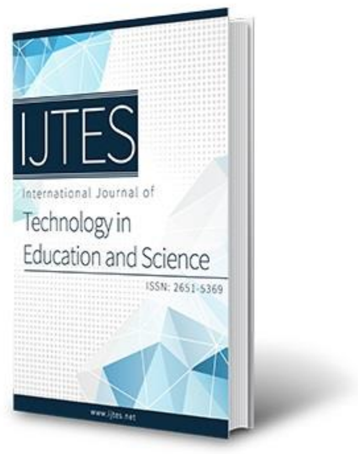

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The Effect of *Matific* Platform on Preschool Students' Academic Performance in Mathematics

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Abstract

This research aimed to examine the effect of the *Matific* platform on preschool students' academic performance in Mathematics in Al Dhafra Region, United Arab Emirates. It also examined the difference between boys' and girls' academic performance after using the *Matific* platform during mathematics learning. An experimental research design with pre- and posttest was conducted over a four-week period. A convenient sampling technique was used to select twenty preschool students in an intact group (11 girls and 9 boys). Data was collected through the Achievement Test instrument using pretests and posttests. Descriptive statistics and paired samples t-tests were used to evaluate differences in pretest and posttest scores among individuals and groups, with further analysis conducted to examine differences between boys' and girls' performance. Findings suggest that there is significant effect of using the *Matific* platform on students' academic performance in Mathematics. However, no statistically significant differences were observed between the performance of boys and girls in utilizing *Matific*.

Introduction

Research indicates that kindergarten students develop foundational mathematical skills through hands-on activities, such as utilizing objects and manipulatives. These studies (Byrne et al., 2023; Furman, 2017; Kinzer, 2016; Laski et al., 2015; Park, 2012) demonstrate a significant enhancement in mathematical proficiency and performance among kindergarten students who engage in such activities. Proficiency in mathematics is a key objective of the Ministry of Education in the United Arab Emirates (UAE), aimed at enhancing students' productivity and academic achievements (Attard, 2016). Amidst the COVID-19 pandemic, educators in the UAE are particularly concerned about a decline in student engagement with mathematics. This disengagement is often attributed to childhood experiences, including the absence of a curriculum tailored to students' learning needs and an overemphasis on traditional drill-and-practice teaching methods. Disengagement can detrimentally impact students' academic performance, widen learning gaps, and constrain future educational opportunities, affecting their ability to make informed decisions and pursue higher education (Mendez et al., 2020).

To address these challenges, the UAE Ministry of Education has significantly invested in Information and Communications Technology (ICT), allocating over 10 billion AED to promote technology integration in schools (Farid, 2021). Many schools in the UAE have adopted innovative teaching methods, leveraging technology and gamification approaches, such as the *Matific* platform, to enhance learning experiences (Al-Johali, 2019). However, several pedagogical limitations persist in the implementation of these technologies. Challenges include educators' limited understanding of technology's relevance to addressing student needs, a lack of organizational culture supporting innovative teaching methods, inadequate technical support, such as teacher training programs for technology integration, and insufficient institutional initiatives to address mathematics learning challenges (Dagyar, Kasalak & Sezgin, 2020). Integrating Information Communication Technologies (ICT) into the learning process necessitates corresponding changes in teaching methodologies, emphasizing interactive learning approaches. Effective instruction in mathematics involves fostering students' ability to interact with mathematical concepts and employ critical thinking skills to solve mathematical problems.

Traditional approaches to teaching mathematics have often been linked with shortcomings such as diminished student engagement in learning activities and the cultivation of negative attitudes towards learning (Bakhmat et al., 2020). One contributing factor to this scenario is the failure of these methods to align with learners' individualized learning needs. Consequently, there is a growing emphasis on teaching strategies that facilitate students' connection of mathematical concepts to real-life contexts and promote unconscious learning. Kindergarten-level instruction should leverage students' prior knowledge and create an instructional environment that complements their experiences outside the classroom, fostering motivation and facilitating future knowledge and skill development (Drijvers, 2020).

National studies indicate suboptimal numeracy skills among students, a trend often attributed to inadequacies in the kindergarten education system in teaching relevant skills necessary for improved academic performance. The average performance of kindergarten students in the UAE at Year 5 is estimated at 29 percent, highlighting significant nationwide challenges (Darragh & Franke, 2021). In the 21st century, traditional learning techniques may not effectively engage children in their studies. Therefore, there is a pressing need for innovative approaches that enhance numeracy skills and foster positive attitudes towards learning, with early childhood being an optimal stage for achieving these goals (Jablonka, 2017). This entails delivering high-quality classroom instruction and providing personalized support for struggling students.

