Díaz, 2022; Zhao, 2019), while studies examining its Paper Mode in face-to-face classroom environments remain limited (Daniati & Amri, 2025). This gap is particularly evident in primary mathematics education, where device constraints are more pronounced and pedagogical adaptations are urgently needed.

Therefore, this study aims to examine Year 6 pupils' perceptions and attitudes toward the use of Wayground Paper Mode in mathematics learning. The study is guided by the Technology Acceptance Model (TAM) (Davis, 1989), focusing on perceived usefulness, perceived ease of use, and attitudes toward the instructional approach. In addition, the study investigates differences in perceptions and attitudes across levels of mathematics achievement. By addressing these objectives, the study seeks to contribute empirical evidence on the feasibility of low-device gamified learning approaches in primary mathematics classrooms and to provide pedagogical insights for enhancing technology integration in resource-constrained educational contexts.

The objectives of the study are as follows:
1. To identify the level of Year 6 pupils' perceptions towards the use of Wayground Paper Mode in mathematics learning.
2. To identify the level of Year 6 pupils' attitudes towards the use of Wayground Paper Mode in mathematics learning.
3. To determine differences in Year 6 pupils' perceptions and attitudes towards pupils' mathematics achievement using Wayground Paper Mode.

## 2. Literature Review

### 2.1 Gamification Applications in Mathematics Learning

Mathematics is frequently perceived as a difficult and less engaging subject, which can lead to reduced learner motivation and limited active participation in classroom activities Click or tap here to enter text.. This issue is often associated with traditional teacher-centred instructional approaches and the limited incorporation of interactive learning elements Click or tap here to enter text.. In response, gamification has emerged as a promising pedagogical strategy within digital education, with applications such as Quizizz (now rebranded as

Wayground) demonstrating potential in enhancing student engagement and interest in mathematics learning (Jamian et al., 2020).

In mathematics education, Wayground Paper Mode can be applied across various topics, including basic operations, fractions, decimals, percentages, and structured problem-solving. Its core game elements—such as immediate feedback, competitive leaderboards, and reward mechanisms—encourage active participation and sustained engagement in solving mathematical tasks. These features contribute not only to increased motivation but also to more positive learning dispositions among pupils (Kamaliah et al., 2025).

Gamification is generally defined as the integration of game design elements into non-game contexts to enhance user engagement and motivation. Within mathematics learning environments, gamification has been shown to support both motivational and cognitive dimensions of learning, particularly in strengthening procedural fluency and conceptual understanding (Rogget et al., 2025). Specifically, repeated practice facilitated through platforms such as Wayground is critical for mastering foundational mathematical skills, including number facts and computational procedures (Samsuddin & Retnawati, 2019).

Furthermore, feedback mechanisms represent a crucial pedagogical component of gamified learning environments. Immediate feedback supports error correction and helps learners identify misconceptions in real time, particularly in procedural domains such as mathematics (Cameron, 2025). In addition, reward-based systems have been found to enhance learner engagement, concentration, and collaborative behaviour during learning activities (Zhao & Guo, 2019), while also contributing to improved attitudes, reduced mathematics anxiety, and greater learning readiness (Rincon-Flores et al., 2023). Collectively, these findings suggest that gamification may positively influence both affective and cognitive learning outcomes in mathematics education.

Overall, gamification offers a learning environment that integrates enjoyment with structured practice, immediate feedback, and motivational reinforcement. In this study, Wayground Paper Mode is therefore conceptualised as a pedagogical tool that may enhance pupils' perceptions and attitudes toward mathematics learning, particularly through increased engagement and sustained practice.

**2.2 Technology Acceptance Model (TAM)**

The Technology Acceptance Model (TAM), proposed by Davis (1989), is one of the most widely used theoretical frameworks for explaining individuals' acceptance and use of technology. In educational research, TAM has been extensively applied to examine learners' acceptance of digital learning tools, including Quizizz-based applications (Lestari & Nugraha, 2021; Shabraniti & Utamajaya, 2024; Yeap & Chew, 2024).

Although TAM was introduced by Davis (1989), it remains one of the most widely applied frameworks in educational technology research because its core constructs—Perceived Usefulness and Perceived Ease of Use—continue to explain

users' acceptance of emerging technologies. Recent studies have successfully employed TAM to examine learners' acceptance of mobile learning, gamified learning platforms, learning management systems, and AI-supported educational technologies. Therefore, TAM remains relevant for understanding pupils' acceptance of Wayground Paper Mode as a gamified learning approach in contemporary mathematics classrooms.

TAM posits that technology acceptance is primarily influenced by perceived ease of use and perceived usefulness, which subsequently shape users' attitudes toward technology adoption. In the context of this study, these constructs are operationalised as pupils' perceptions of the ease of using Wayground Paper Mode in completing mathematics tasks, the perceived usefulness of the platform in supporting mathematics learning, and their resulting attitudes toward its use. Accordingly, TAM provides a structured lens for evaluating pupils' acceptance of Wayground Paper Mode in mathematics classrooms.

**2.3 Pupils' Perceptions towards the Use of Wayground Paper Mode**

Perception refers to individuals' interpretations, understandings, and judgments formed through experience and interaction with stimuli (Lam et al., 2020). Within the TAM framework, perception is primarily represented through perceived usefulness and perceived ease of use (Davis, 1989).

