

INVESTIGATING THE ATTITUDE TOWARDS
LEARNING MATHEMATICS AND TECHNOLOGY
INTEGRATION USING EDUCATIONAL GAME APPS
AMONG PRIMARY SCHOOL STUDENTS:
IMPLICATIONS ON STUDENT ACHIEVEMENT

BY

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ABSTRACT

This research explored 3rd graders' attitude towards learning mathematics and technology integration with the implication of their performance through an educational mobile game app. The study is a sequential explanatory mixed-method that combined quantitative and qualitative data to explain the issues at hand. Four research questions were employed to guide the study. In the quantitative stage, four pre-test/post-test sets were administered to the sample from the national primary school in Malaysia (N = 32). A set of questionnaires were also given to the sample at the end of the intervention. The qualitative phase involved a series of interviews with the selected teachers as its participant (N = 3). Three statistical analyses, namely the Wilcoxon-signed rank test, descriptive analysis, and spearman's coefficient correlation, were administered to the quantitative data. Additionally, the thematic analysis was administered on the qualitative data gathered. The main findings were: (a) The implementation of educational mobile game apps in the classroom can enhance student performance and interest in learning mathematics; (b) There is a moderate positive relationship between students' attitude towards technology and their attitude towards learning mathematics; (c) Solid basis in the fundamental arithmetic operations: adding, and subtracting, were found to be essential for effective adoption of educational mobile game apps; (d) Guidance on the correct use of technology should be exposed to student from an earlier age. This study also expanded on the theoretical and methodological implications of using educational mobile game app among the students at the primary level. Much more in-depth study on the effective use of technology in 3rd graders' classrooms should be conducted in the future.

خلاصة البحث

تستكشف هذه الدراسة موقف تلاميذ الصف الثالث الابتدائي تجاه عملية تعلم مادة الرياضيات لدى دمجها بالتكنولوجيا، وذلك عن طريق الوقوف على أدائهم في عملية التعلم تلك، من خلال تطبيق ألعاب تعليمي على الهاتف الذكي. تتبع هذه الدراسة نسقاً مختلطاً تفسيريّاً متسلسلاً يجمع بين البيانات الكمية والنوعية، من أجل تناول القضية المطروحة بالبحث. تم توظيف أربعة أسئلة بحثية لتوجيه الدراسة. في المرحلة الكمية، تم إعطاء أربع مجموعات من الاختبارات القبليّة والبعديّة لأفراد العينة المكونة من 32 تلميذاً من المدرسة الابتدائية الوطنية في ماليزيا. كما تم كذلك إعطاؤهم استبياناً في نهاية تلك المرحلة. أما المرحلة النوعية فتضمنت سلسلة من المقابلات التي تم إجراؤها مع ثلاثة معلمين. تم إجراء ثلاثة تحليلات إحصائية للبيانات الكمية، وهي اختبار ويلكوكسون لإشارات الرُّتب، والتحليل الوصفي، وأخيراً معامل ارتباط سبيرمان. وعلاوة على ذلك، تم تحليل البيانات النوعية التي تم جمعها، عن طريق إجراء التحليل الموضوعي. وكانت النتائج الرئيسية كما يلي: (أ) يمكن أن يؤدي توظيف تطبيقات الألعاب التعليمية الذكية في الفصل الدراسي، إلى تعزيز أداء التلاميذ واهتمامهم بتعلم مادة الرياضيات. (ب) هناك علاقة إيجابية معتدلة بين موقف التلاميذ تجاه التكنولوجيا، وموقفهم تجاه تعلم مادة الرياضيات. (ج) تم التوصل إلى أساس متين فيما يخص بعض العمليات الحسائية الأساسية: حيث وُجد أن عمليّتي الجمع والطرح جوهريتان لضمان فاعلية تَبْنِيّ تطبيقات الألعاب التعليمية على الهاتف الذكي في عملية التعلم. (د) من الأهمية بمكان تقديم إرشادات للتلاميذ في سن مبكرة، حول الاستخدام الصحيح للتكنولوجيا. لقد تطرقت هذه الدراسة أيضاً إلى تناول الآثار النظرية والمنهجية الناجمة عن استخدام تطبيقات الألعاب التعليمية الهاتفية بين تلاميذ المرحلة الابتدائية. توصي الباحثة بإجراء المزيد من الدراسات المستقبلية المتعمقة حول الاستخدام الفعال للتكنولوجيا في فصول الصف الثالث الابتدائي.

