THE BEST PRACTICES OF STEM EDUCATION FOR CHILDREN AGED 5 – 6 YEARS OLD

MUHAMMAD NUR AZAM BIN GHAZALI

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

SULTAN IDRIS EDUCATION UNIVERSITY

2022

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

THE BEST PRACTICES OF STEM EDUCATION FOR CHILDREN AGED 5 – 6 YEARS OLD

MUHAMMAD NUR AZAM BIN GHAZALI

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

DISSERTATION PRESENTED TO QUALIFY FOR A
MASTER OF EDUCATION (EARLY CHILDHOOD EDUCATION)
(RESEARCH AND COURSEWORK MODE)

FACULTY OF HUMAN DEVELOPMENT
SULTAN IDRIS EDUCATION UNIVERSITY

2022

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

UPSI/IPS-3/BO 32
Pind : 00 m/s: 1/1

UNIVERSITI PENDIDIKAN SULTAN IDRIS
SULTAN IDRIS EDUCATION UNIVERSITY

Sila tanda (√)
Kertas Projek
Sarjana Penyelidikan
Sarjana Penyelidikan dan Kerja Kursus
Doktor Falsafah

/

INSTITUT PENGAJIAN SISWAZAH

PERAKUAN KEASLIAN PENULISAN

Perakuan ini telah dibuat pada 9 (hari bulan) 8 (bulan) 2022

i. Perakuan pelajar :

Saya, **MUHAMMAD NUR AZAM BIN GHAZALI (M20201000122)** (SILA NYATAKAN NAMA PELAJAR, NO. MATRIK DAN FAKULTI) dengan ini mengaku bahawa disertasi/tesis yang bertajuk **THE BEST PRACTICES OF STEM EDUCATION FOR CHILDREN AGED 5-6 YEARS OLD**
adalah hasil kerja saya sendiri. Saya tidak memplagiat dan apa-apa penggunaan mana-mana hasil kerja yang mengandungi hak cipta telah dilakukan secara urusan yang wajar dan bagi maksud yang dibenarkan dan apa-apa petikan, ekstrak, rujukan atau pengeluaran semula daripada atau kepada mana-mana hasil kerja yang mengandungi hak cipta telah dinyatakan dengan sejelasnya dan secukupnya

Tandatangan pelajar

ii. Perakuan Penyelia:

Saya, **DR. ROMARZILA BINTI OMAR** (NAMA PENYELIA) dengan ini mengesahkan bahawa hasil kerja pelajar yang bertajuk

THE BEST PRACTICES OF STEM EDUCATION FOR CHILDREN AGED 5-6 YEARS OLD

(TAJUK) dihasilkan oleh pelajar seperti nama di atas, dan telah diserahkan kepada Institut Pengajian Siswazah bagi memenuhi sebahagian/sepenuhnya syarat untuk memperoleh Ijazah **IJAZAH SARJANA PENDIDIKAN AWAL KANAK-KANAK** (SLA NYATAKAN NAMA IJAZAH).

Dr. Romarzila Omar
Pensyarah Kanan
Jabatan Pembangunan Awal Kanak-Kanak
Fakulti Pembangunan Manusia
35900 Tanjong Malim

9/8/2022

Tarikh

Tandatangan Penyelia

UPSI/IPS-3/BO 31
Pind.: 01 m/s:1/1

UNIVERSITI PENDIDIKAN SULTAN IDRIS
SULTAN IDRIS EDUCATION UNIVERSITY

INSTITUT PENGAJIAN SISWAZAH /
INSTITUTE OF GRADUATE STUDIES

BORANG PENGESAHAN PENYERAHAN TESIS/DISERTASI/LAPORAN KERTAS PROJEK
DECLARATION OF THESIS/DISSERTATION/PROJECT PAPER FORM

Tajuk / *Title*: THE BEST PRACTICES OF STEM EDUCATION FOR CHILDREN AGED 5-6 YEARS OLD

No. Matrik /*Matric's No.*: M20201000122

Saya / *I* : MUHAMMAD NUR AZAM BIN GHAZALI

(Nama pelajar / *Student's Name*)

mengaku membenarkan Tesis/Disertasi/Laporan Kertas Projek (Kedoktoran/Sarjana)* ini disimpan di Universiti Pendidikan Sultan Idris (Perpustakaan Tuanku Bainun) dengan syarat-syarat kegunaan seperti berikut:-
acknowledged that Universiti Pendidikan Sultan Idris (Tuanku Bainun Library) reserves the right as follows:-

1. Tesis/Disertasi/Laporan Kertas Projek ini adalah hak milik UPSI.
   The thesis is the property of Universiti Pendidikan Sultan Idris
2. Perpustakaan Tuanku Bainun dibenarkan membuat salinan untuk tujuan rujukan dan penyelidikan.
   Tuanku Bainun Library has the right to make copies for the purpose of reference and research.
3. Perpustakaan dibenarkan membuat salinan Tesis/Disertasi ini sebagai bahan pertukaran antara Institusi Pengajian Tinggi.
   The Library has the right to make copies of the thesis for academic exchange.
4. Sila tandakan (√) bagi pilihan kategori di bawah */ Please tick (√) for category below:-*

☐	**SULIT/*CONFIDENTIAL***	Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub dalam Akta Rahsia Rasmi 1972. / *Contains confidential information under the Official Secret Act 1972*
☐	**TERHAD/*RESTRICTED***	Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan ini dijalankan. / *Contains restircted information as specified by the organization where research was done.*
/	**TIDAK TERHAD / *OPEN ACCESS***	

Dr. Romarzila Omar
Pensyarah Kanan
Jabatan Pendidikan Awal Kanak-kanak
Fakulti Pembangunan Manusia
35900 Tanjong Malim

(Tandatangan Pelajar/ Signature)

Tarikh: 9/8/2022

(Tandatangan Penyelia / *Signature of Supervisor*)
& (Nama & Cop Rasmi / *Name & Official Stamp*)

Catatan: Jika Tesis/Disertasi ini **SULIT** @ **TERHAD**, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan ini perlu dikelaskan sebagai **SULIT** dan **TERHAD**.

Notes: If the thesis is CONFIDENTAL or RESTRICTED, please attach with the letter from the organization with period and reasons for confidentiality or restriction.

APPRECIATION

First of all, I would like to thank Allah S.W.T, because of His bounty and grace, then I was able to complete this thesis successfully even though I had to face various trials, tribulations and challenging before, during and after writing this full research. Alhamdulillah, with His permission, this thesis was successfully completed within the time period set by the university. In effort to collect study materials, analyse findings and prove documentation, this research has received direct and indirect assistance from a number of important individuals. On this occasion, I would like to say a million thanks to my lecturer supervisor, Dr. Romarzila Omar for showing amazing patience, support, advice and guidance in helping me earn success in the production of this thesis. All the help, enthusiasm, strategy and her wisdom have taught me a lot to be a patient researcher and a good educator. Not to forget to all lecturers and staffs at Department of Early Childhood Education and other departments of Faculty of Human Development, Sultan Idris University of Education who are willing to share their experiences and knowledge throughout this study conducted. All the experiences are definitely unforgettable.

Apart from that, I would also like to thank the teachers and children from Perak and Selangor kindergartens roughly who were sincerely becoming the participants in this study. I would also like to thank my examiners as well as research experts in order to help and advise me in creating a quality research. Not to be forgotten, thank you to the lecturers of my Master's Degree study who have provided knowledge and guidance to me for completing this thesis. Thanks also to my fellow friends and classmates for giving a lot of help and encouragement and also not forgetting to mention thank you so much to my mother, Mrs. Jaina Binti Yusoff and family members who always give infinite support while I am sincerely striving to complete this research. Last but not least, I would like to thank to Ms. Che Noor Hawa Binti Che Ismail and Mrs. Maziah Zee Binti Abdullah for becoming my guarantors for study scheme. Finally, I have successfully completed this writing. Alhamdulillah.