In this study, pupils' perceptions refer to their evaluation of how easy Wayground Paper Mode is to use and how effectively it supports their mathematics learning. Empirical evidence suggests that positive perceptions of gamified learning tools are associated with increased attention, engagement, and interest in mathematics learning activities (Supriyatin, 2024). Conversely, negative perceptions may hinder technology acceptance and reduce the effectiveness of instructional innovation (Davis, 1989). Therefore, perception is considered a critical determinant of successful integration of gamified learning tools in mathematics education.

**2.4 Pupils' Attitudes towards Wayground Paper Mode**

Within TAM, attitude is defined as an individual's overall positive or negative evaluation of using a particular technology (Davis, 1989). In educational contexts, attitude reflects learners' affective orientation toward learning activities, encompassing cognitive beliefs, emotions, and behavioural intentions (Tarwiyani et al., 2020).

In mathematics education, positive attitudes are particularly important as they are closely associated with increased engagement, persistence, and willingness to engage in repeated practice, which is essential for developing procedural fluency and logical reasoning (Japelj Pavešić et al., 2022). Previous research indicates that gamification can positively influence learners' attitudes by enhancing enjoyment and reducing perceived stress during mathematics learning activities (Alt, 2023; Ukgoda, 2025). These effects are often attributed to game-based reinforcement mechanisms such as rewards, progress tracking, and competitive elements.

**2.5 Empirical Studies on Wayground/Quizizz Paper Mode**

Existing studies generally report positive perceptions and attitudes toward Quizizz-based learning among both teachers and students. For instance, Mahmud & Law (2022) found that primary mathematics teachers expressed favourable attitudes toward integrating Quizizz into classroom instruction. From the learner perspective, Periasamy & Alias (2022) reported that Quizizz enhanced interactivity, enjoyment, and engagement in mathematics learning, largely due to features such as immediate feedback and competitive elements (Rivas-García & Magadán-Díaz, 2022). Similar positive findings have been reported among higher education learners, who demonstrated increased satisfaction and improved learning experiences (Rosli et al., 2023).

Recent studies focusing specifically on Paper Mode suggest promising pedagogical potential. Apriadi & Zulfadewina (2024) reported significant improvements in mathematics achievement following the use of Paper Mode, while Putra (2023) and Khasanah et al. (2023) highlighted increased motivation and enjoyment among learners. A bibliometric study by Kamaliah et al. (2025) further indicates a growing research trend in Quizizz Paper Mode, reflecting increasing academic interest in this instructional approach.

However, despite this growing body of literature, most empirical studies have been conducted in Indonesia, while research within the Malaysian primary education context remains limited. This indicates a geographical and contextual gap, particularly in mathematics education settings where infrastructural constraints may influence implementation effectiveness. Therefore, further empirical investigation is required to examine pupils' perceptions and attitudes toward Wayground Paper Mode in Malaysia.

**2.6 Academic Achievement and Technology Acceptance**

Academic achievement is an important moderating factor influencing learners' perceptions and attitudes toward technology use in education. High-achieving pupils tend to perceive technology as a tool for reinforcing mastery and enhancing learning efficiency, whereas low-achieving pupils may experience cognitive overload or time-related pressure when engaging with technology-based learning tasks (Navarro et al., 2023).

In addition to prior academic achievement, mathematics self-efficacy provides an important theoretical explanation for differences in pupils' acceptance of gamified learning technologies. According to Bandura (1997), self-efficacy refers to individuals' beliefs about their capability to successfully perform specific tasks. In mathematics education, pupils with higher mathematics self-efficacy are generally more willing to engage with challenging tasks, persist after making mistakes, and view feedback as opportunities for improvement (Ford & Usher, 2025; Street et al., 2022; Yustiana et al., 2025).

Conversely, pupils with lower mathematics self-efficacy are more likely to experience anxiety, avoid challenging activities, and interpret incorrect responses negatively. Consequently, differences in mathematics self-efficacy may shape pupils' perceived usefulness, perceived ease of use, and attitudes toward gamified

learning technologies, thereby influencing technology acceptance (Filiz & Gür, 2026; Khan et al., 2023). As Wayground Paper Mode incorporates gamified learning elements, pupils with different levels of mathematics self-efficacy may respond to its use differently.

In mathematics education, these differences are particularly relevant, as learners' prior achievement levels may shape their confidence, engagement, and response to instructional innovations. Accordingly, this study examines whether pupils' perceptions and attitudes toward Wayground Paper Mode differ according to mathematics achievement levels. Mathematics achievement levels were determined based on pupils' mathematics grades obtained from school academic records. Pupils who obtained Grades A and B were classified as high-achieving, those who obtained Grade C and D were classified as moderate-achieving, and those who obtained Grades E and F were classified as low-achieving. Understanding these differences is essential for ensuring that gamified instructional approaches are inclusive and effective across diverse learner abilities.

## 3. Methodology

### 3.1 Research Design

This study employed a quantitative research design using a survey method to examine Year 6 pupils' perceptions of and attitudes toward the use of Wayground Paper Mode in mathematics learning. The survey design was deemed appropriate as it enables the systematic collection of data from a relatively large sample within a limited timeframe while allowing for statistical analysis of relationships and group differences (Manstein et al., 2023). In addition to descriptive analysis, the study also examined differences in pupils' perceptions and attitudes according to categories of mathematics academic achievement.

### 3.2 Population and Sampling

The target population comprised 285 Year 6 pupils from a Chinese National-Type Primary School (SJKC) located in the Pudu Zone, Kuala Lumpur. A simple random sampling technique was employed to ensure that each pupil in the population had an equal probability of selection, thereby reducing selection bias and enhancing the representativeness of the sample (Williamson, 2018). The sampling frame was obtained from the school administration, and random selection was conducted using the RAND function in Microsoft Excel.