The advent of digital technologies, such as the *Matific* platform, presents opportunities for integration into learning activities. The UAE has pioneered one of the largest e-learning platforms in the Arab World, with the *Matific* platform being among those endorsed by the Ministry of Education for use in public schools, especially during the COVID-19 pandemic (MOE, 2020). Given that most young children engage in various forms of play, including digital games, it stands to reason that leveraging digital learning techniques could enhance their engagement with subjects like mathematics, which might otherwise seem disconnected from their learning needs (Tsatsou, Vretos & Daras, 2019). *Matific* platform constitutes a suite of digital mathematics resources designed to enhance mathematical proficiency through gamified applications. Each "episodes" targets a specific mathematical concept aligned with the curriculum, presenting a sequential set of five questions of escalating difficulty.

With support for over 40 languages, *Matific* offers a diverse range of mathematics activities tailored to students from kindergarten through 6th grade. The platform integrates interactive meta-games, customizable avatars, both independent and collaborative exercises, alongside assessment tools to reinforce learning. Additionally, it assists educators in task management, assessment, and curriculum design by furnishing lesson plans and activity resources. *Matific*'s adaptable curriculum addresses individual student needs and proficiency levels, fostering fundamental mathematical competencies. Through real-time feedback mechanisms, it not only tracks but also enhances student performance, accommodating various learning modalities, including remote education, and promoting self-directed mathematical practice. Consequently, *Matific* exhibits potential in enhancing student motivation and engagement in mathematics, alleviating anxiety, and cultivating essential mathematical skills such as arithmetic, measurement, geometry, and problem-solving.

Research into digital resources tends to focus on the affordances of these programs for mathematics learner cognition and motivation (Reinhold et al., 2019; Robin & Kwak, 2018), or teacher uptake of the resources (e.g. Remillard, 2016; Utterberg et al., 2019). Numerous studies have compared computer games to traditional teaching methods, identifying three primary advantages of digital technologies: increased entertainment value, enhanced student motivation, and improved engagement through a learning environment tailored to individual needs (Wouters & Van Oostendorp, 2013; Giannakos, 2013; Chang et al., 2015; de Lope et al., 2017). This study, however, examines the broader impact of the *Matific* platform on various mathematical competencies. It seeks to explore how gamification can reduce learner anxiety and enhance engagement in mathematics learning. Notably, there is a dearth of research on the *Matific* platform in the Middle East, particularly in the UAE, with preschool students. Therefore, this study aims to address this gap in the literature and contribute to understanding the efficacy of the *Matific* platform at the preschool level in this region.

The study aims to achieve the following objectives:

1) evaluate the impact of the *Matific* platform on the academic performance of preschool students in Mathematics within the Al Dhafra Region.
2) investigate potential disparities in academic performance between male and female students subsequent to utilizing the *Matific* platform during mathematics instruction.

This study aims to address the following research questions:

1. Is there a statistically significant difference in the pre- and posttest of mathematics achievement of preschool students after using *Matific* platform?
2. Is there a statistically significant difference in the pre- and posttest of mathematics achievement of preschool boys and girls after using *Matific* platform?

Null hypotheses:

H_{01}: There is no statistically significant difference in the pre- and posttest of mathematics achievement of preschool students after using *Matific* platform.

H_{02}: There is no statistically significant difference in the pre- and posttest of mathematics achievement of preschool boys and girls after using *Matific* platform.

Theoretical Framework

Piaget's Constructivist Theory

Piaget's Constructivist theory posits that individuals construct knowledge through the interaction between their experiences and ideas. This theory, grounded in Piaget's observations of children, challenges the notion of children as inferior thinkers, and asserts that their cognitive abilities are comparable to adults (Ackermann, 2001). Central to Piaget's theory is the idea that experiences enhance the acquisition of knowledge and meaning. Through the assimilation of new experiences into existing mental frameworks and accommodation, wherein individuals reframe their understanding based on new experiences, new knowledge is constructed (Waite-Stupiansky, 2017). This theory underscores the role of the teacher as a facilitator of learning, providing resources and guidance to help students assimilate new knowledge and adapt their existing understanding. Moreover, Piaget's theory suggests that learning should be student-centered, encouraging individual exploration and discovery rather than passive reception of information (Ackermann, 2001). The relevance of Piaget's constructivist theory to this research lies in its support for interactive learning facilitated by platforms like *Matific* in effectively acquiring new knowledge. *Matific* platform’s approach to teach mathematics through interactive games and activities, aligns closely with Piaget's learning theory, which emphasizes active learning and discovery through hands-on experiences. According to Piaget, children learn best when they are actively involved in the learning process, constructing knowledge through exploration and problem-solving. *Matific*'s approach of engaging students with interactive tasks mirrors Piaget's concept of cognitive development, where learners progress through stages by interacting with their environment, thus facilitating deep understanding and retention of mathematical concepts.

John Dewey's Theory of Learning by Doing

John Dewey's theory of learning by doing emphasizes experiential learning, asserting that individuals learn best through active engagement with their environment (Williams, 2017). According to Dewey, learning occurs through experiences that involve movement, communication, exploration, and individual reflection. While advocating for student autonomy in learning, Dewey also emphasizes the importance of the teacher's role in providing guidance and support. Additionally, Dewey critiques traditional educational theories, such as behaviorism, for oversimplifying the learning process (Roberts, 2012). Instead, he emphasizes the need for learning processes that allow learners to connect new knowledge with prior experiences. This theory aligns with the *Matific* platform's approach, which involves active participation in learning tasks and encourages students to explore and discover mathematical concepts (Sikandar, 2015).