ABSTRACT

The purpose of this study is to determine how STEM education can bridge the gap between the productivity of early childhood educators and government policies in elevating the quality of education based on 21st century learning in Malaysia. There are 4 objectives of this study which are *(i)* explore the best practice in Early Science towards the implementation of STEM activity in kindergarten; *(ii)* explore the best practice in Early Mathematics towards the implementation of STEM activity in kindergarten; *(iii)* explore technology-assisted teaching tools towards the implementation of STEM activity in kindergarten; and *(iv*) explore engineering activity towards the implementation of STEM activity in kindergarten. The method of exploratory case study was used to design this study, which was based on a qualitative study. It was successfully carried out at three different private kindergartens in Malaysia, with four kindergarten teachers and 39 kindergarten students participating. They were selected using the purposive sampling technique. The data of the study were obtained through the results of data triangulation using three research instruments which are interviews, observations, and document analysis. The data of this study were analysed inductively using thematic analysis using ATLAS ti.8. According to the findings, there are eight best practises of STEM education based on the teacher's teaching and learning session. The study's implications revealed that teachers' initiative in providing STEM activities to children is a benchmark for the improvement of STEM education in Malaysia. The most significant contribution of this study is that it can bridge the gap between the Ministry of Education Malaysia's aspirations for elevating STEM education at the global level. If teachers are able to provide effective activities to children by implementing best teaching practices, it will result in children who will continue to explore such STEM activities for the sake of their future and nation.

AMALAN TERBAIK PENDIDIKAN STEM UNTUK KANAK-KANAK BERUMUR 5-6 TAHUN

ABSTRAK

Tujuan kajian ini dilaksanakan adalah untuk menentukan bagaimana pendidikan STEM dapat merapatkan jurang antara produktiviti pendidik awal kanak-kanak dengan dasar kerajaan dalam memartabatkan kualiti pendidikan berasaskan pembelajaran abad ke-21 di Malaysia. Terdapat 4 objektif kajian ini iaitu (i) meneroka amalan terbaik Sains Awal terhadap pelaksanaan aktiviti STEM di tadika; (ii) meneroka amalan terbaik dalam Matematik Awal ke arah pelaksanaan aktiviti STEM di tadika; (iii) meneroka alat pengajaran berbantukan teknologi ke arah pelaksanaan aktiviti STEM di tadika; dan (iv) meneroka aktiviti kejuruteraan ke arah pelaksanaan aktiviti STEM di tadika. . Kaedah kajian kes penerokaan digunakan untuk mereka bentuk kajian ini yang berasaskan kajian kualitatif. Ia berjaya dijalankan di tiga tadika swasta yang berbeza di Malaysia di mana terdapat empat guru tadika dan 39 pelajar tadika yang berjaya mengambil bahagian dalam kajian ini. Mereka dipilih menggunakan teknik persampelan bertujuan. Data kajian diperoleh melalui hasil triangulasi data dengan menggunakan tiga instrumen kajian iaitu temu bual, pemerhatian, dan analisis dokumen. Data kajian ini dianalisis secara induktif menggunakan analisis tematik melalui aplikasi ATLAS ti.8. Berdasarkan dapatan kajian, terdapat lapan amalan terbaik pendidikan STEM yang direkodkan melalui sesi pengajaran dan pembelajaran guru. Implikasi kajian menunjukkan bahawa inisiatif guru dalam menyediakan aktiviti STEM kepada kanak-kanak merupakan penanda aras bagi penambahbaikan pendidikan STEM di Malaysia. Sumbangan paling signifikan kajian ini adalah ia dapat merapatkan jurang antara hasrat Kementerian Pendidikan Malaysia untuk memartabatkan pendidikan STEM di peringkat global. Sekiranya guru dapat menyediakan aktiviti yang berkesan kepada kanak-kanak dengan melaksanakan amalan pengajaran terbaik, ia akan mengilap dan seterusnya menghasilkan kanak-kanak yang akan terus meneroka aktiviti STEM tersebut demi masa depan diri mereka dan juga negara.

CONTENT

		PAGE NUMBER
ACKNOWLEDGMENT		i
DECLARATION		ii
APPRECIATION		iii
ABSTRACT		iv
ABSTAK		v
CONTENT		vi
LIST OF TABLE		xii
LIST OF FIGURE		xiii
LIST OF ABBREVIATION		xv
LIST OF ATTACHMENT		xvii
LIST OF APPENDIX		xix
CHAPTER 1 INTRODUCTION OF RESEARCH		
1.1	Introduction	1
1.2	Background of Study	2
1.3	Problem Statement	6
1.4	Conceptual Framework	11
1.5	Research Objective	13

1.6 Research Question 14

1.7 Research Gap 14

1.8 Significance of Research 15

1.8.1 Related Theories 15

1.8.2 Teaching Model 17

1.8.3 21st Century's STEM Pedagogy in Early Childhood Education 18

1.8.4 The Policy of Ministry of Education Malaysia 20

1.9 Rationale of Research 22

1.10 Research Limitation 24

1.11 Operational Definition 25

1.11.1 Best Practice 26

1.11.2 STEM Education 26

1.11.3 Teacher's Roles in a STEM Setting 27

1.11.4 Best Practices Of STEM Education In Kindergarten 27

1.11.5 Teacher's Implementation of STEM Education 28

1.12 Conclusion 29

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction 30

2.2 The Implementation of STEM Education in Malaysia 31

2.3 The Role of Teachers in Implementing STEM Education 34

2.4 Related Theories And Framework to the Implementation of STEM Education in Preschool 37

2.4.1 Theoretical Framework for Implementing STEM Education 43

2.4.2 The Best Practices of Focused Discipline in STEM Education 51

2.4.2.1 The Best Practice of Early Science Activity Through STEM Education 52

2.4.2.2 The Best Practice of Early Mathematics Activity through STEM Education 54

2.4.2.3 The Best Practice of Integrating Technology Discipline in STEM Activity 55

2.4.2.4 The Best Practice of Integrating Engineering Discipline in STEM Activity 57

2.5 Preschool STEM Curriculum 58

2.6 The Importance and Challenges in Implementing STEM Education 66

2.7 Past Studies 73

2.8 Conclusion 80

CHAPTER 3 METHODOLOGY

3.1 Introduction 81

3.2 Design of Research 82

3.3 Research Location 83

3.4 Population and Sample 86

3.5 Research Instrument 88

3.5.1 Document Analysis 89

3.5.1.1 National Preschool Standards-Based Curriculum And Assessment Document (2017 Edition) 82

3.5.1.2 Lesson Plan 90

3.5.1.3 Teaching Reflection 90

3.5.2 Observations 91

3.5.2.1 Checklist 92

3.5.2.2 Video Recording 93

3.5.2.3 Pictures 94

3.5.2.4 Worksheets 94

3.5.3 Interviews 94

3.5.3.1Protocol Interview 96

3.6 Validity and Reliability 97

3.6.1 Validity 98

3.6.1.1 Expert Validation 99

3.6.2 Reliability 101

3.6.2.1 Triangulation 101

3.6.2.2 Cohen's Kappa Index 103

3.7 Procedure of Collecting Data 104

3.7.1 Permission Application 105

3.7.2 Work Planning 106

3.7.3 Research Tools Preparation 107

3.7.4 Research Time 107

3.7.5 Method of Data Collection 108

3.7.6 Collecting Assessment Form from Experts 109

3.8 Procedure of Data Analysis 110

3.9 Research Ethics 112

3.10 Conclusion 114

CHAPTER 4 FINDINGS

4.1 Introduction 115

4.2 Research Findings 116

4.3 Analysis of Background of Participant 116

4.4 Analysis of Research Findings 118

4.4.1 Objective 1: Explore the Best Practice in Early Science towards the Implementation of STEM Activity in Kindergarten 119