The required sample size was determined using G*Power software (version 3.1.9.7) (Faul et al., 2009). Based on an assumed medium effect size ($d = 0.50$), significance level ($\alpha = 0.05$), and statistical power ($1 - \beta = 0.80$), the minimum required sample size for a one-way ANOVA was calculated as 159 participants. This ensures adequate statistical power to detect meaningful group differences while minimising the risk of Type II error (Alam & Winoker, 2025). Accordingly, a total of 162 Year 6 pupils were included in the final sample.

### 3.3 Research Instrument

The research instrument was a structured questionnaire developed based on the Technology Acceptance Model (TAM) and adapted to the context of Wayground Paper Mode in mathematics learning. The instrument measured three constructs: perceived ease of use, perceived usefulness, and attitude toward Wayground Paper Mode. Table 1 presents the constructs, indicators, and number of items included in the questionnaire.

**Table 1: Constructs and Indicators of the Questionnaire**

| Constructs | Indicators | Number of Items |
|---|---|---|
| Perceived Ease of Use | Ease of operation, ease of learning, ease of reading instructional content, ease of interpreting visual information | 4 |
| Perceived Usefulness | Support for learning concentration, support for classroom participation, enhancement of learning engagement, support for self-improvement and feedback-based learning | 4 |
| Attitude toward Wayground Paper Mode | Preference for use, enjoyment of use, motivation to learn, positive evaluation of use | 4 |

For data collection, the questionnaire was administered in printed format immediately after a mathematics lesson involving the use of Wayground Paper Mode. Prior to the activity, the teacher introduced pupils to the Wayground Paper Mode feature and explained how it was used during the lesson. The teacher then selected mathematics questions based on skills that pupils had previously learned and displayed the questions for classroom participation. Pupils responded to the questions by holding up their printed Wayground Paper Mode response cards, which contained unique response codes. The teacher scanned the response cards using a mobile device to record pupils' answers.

Immediate feedback was then provided, allowing pupils to identify whether their responses were correct or incorrect. Upon completion of the lesson, the questionnaire was distributed to collect pupils' perceptions and attitudes toward the learning experience. This in-class administration approach was adopted to ensure high response rates and to capture pupils' immediate perceptions following authentic learning experiences. Such an approach also allows for more accurate reflection of learners' engagement and understanding within the instructional context (Ferguson, 2012). Upon completion of data collection, all responses were coded and entered into IBM SPSS Statistics version 27 for further statistical analysis, including descriptive and inferential procedures.

The questionnaire consisted of three sections, as shown in Table 2 below.

**Table 2: Structure of Questionnaire Items**

| Section | Measured Construct | Number of Items |
|---|---|---|
| A | Background Information<br>• Gender<br>• Experience Using Wayground Paper Mode<br>• Mathematics Achievement Grade | 3 |
| B | Perceptions towards Wayground Paper Mode<br>• Perceived Ease of Use<br>• Perceived Usefulness | 8 |
| C | Attitude towards Wayground Paper Mode | 4 |

A five-point Likert scale was used to measure respondents' level of agreement. This scale was chosen because it is easy to understand and capable of producing a high response rate and stable data (Kusmaryono et al., 2022). In this study, face validity and content validity were evaluated by three experts in the field of mathematics education, two from IPG Kampus Sarawak and one from IPG Kampus Batu Lintang. The expert evaluation focused on language suitability, clarity of items, and alignment of the items with the constructs being studied. After improvements were made based on the experts' feedback, a pilot study was conducted involving 30 Year 6 pupils.

The reliability of the instrument was tested using Cronbach's alpha. The alpha value for the perception construct was 0.85, while the alpha value for the attitude construct was 0.839. The overall alpha values exceeded 0.8, indicating that the instrument had high and acceptable reliability (Daniel et al., 2015).

### 3.4 Respondents' Background

The respondents' background is presented in Table 3. The respondents consisted of 86 male pupils (53.1%) and 76 female pupils (46.9%). In terms of mathematics achievement in school examination, the majority of pupils were in the high achievement category (52.5%), followed by the moderate (25.3%) and low (22.2%) categories.

**Table 3: Background of the Respondents**

| Item | | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 86 | 53.1% |
| | Female | 76 | 46.9% |
| Mathematics Academic Achievement Category in School Examination | Low | 36 | 22.2% |
| | Moderate | 41 | 25.3% |
| | High | 85 | 52.5% |
| Have you used Wayground Paper Mode in mathematics learning? | Yes | 162 | 100.0% |
| | No | 0 | 0.0% |

### 3.5 Data Analysis

Descriptive statistics were used to determine the levels of perceptions and attitudes of Year 6 pupils towards the use of Wayground Paper Mode. The mean score levels were interpreted based on Table 4 below.

**Table 4: Interpretation of Mean Scores**

| Mean Score Scale | Interpretation of Mean Score |
|---|---|
| 1.00-1.80 | Very Low |
| 1.81-2.60 | Low |
| 2.61-3.40 | Moderate |
| 3.41-4.20 | High |
| 4.20-5.00 | Very High |

*Source: Tschannen-Moran and Gareis (2004)*

For inferential analysis, a one-way ANOVA test was conducted to evaluate differences based on pupils' mathematics achievement categories. If the assumptions of normality or homogeneity of variance were not met, non-parametric tests such as the Kruskal–Wallis H test were used (Jan & Shieh, 2020; Perme & Manevski, 2019).