The *Matific* platform, which uses interactive games to teach mathematics, is well-aligned with Dewey's theory, which advocates for experiential education, emphasizing that students learn best through active participation and real-world experiences. *Matific* embodies this principle by providing hands-on, engaging activities that require students to experiment, solve problems, and apply mathematical concepts in dynamic scenarios. This experiential learning approach helps students to better understand and retain knowledge, consistent with Dewey's belief that education should be an active, constructive process.

The Play-Based Approach to Learning

Play-based learning emphasizes active engagement with people, objects, and the environment to promote holistic development and literacy skills (Ackermann, 2001). In play-based learning, students organize, construct, manipulate, explore, create, investigate, pretend, negotiate, and imagine, facilitating their understanding of the world. Teachers play a crucial role in constructing play scenarios, modeling play activities, and guiding students' participation, while allowing freedom and flexibility for individual exploration (Waite-Stupiansky, 2017). Play-based learning is voluntary, enjoyable, and unstructured, fostering emotional satisfaction, exploration, and discovery. This approach is relevant to children's developmental needs, as it enables them to develop a wide range of skills and concepts in a natural and engaging manner (Williams, 2017). The *Matific* platform, with its interactive math games and activities, embodies the Play-Based Approach to Learning, which emphasizes the importance of play in children's education. This approach recognizes that play is a natural and effective way for children to explore, experiment, and understand new concepts. By incorporating playful elements into its math exercises, *Matific* engages students in a manner that makes learning enjoyable and intuitive. This playful interaction not only fosters a positive attitude towards mathematics but also supports cognitive development by allowing children to learn through exploration and imagination.

Engagement in Mathematics

Student engagement in mathematics refers to active involvement and motivation in learning activities, leading to the acquisition of knowledge and skills necessary for academic success (Levin & Wadmany, 2008). Engaged learners demonstrate cognitive, affective, operative, and effective engagement, which positively impact their attitudes towards learning and their use of digital technologies (Kingsley & Grabner-Hagen, 2015). Effective engagement in mathematics is essential for developing problem-solving skills and fostering a positive attitude towards learning. The *Matific* platform significantly enhances engagement in mathematics by utilizing interactive and gamified learning experiences. By transforming traditional math problems into engaging activities and games, *Matific* captures students' interest and motivates them to participate actively in their learning process. This heightened engagement helps to reduce math anxiety and fosters a positive attitude towards the subject, making students more likely to persevere and succeed in their mathematical studies. Through its dynamic and enjoyable approach, *Matific* ensures that students remain interested and invested in learning mathematics.

Skills Needed by preschool students

Preschool students require a range of mathematical skills, including counting, simple addition and subtraction, early geometry, measurement, algebraic thinking, and problem-solving (Almekhlafi & Almeqdadi, 2010). These skills are best developed through hands-on experiences, exploration, and play-based learning activities that allow for active engagement and discovery (Soomro, 2019). Teachers and parents play crucial roles in fostering the development of these skills by providing opportunities for children to practice counting, explore shapes and measurements, and solve problems in everyday contexts (Kupferman & Schocken, 2015). Additionally, encouraging self-directed learning and providing opportunities for brainstorming and creative expression can further enhance students' problem-solving abilities and promote a sense of self-actualization (Mendez et al., 2020).

Technology in Teaching and Learning Mathematics

Shin et al. (2012) investigated the impact of game technology on elementary students' mathematics learning in Michigan, United States, specifically focusing on second graders. Their quasi-experimental study compared the performance of two groups, one using technology-based games and the other using paper-based games. Utilizing variance and covariance analyses, the study revealed that technology-based games significantly enhanced arithmetic skills across all student ability levels. Moreover, increased usage of technology-based games correlated with higher performance levels, underscoring the effectiveness of incorporating such games in learning environments.

A meta-analysis study in Turkey explored the impact of games on mathematics education and academic achievement across various educational levels. Results indicated that the integration of technological games positively influenced mathematics teaching and academic outcomes, surpassing traditional teaching methods. Students exhibited increased engagement, motivation, and performance, with computer-assisted educational games enhancing their understanding of mathematical concepts and fostering positive attitudes toward learning (Turgut & Temur, 2017). Kermani (2017) conducted a study with pre-kindergarten students to assess the effectiveness of mathematics computer games on young children's number sense under different conditions: individual, peer-assisted, and teacher-facilitated. Findings revealed that students' number sense improved significantly when engaged in mathematics computer games with teacher support. This underscores the role of educators as facilitators in leveraging technology for effective learning outcomes.