4.4.1.1 (ES1) Collaborative Learning 121

4.4.1.2 (ES2) Learning through Play 126

4.4.1.3 (ES3) Exploration Encouragement 136

4.4.1.4 Summary of Findings of Objective 1 141

4.4.2 Objective 2: Explore the Best Practice in Early 142

Mathematics towards the Implementation of STEM Activity in Kindergarten

4.4.2.1 (EM1) Learning through Play 144
4.4.2.2 (EM2) Entertainment Influence in Teaching 149

4.4.2.3 (EM3) Themed Learning 154

4.4.2.3 Summary of Findings for Objective 2 159

4.4.3 Objective 3: Explore Technology-Assisted Teaching Tools towards the Implementation of STEM Activity in Kindergarten 160

4.4.3.1 (T1) Computer Based Learning 162

4.4.3.2 (T2) Interactive Visual 172

4.4.3.2 Summary of Findings for Objective 3 177

4.4.4 Objective 4: Explore Engineering Activity towards the Implementation of STEM Activity in Kindergarten 178

4.4.4.1 (E1) Innovation Empowerment 179

4.4.4.2 (E2) Two Ways Communication 188

4.4.4.3 (E3) Learning through Play 193

4.4.4.4 Summary of Findings for Objective 4 198

4.4.5 Overview analysis 188

4.4.6 Findings of Cohen Kappa's Coefficient 203

4.5 Conclusion 207

CHAPTER 5 CONCLUSION

5.1 Introduction 208

5.2 Summary of Research 209

5.3 Discussion of Research Findings 212

5.3.1 Discussion on the Best Practice in Early Science Towards the Implementation of STEM Activity in Kindergarten 213

5.3.2 Discussion on the Best Practice in Early Mathematics Towards the Implementation of STEM Activity in Kindergarten 218

5.3.3 Discussion on Technology-Assisted Teaching Tools 221

Towards the Implementation of STEM Activity in Kindergarten

5.3.4 Discussion on Engineering Discipline towards the Implementation of STEM Activity in Kindergarten 224

5.4 Research Recommendation 227

5.4.1 Theories Application and Teaching Methodology 227

5.4.2 Suggestion for Ministry of Education Malaysia 229

5.4.3 Empower STEM Pedagogy in Early Childhood Education in Line with 21st Century's Education 231

5.4.4 Suggestion to Strengthen STEM Module for the Learning of Children 234

5.5 Research Implication 236

5.5.1 Bridging the Gap to Enhance the Malaysian Education System 236

5.5.2 Benchmark for Best Practice of STEM Education 239

5.5.3 Best Teaching and Learning Practices through Strong Theoretical Framework 241

5.6 Suggestion for Further Research 244

5.7 Conclusion 247

REFERENCE 249

LIST OF TABLE

TABLE NO.		Page Number
2.1	Strategies for Creating a STEM-Focused Classroom	61
2.2	STEM Curriculum for Malaysian Pre-schoolers	62
2.3	A Day in the Life of a Preschool	65
2.4	List of past studies and their importance to current study	73
3.1	Research Location	84
3.2	Number of Participants in Each Preschool	87
3.3	Research Instrument	88
3.4	Document Analysis	89
3.5	Tools of Observation	91
3.6	Interview Session Timeline	95
3.7	The Arrangement of Interview Protocol	96
3.8	The Backgrounds of Participants	97
3.9	Tools of Validity and Reliability	98
3.10	Details of Experts	101
3.11	Interpretation of Cohen's Kappa Statistic for Strength Agreement	104
3.12	Objectives of Data Collection	105
3.13	Procedure of Data Collection Timetable	105
3.14	Work Planning	106
3.15	Research Time	107
3.16	Timeline of Collecting Data	109
3.17	Collection of Assessment Form for the Item Validation	110
3.18	Collecting of Assessment Form for the Data Validation	110
3.19	The Analysis Method for Collected Data	112

4.1	Details of Participant	117
4.2	Analysis of the best practices of STEM education	199
4.3	Kappa Values for the Validity of Interview Questions	204
4.4	Kappa Values for Validity of Checklist Questions	204
4.5	Kappa Values for Validity of Interview Data	205
4.6	Kappa Values for Validity of Checklist	206

LIST OF FIGURE

FIGURE NO.		Page Number
1.1	Conceptual Framework	11
2.1	Theories Framework	37
2.2	Pathed STEM Education Framework	44
2.3	The Science, Technology, Engineering and Mathematics Education (STEME) Model	47
2.4	Aspects of STEM Core-competencies	51
3.1	Data Collection – John Latham	102
4.1	Maps for Theme and Sub-Theme	118
4.2	Themes and Sub-Themes for Disciplines of Early Science	119
4.3	Themes and Sub-Themes for Disciplines of Early Mathematics	142
4.4	Themes and Sub-Themes for Disciplines of Technology	161
4.5	Themes and Sub-Themes for Disciplines of Engineering	178
5.1	Connection between the Policies of Ministry of Ministry Of Education Malaysia and the Implementation of STEM Education from Teacher	236
5.2	The Connection between Students and Teacher Creates a Benchmark for the Best Practice of STEM Education	239
5.3	Best Teaching and Learning Practices through Strong Theoretical Framework	242
5.4	Model Framework	244

LIST OF ABBREVIATION

DSKP 2017	Dokumen Standard Prasekolah Kebangsaan 2017
DSTIN	National Science, Technology, and Innovation policy
E/T S-E/T-M	Engineering/ Mathematics Science-Engineering/ integration Technology/ Mathematics
EPRD	Education Planning and Research Department
ES-T-M	Engineering <Science, Technology, Mathematics>
KBAT	Kemahiran Berfikir Aras Tinggi
IBME	Inquiry-Based Mathematics Education
IBSE	Inquiry-Based Science Learning
K-12	Kindergarten to 12th Grade
KSPK	Kurikulum Standard Prasekolah Kebangsaan
MBEB	Malaysia Education Blueprint
MOE	Ministry of Education Malaysia
NAE	National Academy of Engineering
NAEP	National Assessment of Educational Progress Report
NGSS	Next Generation Science Standards
NRC	National Research Council
PAK-21	Pendidikan Abad Ke-21
PERMATA	Pusat Pendidikan Awal Kanak-Kanak
PISA	Program for International Student Assessment
SMATE	Science, Mathematics, Art, Technology and Engineering
SMET	Science, Mathematics, Engineering and Technology
STEAM	Science, Technology Mathematics, Arts and Engineering

SteM	Science <Technology, Engineering> Mathematics
STEM	Science, Technology, Engineering, Mathematics
STEME	The Science, Technology, Engineering and Mathematics Education
S-T-E-M	Science-Technology-Engineering-Mathematics
TI	Total Integration
TIMS	Trends in International Mathematics & Science Study
TM	Time Management
UPSI	Universiti Pendidikan Sultan Idris
USA	United States of America
UTA	University of Texas Arlington
ZPD	Zone of Proximal Development
4C	Communication, Collaboration, Creativity, And Critical Thinking