## 4. Results and Findings

### 4.1 Pupils' Perceptions towards the Use of Wayground Paper Mode in Mathematics Learning

Table 5 shows the frequency and percentage distribution of respondents for each item related to pupils' perceptions towards the use of Wayground Paper Mode in mathematics learning. The findings indicate that the overall mean score for pupils' perceptions towards the use of Wayground Paper Mode in mathematics learning was at a high level (M = 4.03, SD = 0.60).

**Table 5: Frequency and Percentage Distribution of Pupils' Perception Items**

| No. | Item | Strongly Disagree | Disagree | Uncertain | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| P1 | I do not face difficulties in using Wayground Paper Mode in mathematics learning. | 2 (1.2%) | 8 (4.9%) | 36 (22.2%) | 73 (45.1%) | 43 (26.5%) |
| P2 | I can easily apply Wayground Paper Mode in mathematics learning after my teacher demonstrates how to use it. | 1 (0.6%) | 1 (0.6%) | 34 (21.0%) | 57 (35.2%) | 69 (42.6%) |
| P3 | I can easily read the numbers and text displayed in Wayground when using the Paper Mode feature in mathematics learning. | 2 (1.2%) | 6 (3.7%) | 28 (17.3%) | 76 (46.9%) | 50 (30.9%) |
| P4 | I can easily understand the images displayed in Wayground when using the Paper Mode feature in mathematics learning. | 1 (0.6%) | 4 (2.5%) | 35 (21.6%) | 71 (43.8%) | 51 (31.5%) |
| P5 | I can focus while learning mathematics using Wayground Paper Mode. | 3 (1.9%) | 6 (3.7%) | 35 (21.6%) | 75 (46.3%) | 43 (26.5%) |
| P6 | My classmates and I can display answers to mathematics questions simultaneously without waiting for our turn. | 0 (0.0%) | 3 (1.9%) | 23 (14.2%) | 74 (45.7%) | 62 (38.3%) |
| P7 | I feel directly involved in mathematics learning through the use of Wayground Paper Mode without requiring digital devices. | 3 (1.9%) | 8 (4.9%) | 38 (23.5%) | 57 (35.2%) | 56 (34.6%) |
| P8 | I can identify the mathematics skills that I need to improve through the Wayground Paper Mode report. | 3 (1.9%) | 10 (6.2%) | 33 (20.4%) | 58 (35.8%) | 58 (35.8%) |
| | **Overall** | **Mean = 4.03** | | **Standard Deviation = 0.60** | | |

Based on the analysis conducted, the item with the highest percentage of agreement was item P6, which relates to pupils' and classmates' ability to display

answers to mathematics questions simultaneously without waiting for their turn. A total of 136 pupils (84.0%) agreed and strongly agreed with this item. This finding indicates that the use of Wayground Paper Mode allows simultaneous pupil participation during mathematics learning sessions. The ability of pupils to answer questions simultaneously not only makes the learning process smoother but also reduces disruptions commonly found in traditional question-and-answer methods. This situation also enables pupils to focus fully on solving mathematical problems without social pressure, such as fear of being called upon or anxiety about making mistakes in front of classmates.

Furthermore, item P2 also recorded a high level of agreement, indicating that the majority of pupils perceived the approach as easy to understand and apply in primary school mathematics learning. This suggests that Wayground Paper Mode is accessible to pupils at the primary level and is aligned with their cognitive abilities, allowing them to process learning tasks with minimal difficulty. This ease of understanding helps reduce cognitive overload during learning, enabling pupils to focus more on mathematical concepts rather than the mechanics of using the learning tool. This finding is consistent with the study by Dewanto et al. (2023), which reported that Wayground Paper Mode is easy to use, reduces learning pressure, and provides pupils with better preparation opportunities. Therefore, the use of Wayground Paper Mode has the potential to become an effective alternative approach in primary school mathematics learning, particularly in creating a more conducive, responsive, and pupil-friendly learning environment (Lesviza et al., 2024).

In addition, items P3 and P4 recorded high agreement levels, indicating that pupils were able to clearly interpret numerical and textual information as well as understand visual representations presented in Wayground Paper Mode. This suggests that the clarity of content presentation plays an important role in supporting pupils' comprehension and reducing misinterpretation during learning activities. As a result, pupils are more likely to engage actively with learning materials, as clearer presentation reduces barriers to understanding and supports smoother learning processes. These findings are consistent with the studies by (Magadán-Díaz & Rivas-García, 2022) and (Zulkhaeriyah et al., 2024).

Overall, pupils demonstrated positive views towards this method in terms of the clarity of question displays, ease of answering, and its ability to support active pupil engagement in the mathematics learning process. The findings of this study also support Dewanto et al. (2023), who stated that pupils' perceptions towards the use of Wayground Paper Mode are influenced by factors such as ease of use and enjoyment. These elements not only increase pupils' interest but also encourage active participation in mathematics learning activities.

However, several items recorded relatively lower agreement compared to other items. Item P7, which relates to pupils' direct involvement in learning without requiring digital devices, recorded a moderate level of agreement, while item P8, relating to pupils' ability to identify mathematics skills that need improvement through the Wayground Paper Mode report, also showed slightly lower

agreement. This suggests that although most pupils accepted the approach positively, some were still uncertain about the reflective function of the learning reports. This indicates that pupils are more familiar with immediate task completion rather than self-assessment practices, which require higher levels of metacognitive awareness. Therefore, additional guidance is needed to help pupils better understand how learning reports can be used to improve their learning strategies and identify areas for improvement.

