

**AN EVALUATION OF STEM-BASED LEARNING
ACTIVITIES: STUDENT'S INTEREST AND
UNDERSTANDING OF THE FORCE
AND MOTION CONCEPTS**



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UNIVERSITI MALAYSIA SABAH

**FACULTY OF PSYCHOLOGY AND EDUCATION
UNIVERSITI MALAYSIA SABAH
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**THESIS SUBMITTED IN FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY**

**FACULTY OF PSYCHOLOGY AND EDUCATION
UNIVERSITI MALAYSIA SABAH
2022**

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DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, equations, summaries and references, which have been duly acknowledged.

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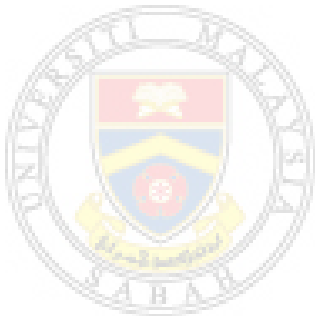
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Maya Insana Binti Mohd Terang
21 June 2022

ABSTRACT

This study's objective is to assess a number of STEM-based learning activities (STEM-bLA) utilising the Context, Input, Process, and Product (CIPP) model in order to gauge students' conceptual interest in and grasp of the subject of Force and Motion. Researchers used the Analysis, Designing, Development, Implementation, and Evaluation (ADDIE) paradigm of instructional design for creating STEM-bLA. In a typical everyday school in a rural area of Sabah, researchers have looked at the qualities of learning activities that can pique students' interests, particularly among form four secondary physics students. The researcher then developed a series of STEM-bLA on the basis of the identified learning activities with the goal of influencing students' conceptual knowledge of the subject of force and motion. A case study methodology is used in this evaluation research to investigate the genuine context-bound factors as informants, location, and time. This qualitative study was conducted with 17 students in a science stream class in a regular B school in a rural part of Sabah. Data were gathered by observation, discussion in the classroom, student responses to the assigned activities, and use of the STEM-bLA, SM1, SM2, and others. The primary materials for this study were the researcher's field notes and the students' written responses during a three-month period. The transcribed interviews with the informants were triangulated with member and panel experts to confirm the reliability of the data. The information gleaned from participant responses to the diagnostic test and tasks at the conclusion of each STEM-bLA was compared to the data gathered. The outcome demonstrates that this STEM-bLA has increased students' enthusiasm in studying physics. Additionally, there were modifications in the way that students understood physics conceptually. The preceding misunderstanding is successfully corrected. At the same time, a fresh misunderstanding is emerging. This STEM-bLA is used as teaching resources by educational professionals, particularly for certain physics ideas. In addition, this STEM-bLA serves as an "engagement tool" to pique students' curiosity about what they are learning. Last but not least, this STEM-bLA can be used as a "learning probe" to track how well the physics students are grasping particular physics ideas. However, the study only touched on a few Force and Motion-related physics concepts. In order to help instructors use STEM-bLA in the teaching and learning of physics ideas for the topic of Forces and Motion, a framework was later developed using the qualitative findings. The framework can be effectively used to promote students' HOTS, foster conceptual understanding, and enable meaningful science learning. More STEM-bLA will be created as a result, as indicated for further research. Other subjects and more physics concepts will be covered in the exercises. This work will eventually result in more engaging physics learning exercises for the students and will aid in the improvement of their conceptual knowledge of physics.