LIST OF ATTACHMENT

A	Expert Appointment Confirmation Letter for Research Instrument Data (Expert 1)
B	Expert Assessment Form for Research Instrument Data (Expert 1)
C	Expert Appointment Confirmation Letter for Research Instrument Data (Expert 2)
D	Expert Assessment Form for Research Instrument Data (Expert 2)
E	Expert Appointment Confirmation Letter for Research Instrument Data (Expert 3)
F	Expert Assessment Form for Research Instrument Data (Expert 3)
G	Expert Appointment Confirmation Letter for Research Analysis Data (Expert 1)
H	Expert Assessment Form for Research Analysis Data (Expert 1)
I	Expert Appointment Confirmation Letter for Research Analysis Data (Expert 2)
J	Expert Assessment Form for Research Analysis Data (Expert 2)
K	Expert Appointment Confirmation Letter for Research Analysis Data (Expert 3)
L	Expert Assessment Form for Research Analysis Data (Expert 3)
M	Expert Appointment Confirmation Letter for Research Analysis Data (Expert 4)
N	Expert Assessment Form for Research Analysis Data (Expert 4)
O	Letter of Approval to Conduct Research in Early Childhood Institutions

P	Lesson Plan for STEM Activity (Science Activity)
Q	Lesson Plan for STEM Activity (Mathematics Activity)
R	Lesson Plan for STEM Activity (Digital Learning Activity)
S	Lesson Plan for STEM Activity (Engineering Activity)

LIST OF APPENDIX

A	Kappa Values for Validity of Interview Questions
B	Kappa Values for Validity of Checklist Questions
C	Kappa Values for Validity of Interview Data
D	Kappa Values for the Validity of Checklist Data

CHAPTER 1

INTRODUCTION OF RESEARCH

1.1 INTRODUCTION

This chapter includes background of research, problem statement, research objectives and research questions, importance of research, limitation of research, conceptual definition, operational definition, conceptual frame and conclusion. The researcher will be discussing about the rough content in this chapter.

1.2 BACKGROUND OF STUDY

Science, technology, engineering, and mathematics play important roles (STEM) Education in terms of student learning outcomes is an important topic in the educational field. STEM Education, on the other hand, is a very broad term (Baran, Bilici, Mesutoglu, & Ocak, 2016). STEM (Science, Technology, Engineering, and Mathematics) refers to education policies and school curriculum options in Malaysia that emphasizes STEM education at the school level through curriculum and co-curricular activities with support from various stakeholders (Mohammud *et* al., 2020). Blueprint 2013-2025 (Ministry of Education, 2013) emphasizes STEM education needs to be promoted at the school level through curriculum and co-curricular activities with the support from various stakeholders. STEM education was a means of engaging the younger generation. The concept of 4C components, namely communication, collaboration, creativity and critical thought, as found in learning of the 21st century (PAK-12) is underlined high-level thinking skills (KBAT). The development of these components is viewed as producing young people with advanced problem-solving abilities (Chinedu *et* al., 2015). On the other hand, through the implementation of STEM Education, educators can evolve the development of children concussively. According to Moore, Johnson, Peters-Burton, and Guzey (2016), there are six cores that children can reach from STEM integration which are:

i. To use an important learning environment relevant to the real life of the student.
ii. To develop critical and creative thinking through related activities by using a conceptual engineering approach to challenge students' potential.
iii. Undertaken by student to design technology and engineering solutions with already existing designs that can be learned from the failure.
iv. Integration of Math and Science into teaching and learning sessions, and also other relevant subjects such as literature, humanities and social studies.

v. Implementing teaching and learning activities that focus on students so that they are actively involved.
vi. Teach students how to collaborate and communicate during education.

It has been suggested that, if done correctly, STEM at the early childhood level could provide chances for teachers to engage young children in activities that leverage on their interests, experiences, and past knowledge (NRC, 2011). STEM education is critical for fostering and maintaining young children's natural interest in the topics and career fields covered by the programme, as well as developing their problem-solving and critical and logical thinking skills, as well as cultivating habits of mind like curiosity, creativity, persistence, collaboration, and communication (Isabelle & Valle 2016; Lange *et* al. 2019). According to Sneideman (2013), STEM is a theory or way of thinking in which several subjects, such as Science, Mathematics, Engineering, and Technology, are combined into one field of education that is considered more suitable and important to be taught, especially in schools, since it emphasizes practicality and real thing. Through the usage of technology and invention, children can learn Science and Mathematics in a real, realistic, and meaningful context. Learning in this manner is more enjoyable, hands-on, and provides a straightforward experience that encourages children to think and solve problems.

Engineering serves as a natural binding factor in the integration of STEM disciplines into educational environments because it requires knowledge of math and science to develop technologies and solve engineering problems. It also provides children of all ages with realistic learning experiences in an engaging way (Pantoya *et* al, 2015). STEM Education has become a new topic that teachers are discussing to ensure effective children's learning. According to Stohlmann, Moore, & Roehrig (2012),

the future success of the students is driven by quality education in science, technology, engineering and mathematics. In fact, Malaysian government has also taken various initiatives to improve the quality of education through stalemate so that workers and experts can be produced in the future. We provide the teachers with a general guideline on STEM education and learning process according to the Malaysian Ministry of Education (2016). Moreover, Adam and Halim stated (2019):

> *"Ministry of Education Malaysia (MOE) is working to build qualified staff and industry experts, and so the consolidation of STEM training in this country is one of our initiatives. Several policies are seen to support this noble intention consist of the Policy of 60% Science: 40% Literature (Policy 60:40), Vision 2020, PPPM 2013-2025, National Science, Technology and Innovation Policy (DSTIN) as well as the operation of the National STEM Center starting since May 2018".*

Science and Mathematics Education in Malaysia seems to have evolved over time with the introduction of STEM Education to children. Naturally, to ensure that a child's strength develops well, STEM education needs to be introduced from an early age. According to the views of experts in the field of early childhood, STEM education should be started at early age (Katz, 2010). With the introduction of STEM education at an early stage, there are various kinds of benefits can be gained by children. One of them is it can be able to build the foundation of learning and development of the mind of children in the future, assist children in the development of critical thinking and reasoning skills, increase children's interest in learning Science and Mathematics and STEM-related careers in the future, develop curiosity in children, make children love to ask and like to investigate as well as give them a broad experience of the natural and artificial worlds around them (Hoachlander & Yanofsky, 2011).

It's interesting to see how the literature is progressively supporting the importance of early STEM exposure. At their core, children are collaborators, problem solvers, and engineers, with limitless leadership, creativity, and invention potential (Stone-MacDonald *et* al., 2012). MOE mentioned that STEM education aims to combine all areas of STEM knowledge in the teaching and learning process starting from the school level to cultivate the interest of the current generation in pursuing the field of STEM education (Daud, 2019). In fact, although the Malaysian government has promoted education at an early stage, however, STEM Education is not the main choice of the majority of Malaysian students today. Only 44 percent of Malaysian students takes the field of STEM compared to 49 percent in 2012 and this is an average reduction of about 6,000 students each year (Malaysian Educational Policy Planning and Research Division, 2019).

Many developed countries like America, Australia, and Canada have started introducing STEM in their early childhood education sySTEM (Hassan *et* al., 2019). While in Malaysia, STEM educational attainment based on the TIMSS and PISA found not encouraging. Malaysia has been in the position of the bottom two-thirds of the entire country involved (Andrews *et* al., 2014). The possibilities of STEM in early childhood education have been relatively unexplored, and early childhood STEM initiatives in Canada are few and far between. STEM may refer to any one of the four individual disciplines, it may denote the fusion of all four disciplines, and it may sometimes denote the combination of two or more of the individual disciplines, adding to the complexity of approaches across North America (National Academy of Engineering and National Research Council, 2014). Therefore, to ensure that STEM Education can be well received by children at an early stage, the role of teachers in making STEM Education attractive is very important. Teachers and STEM

programmes provide children with the opportunities, support, and experiences they need to reach their full potential during the learning and practice required to develop STEM talent (MacFarlane, 2016).