APPROVAL PAGE

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DECLARATION

I hereby declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at the IIUM or other institutions.

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This thesis is dedicated to my precious family:

My beloved father and mother

My brothers

&

My friends

Hj. Mohd Hashim Bin Abd Wahab

Hjh. Rohani Binti Ahmad

Mohammad Izzul Hazim Bin Mohd Hashim

Muhammad Haziq Bin Mohd Hashim

Muhammad Hakim Bin Mohd Hashim

&

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Who gives me strength,

Who provide unswerving supports and doa'

Your heartiness, love, and understanding are irreplaceable.

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TABLE OF CONTENTS

Abstract	ii
Abstract in Arabic	iii
Approval Page.....	iv
Declaration	v
Copyright Page.....	vi
Dedication	vii
Acknowledgments.....	viii
List of Tables	xiii
List of Figures	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Background of Study	1
1.2 Problem Statement.....	6
1.3 Proposed Research Model	9
1.4 Purposes of the Study	13
1.5 Research Hypotheses	15
1.6 Significance of the Study.....	16
1.7 Limitation and Delimitation of the Study.....	17
1.7.1 Limitation.....	17
1.7.2 Delimitation	18
1.8 Operational Definition.....	19
1.9 Chapter Summary	21
CHAPTER TWO: LITERATURE REVIEW.....	23
2.1 Introduction.....	23
2.2 Mathematics and Young Learners: Issues and Trends	23
2.5 How Young Learners’s Attitude and Perception Towards Mathematics Influence their Achievement	29
2.6 How Technology Could Be Used to Address the Mathematics Learning Difficulties.....	32
2.7 Hypotheses Development and Theoretical Framework.....	37
2.7.1 Task-Technology Fit model (TTF)	38
2.7.2 ABC Model of Attitude.....	40
2.7.3 Hypotheses development	41
2.7.3.1 Educational mobile game apps and its implication on student achievement	41
2.7.3.2 The relationship between attitude towards learning and technology integration.....	44
2.8 Chapter Summary	48
CHAPTER THREE: METHODOLOGY.....	49
3.1 Introduction.....	49
3.2 Research Design	49
3.2.1 Setting	51
3.2.2 Sampling	52

3.2.3	Sample size.....	53
3.2.4	Semi-structured interview’s participant	54
3.3	Data Collection Procedure	54
3.3.1	Pre-experimental, repeated measures, one-group pre-test-post-test.....	55
3.3.2	Questionnaire	59
3.3.3	Semi-structured interview	59
3.4	Preliminary Analysis	60
3.4.1	Student Characteristic	60
3.4.2	Topics to be tested and questions’ format.....	61
3.4.3	App selection for intervention.....	63
3.4.3.1	Evaluation rubric for assessing instructional app (Lee & Sloan, 2015).....	65
3.5	Instrumentation	71
3.5.1	Establishment of the Questionnaire	71
3.5.1.1	Questionnaire constructs.....	72
3.5.1.2	The adapted version of the questionnaire for the current study	74
3.5.2	Establishment of Semi-structured Interview.....	77
3.6	Ethical Consideration.....	79
3.6.1	Trustworthiness of Interview Data.....	80
3.7	Validation	82
3.7.1	Validation on Pre-test/Post-test.....	82
3.7.1.1	Content Validity	82
3.7.2	Validation on Questionnaire	82
3.7.2.1	Content Validity	82
3.7.2.2	Face Validity.....	82
3.7.2.3	Pilot testing.....	83
3.7.3	Internal Validity in Research	83
3.7.4	External Validity in Research	85
3.8	Data Analysis Procedure	85
3.8.1	Pre-test/Post-test Data	86
3.8.1.1	Wilcoxon signed-ranked test	86
3.8.1.2	Test of Assumption.....	86
3.8.2	Questionnaire Item Management	88
3.8.2.1	Collapsing the 10-points Likert scale into a 5-points Likert scale	88
3.8.2.2	Recoding negative item	89
3.8.2.3	Descriptive Analysis.....	89
3.8.2.4	Spearman Correlation coefficient.....	90
3.8.3	Semi-structured interview data	90
3.8.3.1	Thematic Analysis for Semi-Structured Interview	90
3.8.3.2	Inter-rater Reliability	92
3.9	Chapter Summary	95