ABSTRAK

SATU PENILAIAN AKTIVITI PEMBELAJARAN BERASASKAN STEM, STEM-bLA: MINAT DAN PEMAHAMAN MURID BAGI KONSEP DAYA DAN GERAKAN

Kajian ini bertujuan untuk menilai satu siri aktiviti pembelajaran berasaskan STEM, STEM-bLA, menggunakan model penilaian Konteks, Input, Proses, dan Produk, KIPP terhadap minat dan pemahaman konsep Daya dan Gerakan. Pengkaji membangunkan siri aktiviti STEM-bLA berpandukan model reka bentuk pembelajaran, ADDIE. Pengkaji ingin meneroka ciri-ciri aktiviti pembelajaran yang dapat menarik minat murid khususnya dalam kalangan murid tingkatan 4 yang mengambil mata pelajaran fizik di sekolah harian biasa di kawasan luar bandar di Sabah. Seterusnya berdasarkan ciri-ciri pembelajaran yang telah dikenal pasti, pengkaji merancang satu siri STEM-bLA dan berharap agar dapat membuat perubahan dalam pemahaman konsep fizik murid bagi topik Daya dan Gerakan. Pengkaji telah menggunakan pendekatan kajian kes dengan harapan agar dapat meneroka konteks sebenar kajian mengikut batasan-batasan seperti peserta, tempat, dan masa kajian dijalankan. Kajian kualitatif ini melibatkan sebuah kelas aliran sains, yang mempunyai 17 orang murid di sebuah sekolah gred B di kawasan luar bandar di Sabah. Kutipan data melibatkan proses pemerhatian, soal-jawab semasa sesi pengajaran dan pembelajaran, respon murid bagi tugas dalam aktiviti pembelajaran, Item soalan SM1 dan SM2 serta penggunaan satu set STEM-bLA. Catatan kerja lapangan dan respon bertulis murid selama tiga bulan merupakan sumber utama data dalam kajian ini. Dalam penentuan kesahan dan kebolehpercayaan kajian, data yang dikumpul melalui kaedah triangulasi, pemeriksaan rakan sebaya, dan pemeriksaan pakar. Dapatan akhir kajian menunjukkan bahawa siri STEM-bLA yang telah dicadangkan oleh pengkaji membantu dalam menarik minat murid terhadap mata pelajaran Fizik. Selain itu, berlaku perubahan dalam pemahaman konsep fizik murid yang mana pemahaman konsep yang salah (miskonsepsi) yang telah dikenal pasti sebelum kajian dapat dibetulkan, akan tetapi terdapat pemahaman konsep yang salah (miskonsepsi) yang baru dikenal pasti. Sebagai seorang pendidik, siri STEM-bLA ini, boleh digunakan sebagai bahan bantu mengajar, terutamanya bagi konsep fizik yang terlibat sahaja. Selain itu siri STEM-bLA ini dapat dilihat sebagai alat yang dapat memancing perhatian murid (engagement tool) untuk belajar fizik. Akhir sekali, siri STEM-bLA ini boleh digunakan sebagai alat pemantau (learning probe) perkembangan pembelajaran murid bagi konsep fizik yang terpilih. Data kajian kualitatif ini akhirnya diguna untuk mencadang satu kerangka kerja yang dapat membantu guru menerapkan STEM-bLA di dalam kedua-dua pengajaran dan pembelajaran konsep Fizik topik Daya dan Gerakan. Menggunakan kerangka kerja ini, pembelajaran Fizik yang bermakna diharap dapat diwujudkan, seterusnya membina kefahaman konsep serta, menyemai KBAT dalam kalangan murid. Oleh itu, dicadangkan agar lebih banyak siri STEM-bLA dapat dibina bagi topik dan konsep fizik yang lain agar pengajaran dan pembelajaran fizik kelak dapat menarik minat serta membantu dalam perkembangan pemahaman konsep fizik murid.

LIST OF CONTENTS

	Page
TITTLE	i
DECLARATION	ii
CERTIFICATION	iii
ACKNOWLEDGEMENT	iv
ABSTARCT	v
<i>ABSTRAK</i>	vi
LIST OF CONTENTS	vii
LIST OF TABLES	xiii
LIST OF FIGURES	xv
LIST OF PHOTOS	xviii
LUST OF ABBREVIATIONS	xiv
LIST OF APPENDICES	xxii
CHAPTER 1: INTRODUCTION	
1.1 Introduction	1
1.2 Background of the Study	3
1.3 Statement of Problem	7
1.4 Purpose of the Study	12
1.5 Research Questions	14
1.6 Significant of the Study	15
1.7 Definition of Terms	16
1.7.1 Evaluation	16
1.7.2 STEM-based Learning Activities, STEM-bLA	16
1.7.3 Concepts of Force and Motion	17