As a result of extraordinary rise in information about how young children learn, early childhood education has evolved fast in recent years (Morrison, 2012). According to a report published by the Boston Children's Museum (2013), the earlier children who do participate in real-world applications of science, technology, engineering, and mathematics, the more equipped they will be to acquire the abilities required in each discipline. Immersion is the ideal approach for children to develop these skills, just like it is for languages. STEM children benefit from regular opportunity to put their abilities to the test and participate in hands-on activities that are relevant to their interests (Gilbert *et* al., 2020). Children learn to make sense of their world by getting a complete and more firm understanding through open-ended and hands-on play exploration and experiences, which are a fundamental component of STEM education, (Nell, Drew, and Bush, 2013).

1.3 PROBLEM STATEMENT

Implementing the STEM approach required students to have a basic understanding of each field of knowledge as well as a strong concept of each field of knowledge. Through the implementation of education in schools, teachers' influence on improving children's mastery of skills is holistically important. According to Margot and Kettler (2019), teachers stress the relevance of student participation in STEM application

activities as a key measure of their academic progress. Clearly, the quality of education received by children will improve if preschool and kindergarten teachers spend a large amount of time to STEM instruction. This statement could be supported through the statement from National Science Foundation (NSF) Initiative (2018), students at all sorts of schools, regardless of size or specialty, can and do engage in high-quality science, mathematics, and engineering instruction, according to best practices in STEM education. Teachers must teach best teaching practices to children in order for them to acquire quality knowledge while participating in STEM activities. Furthermore, effective STEM education required skilled teachers who could deliver knowledge integrated with inquiry-based STEM methods in order to develop STEM capabilities and positive dispositions in all students (Murphy, MacDonald, Danaia & Wang, 2019).

In order to ensure that children are interested to get connected with any activity, the role of teachers is important. Pre-service and in-service teachers' preparation and training programmes should include, in interconnected through meaningful ways. It means that STEM content, training in children's developmental learning progressions in STEM, and well-modeled and practiced pedagogy in the classroom are all required (McClure *et* al., 2017). STEM modification and integration with learning approaches or models has a high potential for facilitating implementation and achieving effective instruction (Martín-Páez, Aguilera, Perales-Palacios, & Vílchez-González, 2019). However, STEM learning can be implemented in conjunction with or in place of other learning approaches (Chung, Lin, & Lou, 2018).

In recent years, there has been a growing acceptance of the idea that STEM implementation should begin in early childhood education (Tippett & Milford, 2017). STEM activities, according to Akgündüz and Akpnar (2018), help students develop

science, math, and 21st-century skills. In addition, STEM education is one of the newest ways to be applied in the educational sySTEM, with the goal of preparing children to solve challenges in their daily life (Idin, 2018). A proper curriculum must be developed to support STEM education initiative at an early age. Soylu (2016) proposed numerous methods for incorporating STEM education into early childhood education, including project-based learning and play-based learning, which provide hands-on experience and active participation. According to the Early Childhood STEM Working Group (2017), offering positive experiences from a young age is critical in developing young children' attitudes and ideas about their capacity to achieve in STEM. However, it will be easier for teachers to implement school activities if they have a good understanding of the STEM concept.

Implementing STEM activities in preschool, kindergarten and school is difficult due to the numerous challenges that either teachers or children should be faced. According to Nadelson and Seifert (2017), implementing integrated STEM education necessitates poorly structured problems with multiple solutions, as well as extensive knowledge across all disciplines. Problem and project-based learning, as well as inquiry-based learning, are examples of integrated STEM approaches used in schools to teach children. On the other hand, other problem that can be seen is according to Rahayu *et* al., (2018), it is stated that science and mathematics teachers have limited time and materials to integrate STEM Education into teaching and learning in a meaningful way. When looking at the issues that teachers frequently face when implementing STEM teaching, it is due to a lack of STEM knowledge itself. Due to a lack of knowledge and skills, many types of STEM education approaches are difficult for students to implement (Khalik *et* al., 2019).

Last but not least, numerous constraints limit the success of integrated STEM efforts, including, but not limited to (a) a lack of time to fully implement STEM lessons; (b) project costs, materials and special equipment; (c) a lack of high quality STEM integrated curriculum and (d) pressures for end-of-course assessment (Dare, Ellis, & Roehrig, 2018). Furthermore, while engineering and technology teachers are adept at creating prototypes and teaching design, they have limited expertise using scientific inquiry to guide the design process (Ntemngwa & Oliver, 2018). At the same time, the inadequate selection and use of the teaching aids such as models, images, IT integration, and other visual representations are another problem faced by the teachers. In spite of their considerable effects on the success of STEM teaching and learning, these instructional aides are either absent in or simply ignored in STEM classes (Alkhaldi et al., 2020).

Create thinking is not only required for students to do and improve in the twenty-first century, but it is also likely owing to the misconception that Mathematics and Science are not the "proper" types of school topics in which students can design and develop design thinking. Thus, teachers of specialized disciplines such as art or engineering are responsible for the development of students' design thinking, but not teachers of standard school subjects such as Science and Mathematics (Li *et* al*.,* 2019). To assist the implementation of integrated STEM lessons or activities, educators must also have pedagogical knowledge (Ling, Pang, & Lajium, 2020). Teachers must be well-prepared in both content and pedagogy to lead high-quality STEM activities in their classrooms to ensure that all preschool children have access to high-quality STEM experiences. Teacher accreditation requirements must be changed to include STEM preparation and continuous assistance, as well as early childhood programmes (ECSWG, 2017).

According to Rahman *et* al., (2020) (a) teachers must be trained to be STEM specialists; (b) efforts must be made to implement STEM education at the preschool level to ensure continuity; (c) student-teachers participating in early education programmes must take science and mathematics courses; and (d) a STEM Education Policy must be established in order for the government to provide funding for STEM implementation at the preschool level. The same challenges faced by Malaysia in implementing this approach STEM integration. If teachers are less exposed to this approach because it is new, professional training in the integration of STEM education in Malaysia should be strengthened and monitored in order to establish a competent teacher in knowledge, skills, and attitudes in the context of STEM integration, (Bahrum, Wahid, & Ibrahim, 2017).

To ensure children can be well-prepared in STEM activity, those who have difficulty adapting to new situations might now form stronger bonds with their peers (Yalçın & Erden, 2021). For schools such as kindergarten and preschool, in order to integrate quality STEM instruction, it is crucial to understand teachers' ideas and perceptions about STEM talent development (Morgot & Kettler, 2019). According to Pawilan & Yuzon (2019), for young children with gifted potentials and interests in the subjects of Science, Technology, Engineering, and Mathematics, the STEM curriculum could be a viable alternative to the traditional kindergarten curriculum.