CHAPTER FOUR: RESULT AND ANALYSIS 96

4.1	Introduction.....	96
4.2	Demographic Information	97
4.2.1	Pre-test/post-test and Questionnaire respondents	97

4.2.2	Semi-Structured Interview’s participants.....	98
4.3	The Use of Educational Mobile Game Apps in facilitating Mathematics Learning among 3rd Graders	99
4.3.1	Homogeneity of Variance	100
4.3.2	Analysis on Session 1 of Educational Game Intervention.	101
4.3.3	Analysis on Session 2 of Educational Game Intervention	104
4.3.4	Analysis on Session 3 of Educational Game Intervention	109
4.3.5	Analysis on Session 4 of Educational Game Intervention	112
4.3.6	Analysis of the overall result of the One Group Pre-test/Post-test Experimentation Design	115
4.4	Trend in 3rd Graders Attitudes towards Learning Mathematics	120
4.5	Trend in 3rd Graders Attitudes towards Technology Integration.....	123
4.6	Relationship between 3 rd Graders Learning Attitude towards Technology Integration	126
4.7	The Effect of Educational Mobile Game Apps towards Students’ Mathematics Achievement: From the View of the Educators	127
4.7.1	Constructive ground for the student to interact positively with mathematics	128
4.7.2	The importance of solid mathematics skills.....	129
4.7.3	Lack of resources and expertise	130
4.7.4	Technology integration in the Classroom	131
4.7.5	The interview data in response to the Research Question.....	133
4.8	Chapter Summary	135
CHAPTER FIVE: DISCUSSION AND CONCLUSION.....		137
5.1	Introduction.....	137
5.2	Discussion.....	138
5.2.1	Research Question 1: The use of educational mobile game apps in facilitating 3 rd graders’ mathematics achievement	139
5.2.2	Research Question 2: Students’ attitude trend towards learning mathematics	142
5.2.3	Research Question 3: Trend of attitude towards technology integration	144
5.2.4	Research Question 4: The relationship between attitude towards learning and technology integration	145
5.3	Addressing the threat to the validity	147
5.4	Implications of the Study	149
5.4.1	Practical Implication	149
5.4.2	Theoretical Implication	150
5.4.3	Contribution to Methodology.....	152
5.4.4	Changes in policies	152
5.5	Recommendations.....	153
5.6	Conclusion	154
REFERENCES.....		156
APPENDIX A: EXPERIMENTAL SCHEDULE.....		174
APPENDIX B: APPROVAL LETTERS		175
APPENDIX C: CONSENT FORM FROM SCHOOL.....		179

APPENDIX D: CONSENT FORM FOR PARTICIPANT (INTERVIEW)	180
APPENDIX E: QUESTIONNAIRE	182
APPENDIX F: INTER-RATER DOCUMENTS	184
APPENDIX G: DETAILS DISTRIBUTION ON THE AGREEMENT PERCENTAGE (STUDENT ATTITUDE)	195
APPENDIX H: DETAILS DISTRIBUTION ON THE AGREEMENT PERCENTAGE (TECHNOLOGY PERCEPTION).....	197
APPENDIX I: QUALITATIVE DATA	198