1.7.4	Physics Students	17
1.7.5	Students' Conceptual Understanding	17
1.7.6	Teaching Strategies	17
1.8	Assumptions	17
1.9	Limitations of the Thesis	18
1.10	Organisations of the Thesis	19

CHAPTER 2: REVIEW OF LITERATURE

2.1	Introduction	21
2.2	Historical Background of Education Development in Malaysia	21
2.2.1	Science Education in Malaysia	24
2.2.2	Enhancement of STEM Initiative	26
2.3	Learning	32
2.3.1	21 st Century Learning (<i>PAK21</i>)	32
2.3.2	Constructivism Learning Theory	33
2.3.3	Criteria of Learning	36
2.3.4	Learning Activities	36
2.3.5	Constructivism Learning Module for Physics Concepts	40
2.4	Learning Physics Concepts	45
2.4.1	Students' Deficiencies	45
2.4.2	Conceptual Understanding	47
2.4.3	Concepts of Force and Motion	50
2.5	Evaluation	53
2.5.1	Theories of Evaluation	54
2.5.2	Evaluation Models	56
2.6	Challenges in Implementing Teaching and Learning STEM Subjects	69

2.7	Conceptual Framework of This Study	72
2.8	Summary	74
CHAPTER 3: METHODOLOGY		
3.1	Introduction	75
3.2	Research Design of the Study	76
3.2.1	Evaluation and Research	76
3.2.2	Qualitative Evaluation Research	82
3.2.3	Qualitative Case Study Research	84
3.3	Research Paradigm	85
3.3.1	Ontology (Reality)	87
3.3.2	Epistemology (Knowledge)	87
3.3.3	Methodology (Systematic Inquiry)	88
3.3.4	Axiology (Ethics)	88
3.3.5	System of Belief	88
3.3.6	Researcher's Philosophical Tenets	94
3.4	Research Plan	96
3.4.1	Evaluation Process	96
3.4.2	The Fieldwork Schedule	100
3.5	Participants and Site	100
3.5.1	Pilot Study, PS	101
3.5.2	Actual Study, AS	102
3.6	Gaining Access and Permissions	103
3.6.1	Pilot Study, PS	104
3.6.2	Actual Study, AS	105
3.7	Data Collection and Instruments Used	106

3.7.1	Interviews	107
3.7.2	Classroom Observation and Filed Notes	108
3.7.3	Mechanics Survey and STEM-based Learning Activities	109
3.7.4	Documents Analysis	111
3.7.5	Types of Data	112
3.7.6	When to End the Data Collection?	113
3.7.7	Implication of the PS Data	114
3.8	Transcribing Data	115
3.9	Qualitative Data Analysis, QDA	117
3.9.1	QDA During PS	119
3.9.2	QDA During AS	119
3.9.3	Coding and Themes Arisen	120
3.10	Research Ethics	122
3.11	Trustworthiness	124
3.12	Summary	127

CHAPTER 4: DEVELOPMENT OF STEM-bLA

4.1	Introduction	129
4.2	Instructional Design Model	129
4.3	Reason to Choose ADDIE Design	130
4.4	Development STEM-bLA	131
4.4.1	Phase 1: Analysis	131
4.4.2	Phase 2: Design	134
4.4.3	Phase 3: Development	135
4.4.4	Phase 4: Implementation	139
4.4.5	Phase 5: Evaluation	140

4.5	Content of STEM-bLA	141
4.6	Trustworthiness of STEM-bLA	141
4.7	Summary of Development Process of STEM-bLA	143
4.8	Summary	144

CHAPTER 5: DATA ANALYSIS AND RESULT

5.1	Introduction	145
5.2	Overview of the Findings	146
5.3	History and the Demographic of the School Settings	147
5.4	Description of the STEM-based Learning Activities	149
5.5	Description of the Participants in Actual Study	152
5.5.1	Principal B	152
5.5.2	Head Panel of Science and Mathematics B	153
5.5.3	Science Teacher B	155
5.5.4	Physics Teacher B	156
5.5.5	Students	157
5.6	Themes Arisen During Evaluation Stages	158
5.7	The Themes Arises	161
5.8	Context Evaluation	162
5.8.1	Students' Responses	162
5.8.2	Designed STEM-bLA	163
5.9	Input Evaluation	166
5.9.1	Students' Responses	166
5.9.2	Designed STEM-bLA	172
5.10	Process Evaluation	174
5.10.1	Students' Responses	174