1.4 CONCEPTUAL FRAMEWORK

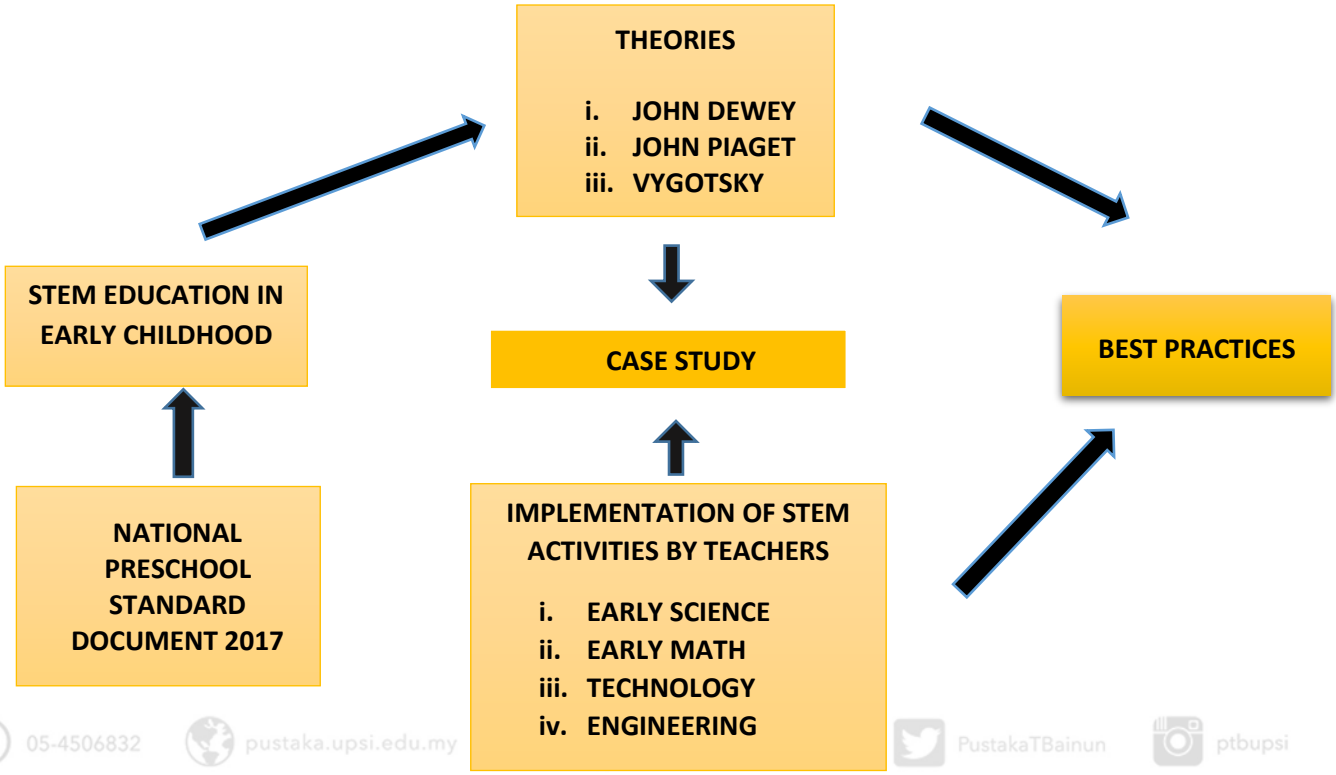

Figure 1.1: Conceptual Framework

Overall, the researcher had conducted a case study to ensure that the objectives of the study are achieved. While conducting the case study, there are two things that are emphasized by the researcher, namely the disclosure of findings through the implementation of teaching and the application of theory in teaching by the study participants. In this way, the researcher will obtain results from this study to achieve the objectives. This case study was conducted to ensure that the researcher could get specific findings based on qualitative study. According to academician, the case study method is the most commonly used method for qualitative researchers (Hancock & Algozzine, 2016). Through this statement, it can be concluded that qualitative study is an appropriate study in obtaining important data from the participants in this study.

Moreover, in terms of the implementation of teaching, it is in line with the objectives of the study where each participant has a specific topic or discipline to answer the research questions. As an in -depth explanation, the first study participants will implement a teaching topic related to Early Science. The second researcher will conduct a study related to Early Mathematics. The third participant will conduct a study of technological activities. And the fourth study will conduct a study of engineering activities. All participants will combine their teaching using all four STEM disciplines even though they have their own teaching topics. To ensure that the data obtained from the implementation of the teaching can be recorded well, there are two ways that are implemented, namely through interviews and observations through checklists.

Furthermore, for the application aspect of teaching, the researcher will try to link the methods, techniques, strategies, and approaches that teachers use with some important theories such as John Dewey, John Piaget and Vygotsky. It means, the researcher will make observations of the teacher's teaching whether there is a relationship or not with the ideas promoted from these theories. In the end of the research, the researcher will support the findings of this study by relating it to the views of these philosophers.

Next, an important item in this study is the implementation of teaching and learning sessions in Early Childhood Education from the perspective of The National Preschool Standards-Based Curriculum and Assessment Document 2017 (DSPK 2017). In this document, many things are discussed about the appropriate standards for teaching children STEM education based on the proposed activities. In addition, this document is the main reference for the multiplier in analyzing the contents and

important information in order to ensure that this study is in line with what is decided by the Ministry of Education Malaysia.

Last but not least, the backbone of this study is the best practices that will be revealed in this study after the completion of the process of collecting, analyzing, and validating the data. It means, there are important data that will be shared with the community, especially early childhood educators, especially kindergarten teachers, early childhood education practitioners, and the Ministry of Education Malaysia in referring to the initiatives shared by researchers in developing Early Childhood Education. Children in the country through STEM Education.

1.5 RESEARCH OBJECTIVE

i. Explore the best practice in early Science towards the implementation of STEM activity in kindergarten.
ii. Explore the best practice in early Mathematics towards the implementation of STEM activity in kindergarten.
iii. Explore technology-assisted teaching tools towards the implementation of STEM activity in kindergarten.
iv. Explore engineering activity towards the implementation of STEM activity in kindergarten.

1.6 RESEARCH QUESTION

i. What is the best practice in early Science towards the implementation of STEM activity in kindergarten?
ii. What is the best practice in early Mathematics towards the implementation of STEM activity in kindergarten?
iii. How do teachers use technology towards the implementation of STEM activity in kindergarten?
iv. How do teachers include engineering activity towards the implementation of STEM activity in early childhood education?

1.7 RESEARCH GAP

A research gap is a question or a problem that has not been answered by any of the existing studies or research within our field. Sometimes, a research gap exists when there is a concept or new idea that has not been studied at all (Wolf, 2019). The gap that can be seen through before the researcher conducts this study is the relationship between the respond of teachers to the implementation of STEM Education teaching in kindergartens with the stipulations that have been outlined by the MOE. This means researcher can see the difference gap roughly through the findings of previous studies. As a proof, the studies on STEM education at the school level are less explored in Malaysia and this will cause STEM Education to be ignored. This is confirmed in the study of Jayarajah, Saat, and Rauf (2014) who found that Integrated STEM studies in Malaysia are more focused on higher education and less emphasis at the school level.

To ensure that this gap can be overcome, this study is seen to provide a reference to early childhood educators, especially in improving self-skills to diversify STEM teaching practices to children. And this is in line with what is targeted and realized by the MOE itself. On the other hand, supported by the Malaysian Education Blueprint 2013-2015 document, it will be a benchmark for teachers in producing children who are able to compete at the global level in line with 21st century learning. In addition, through the success and potential shown by the teachers in improving the development of STEM Education in early school, this idea can be contributed to the MOE to provide encouragement to Malaysian early education teachers nationwide to use this best practice in STEM teaching in kindergarten and preschool.

1.8 SIGNIFICANCE OF RESEARCH

The significance of the study is explained in the written statement that must be made. The researcher will justify the significance of this study and its impact on this field of study. Furthermore, the researcher will discuss how knowledge contributes to new knowledge and how others benefit from it.

1.8.1 RELATED THEORY

As is well known, there are 3 theories that serve as benchmarks as the effectiveness of teachers in implementing STEM teaching to kindergarten children. Commonly known, Jean Piaget's Theory of Constructivism, Vygotsky's Sociocultural Theory, and

John Dewey's Theory of Education are very important in the world of education including early childhood education. If looking at the importance of John Piaget's Theory, adapting instruction to the developmental level of the learner is an essential aspect of Piaget's theory. The topic of education must be appropriate for the learner's developmental stage (Piaget, 1983). If viewed in the context of this study, the researcher emphasizes more on the way of implementation of the teacher's teaching whether the results presented physically coincide or not with the views of these philosophers. It means, are the outcomes of teaching through appropriate developmental levels in a certain way able to have a positive impact on children or vice versa? These findings will further strengthen these theories if teachers directly or indirectly apply the views from the theory of constructivism.