Miller (2018) investigated the impact of interactive technology, specifically iPads, on kindergarten children's numeracy skills within a play-based learning setting. The findings indicated high student engagement and collaboration facilitated by interactive technology. However, while the study highlighted the importance of creativity and appropriate difficulty levels in enhancing student engagement, it also underscored the need for guided instruction and alignment with curriculum standards to optimize learning outcomes. Choi, Jung, and Baek (2013) explored the potential of the Scratch program in teaching mathematics to students. Their study revealed that Scratch not only stimulated students' creativity, logical thinking, and problem-solving abilities but also fostered positive attitudes toward mathematics learning. This suggests the promising role of technology in enhancing student engagement and learning outcomes in mathematics education (Choi, Jung & Baek, 2013).

Matific **Platform**

Matific is a digital platform providing free math learning services, including games designed for students from kindergarten to grade 6. Structured into episodes, these games allow learners to progress sequentially, with each episode building upon the previous one (Utterberg et al., 2019). This method enables teachers to monitor student progress effectively. Widely utilized in the United States (US) and the United Kingdom (UK), *Matific* is tailored to help students grasp mathematical concepts aligned with their curriculum (Dani, 2017). The introduction of

Matific by the UAE Ministry of Education during the COVID-19 pandemic aimed to support students' mathematics learning in public schools (MOE, 2020). Through *Matific*, teachers can assign tasks to students, track their performance, and provide support, while parents or caregivers can also assist during the learning process.

To effectively utilize *Matific* for learning mathematics at the preschool education level, several key characteristics are needed:

1. *Developmentally Appropriate Content*: Activities should be tailored to preschoolers' cognitive abilities, ensuring they align with their developmental stage. *Matific* should incorporate simple, intuitive tasks that build foundational math skills, such as counting, recognizing shapes, and understanding basic patterns. Research shows that developmentally appropriate practices in early childhood education enhance learning outcomes (Copple & Bredekamp, 2009).
2. *Interactive and Engaging Design*: The platform should offer engaging, hands-on activities that capture young children's attention and make learning fun. Interactive elements, such as colorful visuals, sounds, and immediate feedback, are crucial for maintaining preschoolers' interest and encouraging active participation (Hirsh-Pasek et al., 2009).
3. *Focus on Play-Based Learning*: Incorporating play-based learning strategies is essential, as play is a fundamental way young children learn and develop critical thinking skills. *Matific* should integrate playful scenarios and games that teach math concepts in a natural and enjoyable manner (Ginsburg, Lee, & Boyd, 2008).
4. *User-Friendly Interface*: The platform should have an easy-to-navigate interface that preschoolers can use independently or with minimal assistance. Simple, clear instructions and intuitive controls help young children interact with the content effectively (Moore & Adair, 2016).
5. *Support for Individualized Learning*: *Matific* should offer adaptive learning paths that cater to the varying skill levels and learning paces of preschoolers. Personalized learning experiences ensure that each child can progress at their own pace and receive the appropriate level of challenge (Tomlinson, 2001).
6. *Parental and Educator Involvement*: Providing resources and tools for parents and educators to support and extend learning beyond the platform is beneficial. Collaborative involvement enhances the educational experience and reinforces learning in different contexts (Sheridan, Edwards, Marvin, & Knoche, 2009).

Matific episodes are aligned with curriculum documents and offer both student and teacher versions equipped with diagnostics, analytics, and dashboards, enhancing its versatility for classroom use (Afari et al., 2013). Each learning session spans 5 to 15 minutes and features hands-on activities that enable learners to develop an intuitive understanding of mathematical concepts. The *Matific* platform's approach is characterized as a versatile and customizable learning method based on objects, designed to avoid overwhelming learners with excessive content (Dani, 2017). By incorporating virtual hands-on activities, *Matific* enhances problem-solving skills and technological fluency, providing students with exposure to various technological devices during their learning journey.

Previous studies have demonstrated the effectiveness of *Matific* in enhancing student engagement and understanding of mathematical concepts. An Australian case study found that *Matific* significantly improved students' mathematical understanding and performance, with students reporting increased engagement and enjoyment (Attard, 2016). Similarly, a quasi-experimental study in the United States showed that students using *Matific* exhibited significant improvements in mathematics skills compared to those receiving traditional instruction, irrespective of gender or ethnicity (SEGM, 2017). A case study conducted in Fiji also revealed positive outcomes, indicating improved student engagement, and understanding of mathematical concepts through the use of *Matific* (Prasad, 2018).

While the effects of *Matific* on teaching were predominantly positive, some challenges were identified, including teachers' unfamiliarity with certain features of the platform (Berger-Tikochinski, Manny-Ikan & Marmo, 2016). Despite these challenges, *Matific* was found to enhance the pace of teaching and the quality of instructional materials, highlighting its potential as a valuable tool for mathematics education.

Method

Research Design

In this study, an experimental research design was employed to investigate the impact of the *Matific* platform on preschool students' academic performance in Mathematics within the Al Dhafra Region of the UAE. This experimental design incorporated pre-test and post-test procedures utilizing Achievement tests.