5.10.2	Designed STEM-bLA	191
5.11	Product Evaluation	196
5.12	Summary	197
CHAPTER 6: DISSCUSSION, IMPLICATION AND CONCLUSION		
6.1	Introduction	198
6.2	An Overview of the STEM-bLA	198
6.2.1	STEM-bLA as Students' Engagement Tool	199
6.2.2	STEM-bLA as Teaching Aids	201
6.2.3	STEM-bLA as A Learning Probe	211
6.3	The Implication of STEM-bLA for the Study	212
6.3.1	The Implication of STEM-bLA for the Teacher	213
6.3.2	The Implication of STEM-bLA for the Students	213
6.3.3	The Implication of STEM-bLA for the Policy Makers	213
6.4	Suggestion for Further Study	214
6.5	Reflection of the Study	215
6.6	Summary	218
REFERENCES		217
 APPENDICES		243

LIST OF TABLES

	Page
Table 1.1 : Numbers of Students in STEM Stream in Tertiary Level in Tawau District	8
Table 1.2 : <i>SPM</i> Candidates for Three Different Schools in Tawau District	9
Table 1.3 : Research Aims and Research Questions	14
Table 2.1 : Summary of Development of Education in Malaysia	23
Table 2.2 : STEM Initiative Implementation Waves	28
Table 2.3 : Newtonian Mechanics, Students' Common Misconceptions of the Force Concept, and Their Equivalent Ideas in the History of Science	46
Table 2.4 : Learning Objectives, LOs	53
Table 2.5 : Strengths and Weaknesses of Program Evaluation Models	65
Table 3.1 : Evaluation and Research	77
Table 3.2 : Major Paradigms in Evaluation	86
Table 3.3 : Comparison between Guba (1990) and Creswell (2014) System of Beliefs	89
Table 3.4 : Characteristics of Interpretivism	95
Table 3.5 : Four Standards of Quality in Judging an Educational Program Evaluation Program Evaluation	98
Table 3.6 : Schedule for the Study	100
Table 3.7 : Number or Participants in PS	102
Table 3.8 : Number or Participants in AS	103
Table 3.9 : Evaluation Plan	106
Table 3.10 : Purposes of Interviews	108
Table 3.11 : Instruments Used in the Study	111
Table 3.12 : Types of Data Collection	114

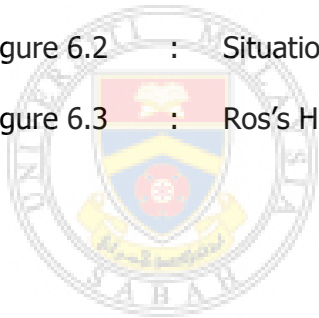
Table 3.13	:	Codes Used in the Transcripts	116
Table 4.1	:	Attributes in Analysis Phase	132
Table 4.2	:	Resources Analysis	134
Table 4.3	:	Details in STEM-bLA	136
Table 4.4	:	Allocation of Physics Concepts, STEM Components and Cognitive Skills in STEM-bLA	141
Table 4.5	:	STEM-bLA Content Validity Panel Experts	142
Table 4.6	:	Content Validity of STEM-bLA	142
Table 4.7	:	Summary Process of Development STEM-bLA	143
Table 5.1:	:	Initial of Informants	152
Table 5.2	:	Summary of the Themes Arises During Evaluation Stages	160
Table 5.3	:	Coding from a Student's MS1 Transcript Sample	161
Table 5.4	:	Student's Initial Perception about Physics Subject and Topic of Force and Motion	162
Table 5.5	:	Characteristic of Desire Physics Learning Activities Among Students	166
Table 5.6	:	Summary of STEM Components in STEM-bLA	192
Table 5.7	:	Physics Concepts Covered for Topic of Force and Motion	195
Table 5.8	:	Students' Performances in MS2	196