Overall, all eight items analysed recorded agreement percentages exceeding 69%. The overall mean value for the perception construct was also at a high level. These findings demonstrate that Year 6 pupils generally have positive perceptions towards the use of Wayground Paper Mode in mathematics learning. The structured and guided nature of the approach helps pupils understand and answer questions more effectively, thereby reducing uncertainty during learning. Consistent with the study by Yeap & Chew (2024), pupils showed positive perceptions towards the use of Wayground as a method that helps them understand and answer questions.

In the context of this study, pupils accepted Wayground Paper Mode as a method that helps them understand and answer mathematics questions more systematically in the classroom. Furthermore, when pupils perceive technological tools as helpful in facilitating learning, their motivation and active engagement tend to increase (Huang et al., 2025). In this sense, the positive perceptions observed in this study imply potential improvements in pupils' learning motivation and classroom participation, highlighting the pedagogical value of integrating such tools into primary mathematics instruction.

In addition, the findings of this study indicate that pupils have positive perceptions towards the use of Wayground Paper Mode, which incorporates gamification elements in mathematics learning. These findings are in line with the studies by Mevia et al. (2024) and Susanto et al. (2025), which reported that the use of gamification elements in mathematics learning is often associated with positive levels of student motivation and engagement. The consistency of these findings with previous studies indicates that gamification-based approaches in mathematics learning are positively accepted by pupils.

### 4.2 Pupils' Attitude towards the Use of Wayground Paper Mode in Mathematics Learning

Table 6 presents the frequency and percentage distribution for the items related to pupils' attitudes towards the use of Wayground Paper Mode in mathematics learning. The overall mean score for pupils' attitudes towards the use of Wayground Paper Mode in mathematics learning was at a high level ($M = 4.07$, $SD = 0.62$).

**Table 6: Frequency and Percentage Distribution of Pupils' Attitude Items**

| No. | Item | Strongly Disagree | Disagree | Uncertain | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| S1 | I like using Wayground Paper Mode in mathematics learning. | 1<br>0.6% | 2<br>1.2% | 28<br>17.3% | 77<br>47.5% | 54<br>33.3% |
| S2 | I enjoy using Wayground Paper Mode in mathematics learning. | 0<br>0.0% | 3<br>1.9% | 22<br>13.6% | 86<br>53.1% | 51<br>31.5% |
| S3 | I feel motivated to learn mathematics when the teacher uses Wayground Paper Mode. | 1<br>0.6% | 8<br>4.9% | 36<br>22.2% | 69<br>42.6% | 48<br>29.6% |
| S4 | I think the use of Wayground Paper Mode in mathematics learning is a good approach. | 3<br>1.9% | 1<br>0.6% | 32<br>19.8% | 70<br>43.2% | 56<br>34.6% |
| | **Overall** | **Mean = 4.07** | | **Standard Deviation = 0.62** | | |

The majority of pupils showed a high level of agreement for all the items presented. The item with the highest percentage of agreement was Item S2, which relates to pupils' enjoyment when using Wayground Paper Mode in mathematics learning. Specifically, 86 pupils (53.1%) agreed, and 51 pupils (31.5%) strongly agreed, resulting in more than 84% of pupils giving positive responses. Wayground Paper Mode creates an enjoyable learning environment through its interactive and game-like features, which reduce monotony and enhance pupil engagement in mathematics lessons.

In addition, Item S4 also recorded a high percentage of agreement, where 43.2% of pupils agreed and 34.6% strongly agreed that the use of Wayground Paper Mode is beneficial in mathematics learning. This suggests that pupils perceive the method as useful in supporting their learning process, particularly in helping them understand and complete mathematics tasks more effectively. For Item S1, which assessed pupils' interest in using Wayground Paper Mode, 77 pupils (47.5%) agreed and 54 pupils (33.3%) strongly agreed, indicating that the majority of pupils tended to accept and favour the use of this approach in mathematics learning.

The findings of the study indicate that pupils' attitudes towards the use of Wayground Paper Mode in mathematics learning were at a high level. These findings are consistent with the studies by Bina et al. (2022), Henukh et al. (2022), and Hernanz et al. (2025). The majority of pupils demonstrated positive attitudes in terms of interest, enjoyment, and motivation when this method was used in mathematics learning. This suggests that gamification-based learning approaches

are capable of creating a more enjoyable, interactive, and less monotonous learning environment compared to conventional methods (Callista & Crystal Tan, 2021). These findings are also aligned with previous studies which reported that gamification-based learning can improve pupils' attitudes towards mathematics by making learning more meaningful and less emotionally burdensome (Alt, 2023; Ukgoda, 2025)

Furthermore, the findings of this study also indicate that pupils displayed positive attitudes throughout the learning process, including maintaining focus and actively participating in the activities planned by the teacher. This can be explained by structured and interactive learning tools can enhance pupils' sense of involvement and confidence during lessons, thereby encouraging sustained participation. Pupils also demonstrated good levels of self-confidence and motivation in mathematics learning. This situation is consistent with previous studies highlighting the importance of positive attitudes in supporting pupils' learning experiences (Nailan & Hodijah, 2025; Susanto et al., 2025). In addition, studies by Susanto et al. (2025) reported that the use of Wayground Paper Mode is associated with positive levels of pupils' interest and motivation in mathematics learning.