In addition, the researcher will also reveal about the importance of Vygotsky's sociocultural theory to this study. According to Vygotsky (1962) in his study, he believed that the greatest way to understand a child's growth is to look at his or her social and cultural experiences. In particular, social interaction is recognized as a vital component in development. Through this view, the researcher will identify to the power of teachers' interactions with children to ensure that children develop holistically through learning through STEM activities. If good interaction and social methods are used by teachers in their teaching, then it has been explained that the key to children's development is their environment through social interaction between teachers and them. And this could support that Vygotsky's theory should be applied in STEM Education at an early stage.

In addition, the third theory is used as a benchmark in this study is the theory of education supported by John Dewey. In early childhood education, his views have

been held by many researchers and teachers in this field. For example, John Dewey (1916) stated that children nowadays require more tangible and experienced activities in order to develop an understanding of how they may contribute to and change society for the better. It means, meaningful children's learning activities will lead them to thrive in the process of contributing to themselves and society in the future. In this study, STEM teaching is an important activity to promote children's development. If a child is able to experience change from various aspects of development, then it can clearly support the views and ideas put forward by John Dewey. Therefore, teachers' best practices provided to children can enhance children's development through STEM education and this will support this theory in the implementation of teaching activities in the future.

1.8.2 TEACHING MODEL

The use of teaching models in an education is very important to achieve a goal set by an individual or institution. STEM Education teaching models for kindergarten children have many variations. In this study in particular, the researcher will look at how teachers in promoting the STEM disciplines itself in encouraging children to learn STEM activities in school. Based on the model founded by Mpofu (2019), there are four ways of integration that can be implemented by teachers in conducting STEM studies in kindergartens. These integrations can be translated through the first four ways, namely isolated integration (S-T-E-M), independence integration (STEM), one into three-integration (ES-T-M), and STEM (all four disciplines infused).

This teaching model will reveal to the researcher about which method is more appropriate and effective in implementing STEM activities with kindergarten children. Through this encouragement, it will be a reference for teachers and practitioners of early childhood education in planning activities appropriate to the child's developmental stage. Teachers and STEM programmes give children with the resources, support, and experiences they need to attain their full potential during the study and practice required to develop STEM talent (MacFarlene, 2016). Therefore, the use of teaching models in STEM education programs is able to give an advantage to children to develop actively through activities implemented by teachers.

Therefore, to ensure that children's development can develop in parallel with the activities carried out in kindergarten, teachers need to play an important role in selecting the most appropriate STEM teaching model. According to the findings of Margot and Kettler's research (2019), STEM education should be introduced into kindergarten level, according to teachers. This is because, it brings a positive effect to children in achieving results through their learning through STEM Education and they will also be able to develop their ideas through the skills provided in STEM activities.

1.8.3 21st CENTURY'S STEM PEDAGOGY IN EARLY CHILDHOOD EDUCATION

Today's learning requires a variety of skills for children to master so that they can survive in the 21st century. Learning through STEM Education is not only concerned with the quality of children's development but more concerned with the learning process than the time planned by the teacher himself to obtain the desired results.

Additionally, time on task metrics are unable to separate essential features of the 21st-century classroom environment, such as the engagement of children, successful use of instructional styles, or emotional components that enhance child development (Seidman et al., 2018). Therefore, teaching in this modern era is not based on the teacher's targets individually, but it needs to take into the consideration of the development of children needed to stay in touch with the challenges of the present.

As we know, 21st century learning requires various skills to be mastered by children and among them are problem solving skills. From the aspect of STEM education, the problem solving element is one of the keys in this educational pedagogy. This can be evidenced through the view of Mobley (2015) which he stated that "STEM education is defined as "an educational method in which multidisciplinary applications are developed to solve real-world problems and connections between disciplines are established." Naturally, mastery of problem solving through STEM education is very important for children's development, as they are not only able to complete a given activity, but they are also able to communicate with their cognitive skills.

Therefore, through the findings of this study, it will reveal to Malaysian teachers about what is the best pedagogy in implementing STEM activities in kindergartens or any early childhood education institution. In addition, through this study as well, it will provide an opportunity for teachers to learn about how to improve children's learning process without criticizing their learning because STEM education itself is a learning process for them to face challenges in next time. Classes and schools that consist of kindergarten, primary, and secondary school must be geared around 21st century skills and knowledge, and educators must integrate and implement these abilities in

order to provide quality education in a global competitive economy (Sen *et* al., 2018). Therefore, the provision of meaningful instruction will give children an advantage also to interact with their environment because the methodology of teaching or pedagogy supporting STEM learning is offered in a variety of ways in early childhood level (Campbell *et* al, 2018).

1.8.4 THE POLICY OF MINISTRY OF EDUCATION MALAYSIA

Each country has its own aspirations about their education. The same is true in Malaysia. In the aspect of STEM education, the Ministry of Education Malaysia (MOE) has set its own vision in developing STEM education in the country. The MOE (2013) stated that MOE's vision is to be a nation of quality and sufficient STEM human capital that drives the economy. It means that Malaysia will develop the potentials, talents, skills, and development of students from kindergarten to secondary school in producing a quality generation through specific activities and programs implemented. According to Malaysia Education Blueprint 2013 - 2025 Foreword 1 (PPPM), There are three goals of the MOE initiative in achieving the PPM vision, namely:

i. Increase student interest through involvement in STEM activities through formal, informal and non-formal learning.
ii. Improving teachers' knowledge, skills, and abilities in STEM education implementation through teacher competency improvement programmes.
iii. Promote STEM education to school students and public through global awareness initiatives.

There are many methods that can be done by the school in improving children's learning to do STEM activities. As evidence, this study will reveal about the role of formal education in motivating children to pursue STEM education. It means how teachers can provide the best possible learning for children learning STEM Education in kindergarten. As a proof, according to Dilek *et* al. (2020), children were able to practice various abilities in a collaborative environment through STEM activities. Therefore, the provision of activities that are interesting, effective, and appropriate to the child's development is a necessity to form a child who has the best personality.

Making improvements for teachers in improving the ability to teach STEM to children is a necessity nowadays. According to Bilican (2020), there are a few recommendations for early childhood educators to master STEM education programs and it can be seen as below:

i. Pre-service STEM-related training and assistance for early childhood educators should be renewed.
ii. Advocacy to raise the profile and understanding of early childhood STEM education
iii. Ensure that early pre-school learning and development goals explicitly cover STEM disciplines and are consistent with K-12 goals.

Based on this statement, it can be shown that teachers' mastery and understanding of STEM education is very important. This is because, children need a clear understanding when they study STEM. Therefore, strengthening programs for teachers need to be done from time to time.

In addition, promoting STEM education to school students and public including kindergarten children is necessary nowadays. Early STEM identity development can be thought of as a social identity formed through early and deliberate exploration of STEM and explicit awareness of the importance of STEM-related activities in everyday life for young children (Harcey, 2020). Therefore, to ensure that these three initiatives can be achieved, early childhood education practitioners, and early childhood education teachers need to play an important role in efforts to improve the development of STEM education in Malaysia. Through this study, it will reveal to stakeholders and policy makers about what are the best practices that can develop children's talents through STEM learning in schools. Next, it will be an encouragement to teachers to cultivate scientific nature in children.

1.9 RATIONALE OF RESEARCH

The rationale in this study is to expose early childhood educators, early childhood education practitioners, early childhood education training teachers, teacher assistants, and individuals who are directly or indirectly involved in child development activities. Through this study, it will encourage various parties to gain ideas on how best practices in implementing STEM activities at an early stage, especially at the kindergarten and preschool levels. Simply put, it will be a reference to various parties in implementing STEM Education with children aged 5-6 years. According to Sarama *et* al, (2018), early childhood educators need appropriate and high quality support in order to teach STEM education to ensure that children can developmentally understand appropriate STEM concepts and practices.