LIST OF TABLES

Table 3.1	Distribution of samples based on schools	53
Table 3.2	Pre-test and Post-test topic and number of questions	62
Table 3.3	Basic description of several apps available online	64
Table 3.4	Students' attitude towards technology integration	75
Table 3.5	Students' attitude towards learning and mathematics	76
Table 3.6	Interview Protocol	79
Table 3.7	Matrix of the data analysis procedure	93
Table 4.1	Respondent' Demographic Background	97
Table 4.2	Participants' Demographic Background	98
Table 4.3	Levene Test for Homogeneity of Variance	100
Table 4.4	Session 1 of Educational Game Intervention [Positive Intervention]	102
Table 4.5	Session 1 of Educational Game Intervention [Negative Intervention]	103
Table 4.6	Session 1 of Educational Game Intervention [Neutral Intervention]	104
Table 4.7	Session 2 of Educational Game Intervention [Positive Intervention]	105
Table 4.8	Session 2 of Educational Game intervention [Negative Intervention]	106
Table 4.9	Session 2 of Educational Game Intervention [Neutral Intervention]	107
Table 4.10	Session 3 of Educational Game Intervention [Positive Intervention]	109
Table 4.11	Session 3 of Educational Game Intervention [Negative Intervention]	110
Table 4.12	Session 3 of Educational Game Intervention [Neutral Intervention]	111
Table 4.13	Session 4 of Educational Game Intervention [Positive Intervention]	112
Table 4.14	Session 4 of Educational Game intervention [Negative Intervention]	113
Table 4.15	Session 4 of Educational Game Intervention [Neutral Intervention]	114
Table 4.16	Overall Analysis of the Intervention according to each Session	115
Table: 4.17	Wilcoxon Signed Rank Test for Total Score	118

Table 4.18	The Wilcoxon Signed-Rank Analysis on the duration of time to complete the task	119
Table 4.19	Wilcoxon Signed-Rank on number of questions answered	119
Table 4.20	Mean, Standard deviation, and percentage of agreement on the attitudes towards learning (N=32)	122
Table 4.21	Mean, Standard deviation and percentage of agreement of Technology Integration attitudes construct (N=32)	125
Table 4.22	Spearman Coefficient Correlation	127
Table 4.23	Themes and subthemes gathered from coding	128

LIST OF FIGURES

Figure 1.1	Task Technology Fit Model (Godhue & Thomson, 1995, p. 220)	10
Figure 1.2	Technology Acceptance Model (Davis, 1989)	11
Figure 1.3	Proposed Conceptual Framework on students' attitude towards learning mathematics and technology integration using educational mobile game apps among primary school student with the implication on their achievement	13
Figure 2.1	Breaking apart [place value] technique	26
Figure 2.2	Breaking apart [the second number only] technique	26
Figure 2.3	Transformation technique	27
Figure 2.4	Technology Acceptance Model (Davis, 1989)	41
Figure 2.5	Proposed framework on students' attitude towards learning mathematics and technology integration using educational mobile game apps among primary school student with the implication on their achievement	47
Figure 3.1	Current study Sequential Explanatory Mixed-Method Design (Creswell, 2013)	51
Figure 3.2	The procedure of getting permission to carry out the experiment	55
Figure 3.3	The experimentation process	58
Figure 3.4	Data collection procedure based on Creswell (2012, p. 220)	60
Figure 3.5	Differences between Mathematical Sentence and Standard Written Method	63
Figure 3.6	Rigorness of the learning task	66
Figure 3.7	Selection of single operation mathematics problem	67
Figure 3.8	Feedback on the wrong answer	68
Figure 3.9	Feedback to teacher	69
Figure 3.10	Diverse choice of questions and level	70
Figure 3.11	Development of the instrument	71
Figure 3.12	10 Likert-scale of Emoticons	73

Figure 3.14 Collapsing of the Likert scale	89
Figure 3.15 Braun & Clarke (2006) Six Phase Framework for Thematic Analysis (pp 77-101)	91
Figure 3.16 Research design and analysis procedure	94
Figure 4.1 Example of students' answer	108
Figure 4.2 Collapsing of the Likert scale	121

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

For more than three decades, Malaysia's education system aims to provide a holistic learning platform to produce an all-rounded individual capable of contributing to his/her growth while nurturing the capabilities and capacities as an individual (National Education Philosophy, 1988, as cited in Ministry of Education Malaysia; 2012). With such grand ambition, mathematics has been one of the focuses and the fundamental subjects within the curriculum encompassing the critical study from primary education to the highest secondary education level (Standard 1 to Form 5). This subject meant for the upper class in the last century has become a crucial discipline within the Malaysian education system.