Overall, the findings of this study indicate that Wayground Paper Mode is viewed as a supportive tool in mathematics learning that is also associated with more positive learning experiences among pupils. Pupils demonstrated good levels of motivation, interest, and engagement throughout the implementation of learning activities using this method. These findings are consistent with previous studies reporting positive experiences of using Wayground in relation to students' affective aspects (Rivas-García & Magadán-Díaz, 2022). Therefore, the use of this method has the potential to help create mathematics learning experiences that are more enjoyable, meaningful, and effective.

### 4.3 Differences in Pupils' Perceptions and Attitudes Based on Mathematics Achievement Categories

Since the data obtained did not meet the assumption of normality, the Kruskal-Wallis H test was conducted to examine differences in pupils' perceptions and attitudes based on mathematics achievement categories in school examination. The results of the Kruskal-Wallis H test are presented in Table 7.

**Table 7: Results of the Kruskal-Wallis H Test**

| Construct | Mathematics Achievement Category | Mean Rank | Kruskal-Wallis H Value | Significance Value, *p* |
|---|---|---|---|---|
| Perception Level | High | 103.02 | 39.48 | < 0.001 |
| | Moderate | 64.17 | | |
| | Low | 50.43 | | |
| Attitude Level | High | 97.18 | 23.29 | < 0.001 |
| | Moderate | 72.63 | | |
| | Low | 54.58 | | |

The Kruskal-Wallis H test showed that there were significant differences in perception levels, $H(2) = 39.48$, $p < 0.001$, and attitude levels, $H(2) = 23.29$, $p < 0.001$, based on mathematics achievement categories. The significance values for both differences were less than 0.001 ($p < 0.05$). Therefore, a post hoc test was conducted to determine which group mean ranks contributed to the significant differences. Table 8 presents the post hoc pairwise comparisons for differences in pupils' perceptions towards the use of Wayground Paper Mode in mathematics learning.

**Table 8: Post Hoc Pairwise Comparisons for Differences in Pupils' Perceptions**

| Group 1 | Group 2 | Adjusted Significance Value (Adj. Sig.) |
|---|---|---|
| Low | Moderate | 0.596 |
| Low | High | < 0.001 |
| Moderate | High | < 0.001 |

Based on Table 8, the findings indicate that there was no significant difference between pupils in the low and moderate achievement categories ($p = 0.596$, $p > 0.05$). However, there were significant differences between pupils in the low and high achievement categories ($p < 0.001$, $p < 0.05$), as well as between pupils in the moderate and high achievement categories ($p < 0.001$, $p < 0.05$). These results indicate that high-achieving pupils had significantly more positive perceptions towards the use of Wayground Paper Mode in mathematics learning compared to pupils in the low and moderate achievement categories.

**Table 9: Post Hoc Pairwise Comparisons for Differences in Pupils' Attitudes**

| Group 1 | Group 2 | Adjusted Significance Value (Adj. Sig.) |
|---|---|---|
| Low | Moderate | 0.266 |
| Low | High | < 0.001 |
| Moderate | High | 0.016 |

Next, Table 9 presents the results of the post hoc pairwise comparisons for differences in pupils' attitude levels based on mathematics academic achievement categories. The analysis revealed that there was no significant difference between pupils in the low and moderate achievement categories ($p = 0.266$, $p > 0.05$). However, significant differences were found between pupils in the low and high achievement categories ($p < 0.001$, $p < 0.05$), as well as between pupils in the moderate and high achievement categories ($p = 0.016$, $p < 0.05$).

The findings of this study indicate significant differences in pupils' perception and attitude levels based on mathematics achievement categories, with high-achieving pupils demonstrating significantly more positive perceptions and attitudes than their moderate- and low-achieving peers. These findings may also be interpreted through the lens of mathematics self-efficacy theory. Pupils with stronger mathematics self-efficacy are more likely to approach mathematical tasks confidently, persist when facing difficulties, and interpret immediate feedback as

a learning opportunity. In contrast, pupils with lower mathematics self-efficacy may experience greater anxiety and frustration during competitive gamified activities, leading to less favourable perceptions and attitudes (Dela Cruz, 2024; Guntur & Wahyu Purnomo, 2026; Hiller et al., 2022; Shore & Kelleher, 2024). This may partly explain why pupils in the high-achievement category reported more positive perceptions and attitudes toward Wayground Paper Mode than those in the moderate- and low-achievement categories.

One possible explanation is that high-achieving pupils generally possess stronger self-regulated learning and metacognitive abilities, enabling them to recognize the instructional value of immediate feedback, performance reports, and opportunities for self-improvement provided by Wayground Paper Mode (Samnia Hammod & Paz-Baruch, 2024; Sandars, 2020; Xiao & Hu, 2025). Rather than focusing solely on competition outcomes, these pupils may interpret the platform as a learning tool that supports reflection and continuous improvement.

In contrast, pupils in the moderate- and low-achievement categories may evaluate the platform differently. Their questionnaire responses may be influenced not only by the usability of the platform but also by emotional reactions experienced during the learning activity, such as disappointment after incorrect answers or frustration when observing higher-performing classmates on the leaderboard (Nie & Tang, 2025). Consequently, lower ratings may reflect temporary affective responses rather than actual difficulties in using the platform.

This interpretation is consistent with research suggesting that learners with stronger metacognitive and self-regulation skills are more likely to perceive formative feedback positively and use it to guide learning, whereas learners with lower academic achievement may be more sensitive to competitive environments and performance comparisons. Therefore, the observed differences should not be interpreted solely as differences in technology acceptance but also as reflections of varying cognitive and affective responses to gamified learning environments.