Sample and Sampling Technique

A convenient sampling technique in an intact group was used to select twenty preschool students from an already assembled preschool class in a kindergarten in the Al Dhafra region, UAE. The group (N=20) comprised eleven girls and nine boys, with ages ranging between four and five years. This method leverages the natural composition of the group, which is easily accessible and minimizes logistical challenges.

Instrumentation

Achievement Test

The researcher developed and administered an Achievement Test to assess students' academic performance in Mathematics before and after using the *Matific* platform (see Appendix). The test consisted of mathematics questions covering various skills such as counting, addition, subtraction, measurement and data, geometry, and problem-solving. Indicators used to assess early mathematical skills and concepts in the *Matific* test include:

1. *Number Recognition and Counting*: identifying numbers and counting objects, understanding the sequence of numbers and basic counting principles.
2. *Basic Arithmetic*: simple addition and subtraction, comprehending the concepts of more, less, and equal.
3. *Pattern Recognition*: identifying and creating patterns, understanding sequences and logical ordering.
4. *Spatial Awareness*: recognizing shapes and their properties.
5. *Measurement Concepts*: basic understanding of length, weight, and volume, comparing sizes and

quantities.

6. *Problem-Solving Skills*: applying logical thinking to solve simple puzzles and problems, understanding cause and effect relationships.

The test comprised 10 questions, with some items requiring students to demonstrate their work. The individual activity in the test typically takes between 5 to 10 minutes to complete. The overall test duration usually lasts between 20 to 30 minutes. In question number 4, researchers transcribed student answers as the preschool students had not been introduced to writing sentences yet. Following the pre-test, students were instructed on how to utilize the *Matific* platform, allowing them time to engage with the platform, practice mathematical concepts, and interact with activities. This approach aimed to enhance learning opportunities and minimize potential challenges.

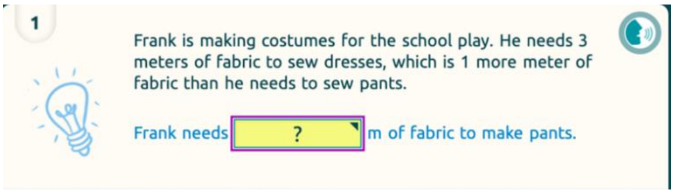

Figure 1. Sample addition and subtraction item

Figure 2. Sample identifying shapes item

Figure 3. Sample addition and subtraction item

Validity and Reliability

To ensure the fidelity of the study, rigorous measures were undertaken concerning validity and reliability. The

Achievement Test, serving as the primary research instrument, underwent a thorough validation process. Two university professors, both specializing in mathematics, were involved as primary validators to ensure the accuracy and clarity of the test questions. Their expertise in mathematical education and assessment was crucial for validating both the content and the language of the test. In addition to the university professors, expert teachers in mathematics were consulted to further validate the test's content from a practical teaching perspective. This multi-faceted approach ensured that the test was not only theoretically sound but also applicable in real-world educational settings.

A pilot test was also conducted, involving five voluntary students from different sections of preschool. This step was essential for assessing the test's reliability and identifying any necessary adjustments. Based on the feedback from the pilot test, modifications were made to enhance both the validity and reliability of the study.

Data Collection Procedure

The study employed an experimental design, with data collection facilitated through pretests and posttests utilizing the Achievement Test. Participants were purposively selected from the student population, and they were trained to understand the study's objectives and how to utilize the *Matific* platform for learning mathematics. Continuous guidance was provided to ensure participants' adherence to study guidelines throughout the longitudinal four-week study period. Pretests were administered to assess students' baseline mathematics proficiency before introducing the *Matific* platform. Following three weeks of mathematics instruction using the *Matific* platform, posttests were administered, and scores were recorded for analysis.

Results

Difference in the Pre- and Posttest of Mathematics Achievement of preschool Students after Using *Matific* Platform

Descriptive Statistics

The minimum scores on the pretest and posttest were 12 and 16, respectively. This increase in the minimum scores from pretest to posttest indicates improvement. The maximum scores for both the pre and posttests were 30. The mean achievement test score for the pretest was 21.15, while for the posttest, it was 24.60 ($t = <.001$). The standard deviation for the pretest scores was 5.207, and for the posttest scores, it was 4.096 (Table 1). These standard deviation values suggest that as students' performance improved in the posttest, their scores clustered closer to the mean. Conversely, during the pretest, students' performance was comparatively lower, with scores further dispersed from the mean, as indicated by the standard deviation values.

Table 1. Descriptive Statistics of Pre- and Posttests Achievement Scores

		Boys	Girls			
	N	Minimum	Maximum	Mean	Std. Deviation	Std. Error Mean
Pretest	20	12	30	21.15	5.207	1.164
Posttest	20	16	30	24.60	4.096	.916

Paired Samples t-test

A paired samples t-test was conducted to assess the statistical significance between the pre and posttest scores of the mathematics achievement test, addressing the first research question: "Is there a statistically significant difference in the pre- and posttest of mathematics achievement of preschool students after using the *Matific* platform?"