Mathematics is more than just a number. It is a fundamental discipline that transcends the language barrier and connects many different subjects such as biology, chemistry, physics, and engineering. It helps to develop and enhance students' cognitive growth and strengthen students' logical reasoning skills (Harris, 2019). This growth will subsequently assist in developing their problem-solving skills (Popat & Starkey, 2019). Nevertheless, the PISA reports (Programme for International Student Assessment) in 2009 and 2012 indicate that Malaysia is lagged behind other ASEAN countries such as Singapore, Vietnam, and Thailand regarding overall students' performance in Mathematics. Additionally, PISA reports in 2015 also shown that Malaysia only managed to score 443 in mathematics mastery, which was way from the global average

of 490. This result proves a critical pattern that might hinder the students' development in their forthcoming future, affecting their future development.

This has rapidly become a critical subject area due to the emerging technology age that highly dependent on the use of mathematics, especially when it comes to the development of the new technology and virtual environment. The current national policy in Malaysia (Industry4WRD) aims to transform the current manufacturing industries into more systematic, smarter, and resilient industries by adopting Industry 4.0 and becoming the future technology hub (MyGOV, 2019). This policy aims to holistically transform and assist Malaysia's enterprise by increasing their efficiency and productivity while remaining relevant and competitive at domestic and global levels. Hence, students' capabilities in manipulating mathematics are becoming more pertinent, especially regarding the scope of jobs available in the future (Tangau, 2016).

Despite the importance, it is undeniable that some of the students are still unable to achieve the education system's expectations. These topics have always been under constant investigation and development as educators worldwide are trying to find the solution to address the situation. After all, not many students able to appreciate the complexity of the subject itself. Students may perceive this discipline as challenging hence losing interest, thus disengaged and demotivated during lessons (Kaur et al., 2020). Typically, for young learners who have continually undergone these repeated inexplicable experiences, many of them became disengaged when dealing with mathematics subject (Attard & Holmes, 2020). Subsequently, this failure seemed to be accompanied by negative emotional states such as anxiety and depression, low perceptions of self, and avoidant behaviours (Maltese et al., 2018; Fadzilah, Noraini, et al., 2017; Higgins, Crawford et al., 2016; Klazalwr et al., 2016).

Another most common factor often associated with young learners' constant mathematics failure was the accumulated errors the students gained. For the young learners particularly, deficiency in their number sense and the necessary counting skills (An et al., 2019) have proven to be the most common factors that led the students to feel overwhelmed in learning mathematics. Since the students could not master the number sense and fundamental counting skills, it generally will affect their mental calculation skills, which hindered them from completing many mathematics tasks. This subsequent failure also impairs their cognitive performance, especially in visualising the much-needed mathematical processes and finding effective strategies to solve the presented equations and numberings (Waalkens, Alevén & Taatgen, 2013; Geary, Hoard, Nugent & Bailey, 2012). During the learning process, these constant failures might strengthen their aversions towards mathematics and develop a negative attitude towards the subject. This negative attitude might subsequently affect their future attainment of the subject. Not to mention their performance in mathematics as a whole.

Research on the importance of attitude when it comes to the mastery of mathematics has been a topic of interest for more than half a century (Mokgwathi et al., 2019; Yaratán & Kasapoğlu, 2012; Farooq & Shah, 2008; Aiken, 1976; Aiken & Dreger, 1961). The importance of attitude is exceptionally essential concerning young learners. A study by Zhou et al. (2019) showed that students' perception of mathematics's importance has declined as they move up in their grades level. This decline implied that primary education has an essential effect on students' later attitudes in mathematics. For that reason, the guidance from the teachers regarding students' perceptions towards mathematics has to be tackled as early as possible.