## 5. Discussion

The findings of this study offer both theoretical and practical insights into the integration of gamified learning tools in primary school mathematics education. From a theoretical perspective, the study extends the applicability of the Technology Acceptance Model (TAM) within the context of hybrid learning environments at the primary level. While previous research has predominantly applied TAM to fully digital learning systems, the present findings suggest that its core constructs—perceived ease of use, perceived usefulness, and attitudes—remain relevant in evaluating semi-digital or low-device instructional approaches such as Wayground Paper Mode. This indicates that technology acceptance in education should not be limited to fully digital contexts but may also encompass blended learning environments (Lazar et al., 2020).

From a pedagogical perspective, the results indicate that Wayground Paper Mode has potential as a supportive instructional strategy for enhancing pupils' engagement and positive attitudes toward mathematics learning. This aligns with

broader pedagogical shifts toward learner-centred and active learning approaches in 21st-century education. The findings also suggest that the effectiveness of such an approach may be particularly relevant in contexts with limited access to digital infrastructure, where low-device gamified solutions can help mitigate resource constraints while maintaining interactive learning experiences (Mahmud & Law, 2022). The positive responses observed are associated with the developmental characteristics of primary school pupils, as previous research has shown that children at this stage benefit from interactive, structured, and feedback-oriented learning environments (Garvis, 2020). The game-based elements and immediate feedback provided by Wayground Paper Mode may help sustain pupils' attention and enhance their motivation during mathematics lessons.

These features may be particularly beneficial when learning mathematical concepts that students often perceive as challenging or abstract, as the gamified format can promote greater participation and reduce anxiety toward learning tasks. However, differences in academic ability should also be considered. High-achieving pupils may adapt more readily to gamified learning environments (Lavoué et al., 2021), whereas low-achieving pupils may require additional scaffolding and teacher support to fully benefit from the activities (Haruehansawasin & Kiattikomol, 2018). Therefore, the implementation of Wayground Paper Mode should be accompanied by differentiated instructional strategies to address diverse learner needs and ensure meaningful participation for all pupils.

However, the results also highlight the importance of differentiated instructional design. Variations in pupils' perceptions and attitudes across achievement levels suggest that a uniform implementation of gamified learning may not be equally effective for all learners. High-achieving pupils may respond more positively due to their greater confidence and readiness to engage with task-based competition, whereas lower-achieving pupils may require additional scaffolding, structured guidance, and simplified task progression to prevent cognitive overload and disengagement (Rosli et al., 2023). These findings underscore the need for teachers to adapt gamified learning activities according to learners' cognitive and academic needs to ensure equitable learning process.

From a scaffolding perspective, gamification can serve as a supportive learning tool for lower-achieving pupils by providing immediate feedback and helping to sustain motivation throughout the learning process. Immediate feedback enables pupils to identify and correct misconceptions promptly (Razzaq et al., 2020), while continued engagement with learning activities helps strengthen confidence and persistence when solving mathematical problems. These forms of support can facilitate learning participation and reduce barriers commonly experienced by lower-achieving pupils (Kam & Umar, 2023). As a result, gamified learning environments can enhance confidence and encourage more active participation in mathematics learning.

The observed differences in perceptions and attitudes across achievement levels should also be interpreted with caution due to potential cognitive and psychological response mechanisms underlying questionnaire-based self-report data. High-achieving pupils may demonstrate more positive evaluations of Wayground Paper Mode because they are generally more capable of engaging in metacognitive reflection (Cromley & Kunze, 2020; Silver, 2023), enabling them to better recognise the instructional value of feedback features, performance reports, and structured practice activities embedded in the platform. Their higher academic confidence may also contribute to more accurate interpretation of the learning support provided by the system.

In contrast, lower-achieving pupils may not necessarily perceive the system as less usable in an objective sense. Instead, their responses may be influenced by self-report bias and affective reactions, particularly frustration experienced when they perform less well in competitive or leaderboard-based activities. Such emotional responses may temporarily influence their perception of usefulness and ease of use, even though the actual operational usability of the platform remains consistent across groups.

In addition, the competitive structure of gamified environments may introduce achievement-related emotional pressure, particularly among lower-achieving pupils. Leaderboard comparisons and visible performance rankings may unintentionally generate feelings of frustration or reduced self-efficacy when pupils perceive themselves as consistently underperforming (Philpott & Son, 2026). This aligns with the notion that gamification can produce differentiated emotional responses depending on learners' prior achievement levels and resilience in competitive learning contexts. Therefore, the observed group differences should not be interpreted solely as differences in usability perception, but rather as a combination of metacognitive capacity, emotional response, and situational learning experience during the intervention.

In terms of teacher professional development, the findings imply that effective implementation of Wayground Paper Mode requires not only technical familiarity but also pedagogical competence in integrating gamification meaningfully into mathematics instruction. Pre-service teacher education programmes should therefore include early exposure to gamified instructional tools within mathematics pedagogy courses, enabling future teachers to develop both technological and instructional design competencies. For in-service teachers, structured professional development programmes should emphasise pedagogical strategies for using gamification to support formative assessment, differentiated instruction, and learner engagement (Hasin et al., 2022), Such training may enhance teachers' capacity to implement innovative, student-centred mathematics instruction aligned with contemporary educational demands.

At the curriculum level, the findings suggest that digital and gamified learning approaches such as Wayground Paper Mode may be considered as complementary instructional strategies within primary mathematics education. Rather than functioning as an optional add-on, such approaches can be

strategically aligned with curriculum goals that emphasise active learning, problem-solving, and formative feedback. Nevertheless, careful implementation is necessary to ensure that pedagogical integration is context-sensitive and does not inadvertently widen achievement gaps among learners with differing academic abilities.