Table 2. Paired Samples Test of the Pre- and Posttest Scores

Paired Samples Test									
	Paired Differences					t	df	Significance	
				95% Confidence Interval of the difference					
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			One-Sided p	Two-Sided p
Pretest-Posttest	-3.450	2.230	.499	-4.493	-2.407	-6.920	19	<.001	<.001

As illustrated in Table 2, the results indicated a significant difference between the pretest scores obtained through traditional mathematics teaching methods ($M = 21.15$, $SD = 5.207$) and the posttest scores after implementing the *Matific* platform in teaching and learning mathematics ($M = 24.60$, $SD = 4.096$); $t(19) = -6.920$, $p < .001$. The p-value (<0.05) indicates that the true significance level is smaller than the assumed significance level, confirming a statistically significant difference between the pre and posttest scores. The results of the paired samples t-test suggest a significant improvement in scores from the pretest to the posttest. The mean difference of -3.450, with a 95% confidence interval ranging from -4.493 to -2.407, and a highly significant p-value (< 0.001) collectively indicate that the intervention (*Matific* platform) had a substantial positive effect on the participants' performance. These findings support the hypothesis that there was a meaningful change in scores due to the intervention, reinforcing the effectiveness of the *Matific* platform.

Overall, the results indicate that the academic performance of students in the posttest, that utilized the *Matific* platform, exhibited significantly higher scores than those in the pretest conducted using traditional mathematics teaching methods. This suggests a positive association between the use of the *Matific* platform and enhanced academic performance in mathematics.

Difference in Academic Performance between Boys and Girls Utilizing the Matific Platform

The paired samples t-test was also used to assess the statistical significance between the pre and posttest scores between boys and girls. As illustrated in Table 3, girls showed an increase in mean scores from 21.86 in the pretest to 25.36 in the posttest. The standard deviation decreased from 5.297 to 3.906, suggesting that the scores became more consistent after the intervention. Boys also demonstrated an increase in mean scores from 20.28 in the pretest to 23.67 in the posttest. The standard deviation slightly decreased from 5.268 to 4.359, indicating a minor reduction in score variability post-intervention. The overall mean scores increased from 21.15 in the pretest to 24.60 in the posttest, indicating a positive impact of the intervention on the entire group. The standard deviation decreased from 5.207 to 4.096, showing a general improvement in score consistency across the participants.

Table 3. Mean and Standard Deviation of the pre- and posttest scores

Gender		Pretest	Posttest
Girls	Mean	21.86	25.36
	N	11	11
	Std. Deviation	5.297	3.906
Boys	Mean	20.28	23.67
	N	9	9
	Std. Deviation	5.268	4.359
Total	Mean	21.15	24.60
	N	20	20
	Std. Deviation	5.207	4.096

Both girls and boys showed improvements in their mean scores from pretest to posttest. The increase in mean scores suggests that the educational intervention was effective for both genders. In the pretest the p-value (0.514) is greater than the common alpha level of 0.05, indicating that there is no significant difference between the pretest scores of boys and girls. In the posttest the p-value (0.379) is also greater than the common alpha level of 0.05, indicating that there is no significant difference between the posttest scores of boys and girls.

Although both girls and boys improved, girls had slightly higher mean scores in both pretest and posttest compared to boys. The standard deviations were also lower for girls in the posttest, indicating more consistent performance among girls compared to boys. The data indicates that the intervention led to an improvement in mathematical performance for both boys and girls. Overall, girls have slightly higher mean scores on both pretest and posttest, but the differences are not statistically significant. Since the p-value > α, H_0 cannot be rejected and therefore suggests that there were no significant differences between the pretest and posttest of both girls' and boys' performances.

Discussion and Conclusion

This study examined the impact of the *Matific* platform on pre- and posttest mathematics achievement among preschool students, revealing a statistically significant improvement. Consequently, H_{01} is rejected, indicating a positive influence of the *Matific* platform on preschool students' mathematical proficiency compared to their pre- and posttest scores. Existing research, including studies by Attard (2016), Kermani (2017), SEGM (2017), and Prasad (2018), consistently supports the platform's efficacy in enhancing students' mathematical comprehension and performance. *Matific* achieves this through interactive computer games, immediate feedback, and rewards, as noted by Attard (2016), who reported a 34% increase in overall school performance attributed to *Matific*.

The *Matific* platform's varied and interactive activities have been shown to significantly improve mathematical performance among preschool students. By providing engaging, collaborative, and supportive learning experiences, *Matific* helps students develop essential mathematical skills and reduces anxiety associated with learning mathematics. The findings align with existing research, highlighting the platform's effectiveness and its potential to prepare students for future educational and leadership roles.