Similarly, researchers have proven by adjusting students' attitudes with a practical and appropriate intervention can help them change their perspectives regarding

things that they have viewed negatively (Higgins, Huscroft-D'Angelo et al., 2019). Since many students found mathematics a dull, uninteresting, and complicated subject, the notion of a change in their mind-set was put forwards to help the students perform positively in mathematics (Daly et al., 2019). Hence, a change in the way mathematics is presented to the students should be put into consideration. Instead of having a common practice of paper and pen, playing mathematical games, for example, proven capable of helping the students to become immersed in the interactive world. This finding is especially pertinent among middle-graders and higher-grader learners (Setiawati & Qohar, 2020; Nugraha et al., 2020). This technology was seen as capable of reducing students' pressure while positively increasing their mathematics engagement (White & McCoy, 2019; Borodkin et al., 2019). Students will no longer dread the subject and put their interest in it, thus promoting their effort to perform in class and ultimately replicate their overall achievement (Basco, 2020). Therefore, the teacher needs to find a way to stimulate students' interest in mathematics to ensure that they can yield better academically.

There has been renewed interest in the use of technology in classrooms in recent years, especially in reaching out to the mixed-ability class while still providing inclusive tutoring with self-paced learning (Sharma, 2017). The emergence of affordable technological tools like smartphones, tablets, and apps, made lessons no longer constricted within the typical classroom (Bernacki et al., 2020). The students are now able to access their learning almost anytime and anywhere. This revolution now demands newer, fresher, and relevant pedagogical strategies within the average classroom itself. Among the widespread integration between education and technology were mobile learning, gamification, and game-based learning. Subsequently, the emergence of educational mobile game apps has continued to highlight the affordances

of technology use in providing stimulating education (Goos, 2020) and productive activity capable of attracting students' interest and curiosity.

The technology used in education was popularised to provide self-paced and independent learning (Yildirim, 2017; Hamari, Koivisto et al., 2014). The early implementer of technology used in school often replaces computer desktop use with Tablets or iPad to watch videos, write reports using word processors, or search the web for information. However, with the recent emergence of various apps, previous studies over the past years have looked at the affordances of those mobile devices as a promising technology in promoting collaboration and engagement in learning to the students (Tokac et al., 2019; Litster et al., 2019). This phenomenon is mostly applicable to the generation alpha, or synonymously known as iGeneration. These children were exposed to technology from a young and had become the most technology-infused demographics. In line with that, this generation is demanding a revolutionise in the way education should be.

Additionally, mobile devices like smartphones and Tablets can augment reality through various apps (Hwang et al., 2019). These technologies can provide a real-life learning experience, and subsequently, reinforce the attain knowledge (Mouza &Barrett-Greenly, 2015). Furthermore, the availability of apps that can be downloaded into the smartphone and Tablet has proven beneficial to students. This technology can provide the environment that can help the student self-paced and work independently anytime and anywhere, as long as they have the handheld devices in their hand. The availability of free Wi-Fi in almost public spaces also helps keep learning on the go. Subsequently, it promotes the notion of autonomous learning among the student. Furthermore, free Wi-Fi availability also helps the student reduce possible expenditure that might occur from using technology in learning. This will reduce possible strains on

their family's economy while providing necessary learning resources using the World Wide Web.

With a brief understanding of how students perceived mathematics, teachers need to provide a suitable environment that could ensure students' interest and curiosity towards the subject will remain strong throughout the learning phase. Studies have proven that the development of students' interests and technology affordances (Akhter et al., 2020) can lead them to perform better academically (Harackiewicz et al., 2016). Therefore, the integration of technology in mathematics for young learners should be considered a step towards pursuing students' positive attitudes in learning mathematics of the current 21st-century context.