Overall, this study contributes to the growing body of literature on gamification in mathematics education by demonstrating the relevance of low-device gamified learning environments in shaping pupils' perceptions and attitudes. It also highlights the importance of balancing technological innovation with pedagogical adaptation to ensure inclusive and effective learning experiences across diverse classroom contexts. It is also important to acknowledge the potential influence of the novelty effect on pupils' responses (W. Huang et al., 2021). As Wayground Paper Mode was introduced as a new instructional approach, pupils' positive perceptions and attitudes may partially reflect short-term excitement and increased engagement associated with exposure to a novel learning tool, rather than stable long-term acceptance or sustained behavioural change.

Furthermore, this study relies entirely on self-reported questionnaire data, which may be subject to response bias, including social desirability effects and momentary emotional states. Pupils' responses may reflect their immediate emotional experiences, which may influence their evaluations of the learning platform (My et al., 2026). Future research should complement self-report measures with observational data, performance-based indicators, or system log analytics to provide a more robust understanding of learning effectiveness.

From a theoretical perspective, the differing responses across achievement groups can be explained through the interaction of Technology Acceptance Model (TAM) constructs with learner characteristics such as prior achievement and self-regulated learning ability. While TAM explains acceptance through perceived usefulness and ease of use, these perceptions are not formed in isolation (Khan et al., 2023). Instead, they are shaped by learners' cognitive readiness, prior knowledge, and affective experiences during task engagement. Recent studies have consistently shown that perceived usefulness and perceived ease of use remain strong predictors of students' acceptance of gamified and digital learning tools, particularly in primary and blended learning contexts (Albayati & Singh, 2026; Camilleri & Camilleri, 2019; Li et al., 2024; Othman et al., 2025).

High-achieving pupils are more likely to experience successful task completion, which reinforces perceived usefulness and strengthens positive attitudes. Conversely, lower-achieving pupils may encounter repeated difficulty during problem-solving activities, which can indirectly lower perceived usefulness despite the system being equally accessible. This pattern is consistent with recent empirical studies reporting that learners with higher academic performance or self-efficacy tend to demonstrate stronger technology acceptance due to more positive learning experiences and higher confidence levels (Khan et al., 2023; Navarro et al., 2023; Zhang, 2024; Zheng et al., 2026). This suggests that TAM constructs in educational contexts are partially mediated by academic self-efficacy

and achievement-related emotions (Navarro et al., 2023), which should be considered when interpreting group differences. However, recent research has also highlighted limitations of TAM in educational settings, arguing that it does not fully account for emotional engagement, motivation, and contextual classroom factors that influence technology acceptance (Kemp et al., 2024; Kemp & Palmer, 2025; Rani et al., 2026).

### 5.1 Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings. First, the study relied exclusively on self-reported questionnaire data, which capture pupils' perceptions and attitudes at a single point in time. Such responses may be influenced by temporary emotional states, recent learning experiences, or performance outcomes during the activity rather than stable evaluations of the platform itself. For example, lower-achieving pupils may have reported less favourable perceptions because of frustration associated with lower scores or leaderboard rankings rather than because Wayground Paper Mode was objectively difficult to use.

Second, although significant differences were identified across mathematics achievement categories, the study did not directly measure metacognitive abilities, self-regulated learning strategies, or emotional responses. Consequently, the explanations proposed in this study should be regarded as plausible interpretations rather than causal conclusions.

Finally, the study employed a cross-sectional design involving pupils from a single primary school, limiting the generalisability of the findings across different educational contexts. Future research should adopt longitudinal or mixed-method designs to examine how pupils' perceptions, attitudes, motivation, and technology acceptance evolve over time and whether repeated exposure to Wayground Paper Mode reduces initial frustration among lower-achieving pupils. Incorporating qualitative interviews and measures of metacognition and emotional engagement would also provide a deeper understanding of the mechanisms underlying differences in technology acceptance.

## 6. Conclusion

This study examined Year 6 pupils' perceptions of and attitudes toward the use of Wayground Paper Mode in mathematics learning. The findings indicate generally positive perceptions and attitudes among pupils toward this instructional approach, suggesting that low-device gamified learning environments may support more favourable learning dispositions in primary mathematics classrooms. In addition, the results reveal variations in perceptions and attitudes across different levels of mathematics academic achievement, indicating that learner characteristics may influence the acceptance and effectiveness of gamified instructional strategies.

Overall, Wayground Paper Mode may serve as a viable pedagogical alternative for enhancing engagement and supporting positive learner dispositions in mathematics, particularly when implemented in a structured manner and

adapted to accommodate differences in pupils' academic abilities. The study contributes to the growing body of literature on gamification in mathematics education by extending empirical evidence to low-device, classroom-based contexts and by highlighting the relevance of the Technology Acceptance Model (TAM) in explaining pupils' responses to hybrid learning tools. These findings suggest that the effectiveness of Wayground Paper Mode is context-dependent and influenced by instructional design and learner differences, highlighting the importance of differentiated implementation in classroom practice.

Future research is recommended to expand the scope of investigation by including more diverse samples across different school types and educational levels, as well as employing qualitative and longitudinal designs to gain deeper insights into pupils' learning experiences over time. Further studies may also incorporate teachers' perspectives and examine the long-term impacts of Wayground Paper Mode on pupils' motivation, engagement, and mathematics achievement.

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