The interactive and gamified nature of activities in *Matific* platform help maintain student engagement and motivation. Research has shown that gamified learning environments significantly enhance student engagement and learning outcomes (Plass et al., 2015; Clark et al., 2016). *Matific* contributes significantly to fostering student engagement, collaboration, and the acquisition of essential mathematical skills through its design and implementation:

- The gamified nature of *Matific* activities makes learning fun and engaging, increasing student motivation. Immediate feedback and rewards keep students motivated and help reinforce learning.
- Many activities on *Matific* encourage collaborative learning, where students can work together to solve problems and complete tasks. This collaborative aspect fosters teamwork and communication skills.
- *Matific* activities cover a broad range of mathematical skills, from basic arithmetic to problem-solving and spatial awareness. The varied and interactive tasks ensure that students gain a comprehensive understanding of different mathematical concepts.
- The interactive and supportive environment provided by *Matific* helps reduce anxiety associated with learning mathematics. By offering immediate feedback and positive reinforcement, *Matific* helps build students' confidence in their mathematical abilities.

The study found no statistically significant difference in pre- and posttest mathematics achievement between boys and girls using *Matific*, though girls' performance slightly exceeded that of boys. Therefore, H_{02} fails to be rejected. Notably, girls' performance slightly exceeded that of boys, possibly influenced by their higher participation in the study. This finding aligns with research by SEGM (2017), indicating that gender and ethnicity do not significantly impact student performance when using *Matific*. This could be due to several factors:

- Girls might engage more thoroughly with collaborative and communicative activities available on *Matific*, which can lead to better performance. Activities that require discussion and teamwork, which are often preferred by girls, might contribute to their slightly higher performance.
- Different learning styles and preferences between boys and girls can influence their engagement and performance. Girls may benefit more from the interactive and structured nature of *Matific* activities, which align with their learning preferences (Cimpian et al., 2016).
- The immediate feedback and positive reinforcement provided by *Matific* can help reduce math anxiety, which is often higher in girls. This reduction in anxiety can lead to better performance and more consistent scores (Ganley & Lubienski, 2016).

The COVID-19 pandemic accelerated the integration of technology across sectors, including education, with the UAE demonstrating notable efforts in sustaining educational operations. The Ministry of Education's support and provision of technological resources enabled institutions to adapt and provide quality education. Through platforms like *Matific* and ALEKS, the UAE government promotes numeracy skills through technology-enabled, play-based learning environments from kindergarten onwards. *Matific* fosters student engagement, collaboration, and the acquisition of essential mathematical skills through:

1. *Engaging Learning Experience*: *Matific* transforms traditional math lessons into engaging, interactive activities that captivate young learners. By presenting mathematical concepts through games and challenges, it helps maintain students' interest and enthusiasm for the subject.

2. *Personalized Learning*: The platform adapts to each student's individual learning pace and style. This personalized approach ensures that all students, regardless of their starting point, can progress effectively and build a strong foundation in numeracy.

3. *Promotes Critical Thinking and Problem-Solving*: *Matific*'s activities are designed to encourage critical thinking and problem-solving skills. Students are not just memorizing formulas but understanding underlying concepts, which prepares them for complex mathematical tasks and real-life problem-solving situations.

4. *Collaborative Learning Opportunities*: The platform includes features that promote collaboration among students. Group activities and challenges foster teamwork and communication skills, essential for future leadership roles.

5. *Teacher Support and Analytics*: *Matific* provides teachers with detailed analytics and insights into students' progress. This data helps educators identify areas where students might be struggling and tailor their instruction accordingly, ensuring that no student is left behind.

6. *Aligned with Curriculum Standards*: *Matific*'s content is aligned with various international curriculum standards, including those in the UAE. This alignment ensures that students are acquiring skills that are relevant and necessary for their academic progression and future careers.

The significance of this study lies in its investigation of the effectiveness of the *Matific* platform on preschool students' academic performance in Mathematics in the Al Dhafra Region, a relatively under-researched area in the United Arab Emirates. Notably, it is the first study to examine the *Matific* platform in the Middle East, particularly in the UAE with preschool students, thereby addressing a significant gap in the literature. This research aligns with the UAE's vision of integrating technology in education, offering innovative methods over traditional techniques to engage young learners.

The study highlights the advantages of the *Matific* platform in developing mathematical skills from an early age, reducing anxiety, and increasing engagement through technological gamification. Higher engagement levels are correlated with better understanding of mathematical concepts. Moreover, this research is distinctive as it examines the platform's impact on various mathematical skills, unlike other studies that focused on a single skill. By empowering teachers and leveraging technology, this study supports the educational agenda of the UAE, ensuring that young students receive an engaging and effective mathematical education.

Recommendations

Based on the findings of this research, it is recommended that future studies expand beyond the Al Dhafra region and kindergarten level to include various regions and grade levels in the UAE for more generalizable results. Increasing the sample size and using control and treatment groups would enhance data accuracy, validity, and reliability. Extending the research duration beyond the initial four weeks, ideally over the first semester, would allow students more time to engage with the *Matific* platform. Additionally, further studies should explore other factors such as student engagement, attitudes, and mathematical skills, and compare the effects of the platform between experimental and control groups. Investigating other mathematical platforms used in the UAE could provide insights into their benefits and potential implementation based on student needs. Lastly, employing diverse research instruments like surveys to gauge teachers' and students' perceptions, as well as parental roles, would offer a more comprehensive understanding of the platform's impact.