1.2 PROBLEM STATEMENT

According to Ajzen and Fishbein (2000), an attitude refers to how an individual perceives an object, event, individual, or behaviour with a certain degree of conformity or refusals. This notion is supported by Djamasbi et al. (2009), who stated that a person would be able to improve their performance once they feel that they can easily overcome the problem while doing it. Hence, a particular set of attitudes, be it positive or negative, can influence how one acts in a situation. Therefore, in the study's context, it is assumed that it can be used to control students' responses toward mathematics with the right set of perspectives.

Students' attitudes were often associated with their academic performance (Mokgwathi et al., 2019; Yaratana & Kasapoğlu, 2012; Farooq & Shah, 2008). Students' overall classroom experience is connected to their perceived learning experience (Csikszentmihalyi & Wong, 2014). Many researches finding have discussed the importance of instilling positive interest and attitude among young learners (Clements,

2017; McClure et al., 2017; Schacter and Jo, 2017). This set of attitudes will help students develop their brains better, enhance their memory capacity, and promote efficient engagement between their brain and problem-solving skills. By cultivating their interest in mathematics from a young age, it could help students adapt and learn new concepts more effectively as they advanced to more complex problems (Brookman-Byrne & Dumontheil, 2020). Therefore, students' ability to perform in mathematics has proven essential for students' development in their future studies.

Efforts are directed at eliminating current challenges that might lead students to feel overwhelmed and distressed from learning mathematics. Since children are inherently playful by nature, altering the lesson to something that reflects their personality might help these young learners adapt to this complex subject. Therefore, the teacher needs to provide a setting that can positively benefit the students to encounter this subject while developing their confidence in dealing with mathematics. Subsequently, students will foster a positive attitude whenever they faced a difficult problem while interacting with mathematics.

Some attempts were made to solve these problems by introducing technology-related activities, such as games, in mathematics class. Subsequently, the use of games in the classroom is not something unfamiliar to students. The existence of games can be traced to human civilization's early life (Chick, 2015). Regardless of age, nationality, or race, almost everyone enjoys playing games. Games are something integral, especially among young children. Therefore, the use of games in the lesson can provide continuity as it allows a fun yet realistic learning setting within the regular classroom (Khan et al., 2018; Garðarsdóttir et al., 2017; Colliver & Fleeer, 2016). This positive approach might help students to relate their lessons with their normal daily activities (Kiili & Ketamo, 2018), thus building awareness of the importance of this subject in their lives (Poku,

2019). Subsequently, it can positively decrease their negative perception of the difficulties of the subject. Therefore, in engaging the students, games that focus on educational content are essential (Yildirim, 2017; Powell & Mason, 2013; Kinash et al., 2012). This is explicitly applicable among the primary grades, who are more inclined towards playing via learning (Castillo et al., 2019).

Additionally, game players have always shown their capabilities in strategising, persistence play, executing problem-solving skills, and giving their attention to the small details whenever they are partaking in game playing (Klopfer et al., 2009). These sorts of behaviours are typically ideal if it can be ingrained in students. The implementation of this kind of learning was aimed not necessarily to increase the students' achievement, but the changes in their overall attitude towards mathematics. Furthermore, younger learners nowadays are perceptive in using technology, which called for a change in how the lesson was delivered (Camilleri & Camilleri, 2020). Due to this reason, researchers have been debating whether the use of games with educational content in the classroom is capable enough in producing similar effects among students, especially for the primary learners.

The effective use of game in classroom has been experimentally demonstrated by a study from Nor Elleeiana et al. (2016) on the intervention for children with low mathematics achievement in a school located in East Malaysia. The study found out that the young learners showed positive feedback on their understanding of primary mathematical function through the game intervention, focusing on the dyscalculia-remedy-oriented approach. This game includes the use of numbers repetition and operation manipulation in line with the students' needs. Outhwaite, Gulliford et al. (2017) also discovered that repetitive activity is significant, especially in enhancing students' necessary mathematics skills, reducing students' cognitive task demands.