There are various practices in implementing STEM activities at early stage of school. However, the researcher will reveal the best practices in implementing each STEM discipline by integrating other STEM disciplines. What distinguishes this study from other studies is that it will reveal about specific topics such as early science, early mathematics, the application of technology, and the promotion of engineering skills in activities in kindergarten. Therefore, this study will encourage teachers to diversify pedagogy in teaching in kindergarten and it is in line with the view of Thibaut *et* al, (2018) which he stated that teachers should also be well-versed in how to teach STEM subjects to students. In this way, best practices that can be applied to children are able to be a useful reference to other teachers.

Last but not least, through conducting this study, it will be a link between the problems in STEM education with the improvement of STEM content itself. Although there are many difficulties as stated by the MOE (2013), there are five main factors that causing the transmission of enrollment and the quality of student outcomes in STEM which are:

1. Lack of awareness and skills in STEM.
2. STEM subject is considered difficult.
3. The content of curriculum is too tight.
4. Teaching and learning quality is not consistent.
5. Available infrastructure is not enough and old.

However, the researcher will reveal that the above barriers are not a big problem to implement STEM activities because the creativity of the teacher is widespread. Most importantly, teachers must have in-depth knowledge of the Science, Technology, Engineering, and Mathematics topics they teach in order to integrate

STEM effectively (Eckman et al., 2016). Therefore, this study will discuss that teachers 'creativity and understanding of STEM activities will be key in achieving teaching objectives. Naturally every problem and challenge can be overcome with creative and easy ideas for children to learn. Through the results that will be obtained, it will be a reference to the community out there in improving self -efficacy to diversify teaching methods and techniques in STEM activities. In addition, this will indirectly be an interesting and creative educational learning to children in line with the government's intention in focusing on 21st century learning.

1.10 RESEARCH LIMITATION

In this study, researcher was not able to study something larger in a more specific way, so the researcher limited this study in a smaller way to ensure that the findings of the study would be satisfactory. Although the researcher placed a smaller area of the study where only four study locations were selected, but the essence of this study was considerate comprehensively to achieve the fixed of research objectives. On the other hand, the limitation that had been overcome while conducting the study is through selecting the teaching themes in STEM education scope. At the beginning of the study, there were some participants who were less proficient about STEM education, but the researcher did overcome this issue immediately through re-selection of participants. This was done to ensure the implementation of the study runs smoothly without having obstacles to collect data from the selected participants.

Moreover, the limitation in this study that had been experienced by the researcher is the challenge to implement the data collection process in the COVID-19 pandemic. At the beginning of the study, the researcher had searched many study locations, yet not many owners from private institutions and principals from government schools were able to accept the researcher's request to carry out the study because they were worried if something undesirable happened. So the thing that the researcher could do to overcome this problem is through slow talk with the owners and convince them with reference of the implementation of the study based on the right SOPs and research implementation's guidelines. Finally, the researcher had obtained 4 study participants who were willing to offer their expertise in this study.

Last but not least, the limitation in this study is the researcher could not conduct the study session face to face with all participants. This is because researchers need to adhere to ethics and SOPs while conducting research in the new normative rules. Only three lessons could be done face-to-face and another one could be done virtually the researchers were unable to do so because the COVID-19 outbreak was still at a dangerous level at the time. Although one teaching was done online, the researcher was able to record important data throughout the whole teaching.

1.11 OPERATIONAL DEFINITION

According to Muraina (2018), the deep meaning of your conceptual constructs, which are based on the theory behind the research, is dealt with in conceptual definition. Operational definition, on the other hand, is concerned with how you may link the

components you've studied to a specific domain. In this study, the researcher will reveal between the two definitions which will be a comprehensive introduction of what this study actually is.

1.11.1 BEST PRACTICES

The term "best practice" implies that there is a strategy, method, process, activity, incentive, or reward that is more effective than others at achieving a specific goal. The concept is that by following right procedures, performing checks, and testing, the desired output can be achieved with fewer issues and complications. They can also be characterized as the most efficient (least amount of effort) and successful (best results) method of completing a task, based on repeatable methods that have been proved for large groups of individuals over time (Marrison, 2019). To ensure that this study can contribute to children, teachers need to play an important role in creating best teaching practices. Through these best practices, teachers are able to create a quality learning as inspired by MOE.

1.11.2 STEM EDUCATION

STEM education, according to the Malaysian Ministry of Education (2015), entails incorporating all areas of STEM knowledge into the teaching and learning process beginning at early school level in order to encourage the current generation to pursue

STEM careers. Therefore, kindergarten is an important mechanism in creating and introducing a holistic environment through STEM education to children. In ensuring that children can meet the learning challenges of the 21st century, children need to be encouraged to learn STEM activities at an earlier stage such as in kindergarten or preschool.

1.11.3 TEACHERS' ROLES IN A STEM SETTING

STEM teachers must adapt new ways from the disciplinary approaches they were trained for in such a rigorous and demanding educational setting. It means that teachers need to know about the important things that are a benchmark for STEM education before applying the consistency to the activities that have been planned. To organize authentic STEM projects for children, STEM teachers would need to have both topic expertise and professional characteristics (Laboy-Rush, 2011). In this study, the role of educators is very important to provide a positive environment and cultivate 21st century educational skills through STEM activities designed and conducted. Teachers who are able to groom a child's potential at an early stage will produce better quality children to their admission time.

1.11.4 BEST PRACTICES OF STEM EDUCATION IN KINDERGARTEN

For the basis of implementation, the researcher will measure the best practices that would be revealed by four different kindergarten teachers in four different STEM

activities. Each teacher would have a group of children to join STEM activity in classroom. The best practices will be measured based on 4 key disciplines related to early science, early mathematics, use of ICT materials, and engineering skills. These practices would be assessed from interviews, observations, and document analysis. And also, these best practices would be a reference for early childhood educators, early childhood education practitioners and the Ministry of Education Malaysia about how STEM Education does really work in classroom (Kasza & Slater, 2017). Through best practices shared by teachers through the implementation of STEM activities, it will not only improve the quality of teacher teaching and the quality of student development, but it will also bring a change to the national education sySTEM as well. As much is promoted by the MOE, every school needs to provide the best possible teaching needs to children.

1.11.5 TEACHER'S IMPLEMENTATION OF STEM EDUCATION

Understanding STEM is critical because it has the potential to transform STEM teachers' perspectives. We must also emphasise that STEM is not a new concept for teachers. They've already done that, as evidenced by the projects they cited in their comments. The authorities play an essential role in disseminating knowledge and providing training to teachers who will be implementing STEM in schools (Ramli & Talib, 2017). To see the extent to how teachers can apply their understanding of STEM education in teaching, the researcher does not limit the teaching based on certain conditions. Study participants are free to choose what practices they want use in teaching as well as they are also free to give ideas about the best STEM teaching based on their experience. Through a combination of implementation and ideas

through a process of interviews and observations, the researcher will acquire important themes on the best practices of STEM education at the kindergarten level.

1.12 CONCLUSION

In this topic, researcher discussed about introduction, background of research, problem statement, objective and question of research, significance of research, research gap and rationale of research, research limitation, conceptual and operational definition, and conclusion. Hopefully, based on the explanation discussed in this topic, it could make readers understand clearly about the purpose of why the researcher chose this topic as his research. By this rough overview, researcher could thrive and succeed to produce a better research purposely to those who intentionally want to refer this research as their reference. Through the encouragement of educational development through STEM Education, it will encourage children to learn with fun feelings as well as provide exposure to teachers on how to apply the best practices to teach any STEM activity in the future.