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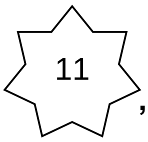
Appendix. Achievement Test

KG2 Mathematics Achievement Test

Question 1

What comes before the number in the star?

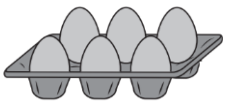
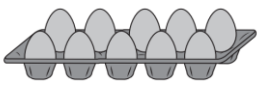
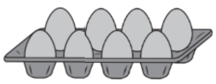
What comes after the number in the star?

__________ , 

, __________ , __________

Question 2

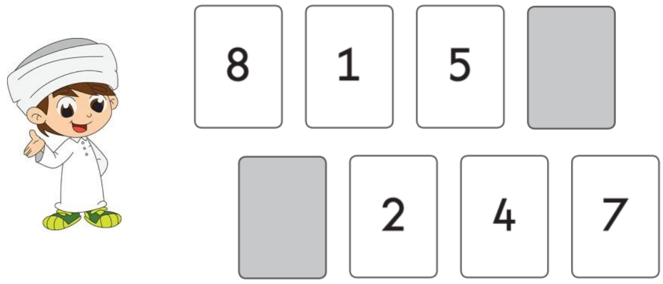
Match each egg box to the correct number of eggs in each box.

	10
	10 - 2
	3 + 3

Question 3

Hamdan has cards that are numbered 1 to 8

Hamdan turns over two of the cards.



Which two cards have Hamdan turned over?

Write the numbers on the cards below

Question 4

Write a story about this number sentence.

3 + 2 = 5

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Question 5

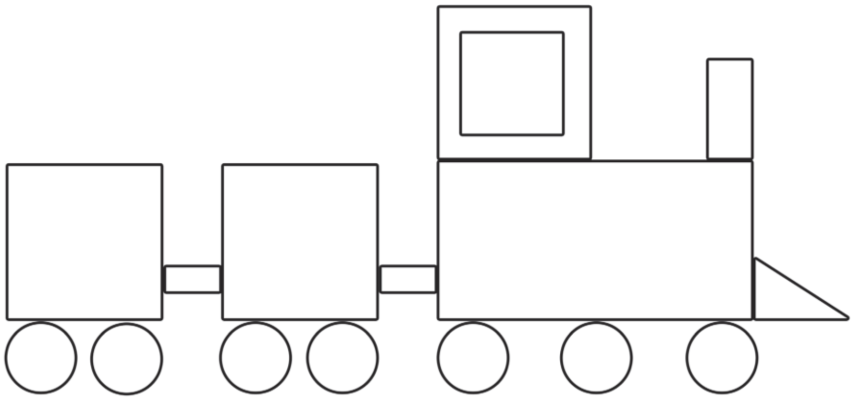
Noora has **6** dirhams.

Her brother Omar has **1** dirham.

How many dirhams are **altogether**?

dirhams

Question 6

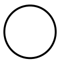


- ☐ Color the **circles** that you see in **blue**
- ☐ Color the **triangles** that you see in **orange**
- ☐ Color the **rectangles** that you see in **red**
- ☐ Color the **squares** that you see in **green**

Question 7

Draw a pattern.

Use 2 triangles 

Use 4 circles 

A **B** **C** **D**

Put the four buildings in order from the **tallest** to **shortest**

tallest **shortest**

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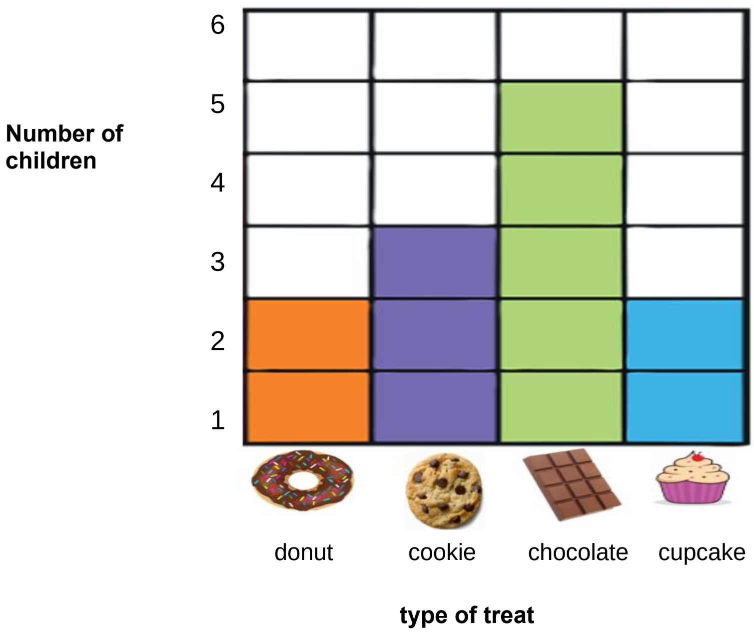
Question 9

The graph shows what class 2-A favorite treats.



What is the **most** favorite treat?

Question 10

Which is the biggest number?

23 32 30