LIST OF FIGURES

		Page
Figure 2.1	: Transition Year of Implementation of <i>PPSMI</i> to <i>MBMMBI</i>	22
Figure 2.2	: Malaysian Average Score in TIMSS Since 1999 to 2019 for 8 th Grade	25
Figure 2.3	: Malaysian Performance in PISA Since 2009 to 2018	26
Figure 2.4	: Concepts of STEM Education	27
Figure 2.5	: 21 st Century Student Outcomes and Support System	33
Figure 2.6	: Tyler's Rational Procedure Model	58
Figure 2.7	: Stake's Contingency-Congruent Model	60
Figure 2.8	: Procedure in Goal Free Model	61
Figure 2.9	: Conceptual Framework of the Study	73
Figure 3.1	: Evaluation Process	97
Figure 3.2	: The First Phase of the Study	99
Figure 3.3	: The Second Phase of the Study	99
Figure 3.4	: The Third Phase of this Study	100
Figure 4.1	: ADDIE Instructional Design Model	130
Figure 4.2	: Sample of LP for STEM-bLA	139
Figure 5.1	: Focused Points Observed in Physics Lesson	147
Figure 5.2	: The Characteristics of STEM Teaching and Learning Activities	150
Figure 5.3	: Researcher's Evaluation Model Adopted and Adapted from Stufflebeam's (1982)	158
Figure 5.4	: Researcher's STEM-bLA Framework for Topic of Force and Motion	165
Figure 5.5	: S1's Answer	168
Figure 5.6	: S2's Answer	168

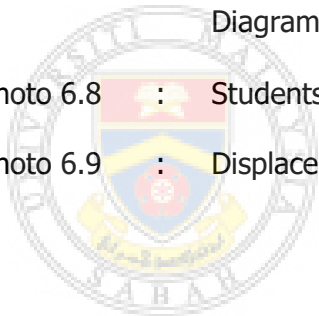
Figure 5.7	: S3's Answer	168
Figure 5.8	: S4's Answer	169
Figure 5.9	: S5's Answer	169
Figure 5.10	: a. S6's Answer b. S7's Answer	170
Figure 5.11	: S8's Answer	170
Figure 5.12	: S9's Answer	171
Figure 5.13	: S10's Answer	171
Figure 5.14	: S4's Answer	174
Figure 5.15	: S6's Answer	175
Figure 5.16	: S3's and S10's Answers for Displacement-Time Graph	176
Figure 5.17	: S4's and S17's Answers for Velocity-Time Graph	177
Figure 5.18	: S7's Answer	178
Figure 5.19	: G3's Answer	179
Figure 5.20	: Situation 1 and Situation 2	180
Figure 5.21	: S1's Answer	180
Figure 5.22	: Situation 3 and Situation 4	181
Figure 5.23	: G4's Answer	182
Figure 5.24	: S2's Answer	183
Figure 5.25	: S5's Answer	184
Figure 5.26	: S4's Answer	184
Figure 5.27	: S2's Answer	185
Figure 5.28	: S10's Answer	185
Figure 5.29	: S7's Answer	185
Figure 5.30	: S8's Answer	186
Figure 5.31	: S5's Answer	186

Figure 5.32	: S10's Answer	187
Figure 5.33	: S9's Answer	187
Figure 5.34	: S14's Answer	188
Figure 5.35	: S15's Answer	188
Figure 5.36	: S16's Answer	189
Figure 5.37	: S16's Answer	189
Figure 5.38	: S3's Answer	190
Figure 5.39	: S2's Answer	190
Figure 5.40	: S1's Answer	191
Figure 5.41	: S1's, S2's, S3's, and S4's Answers	193
Figure 6.1	: Sca-Vec Ruler	205
Figure 6.2	: Situation 1 and Situation 2	206
Figure 6.3	: Ros's Housing Plan	207



LIST OF PHOTOS

	Page
Photo 4.1 : Implementation Phase of STEM-bLA	140
Photo 6.1 : Student with Her Invention	203
Photo 6.2 : Students with Their Invention	203
Photo 6.3 : Students with Their Invention and Story Board	203
Photo 6.4 : Students with Their Invention and Story Board	204
Photo 6.5 : Students Set the Sca-Vec Ruler on a Piece of Plain Paper	208
Photo 6.6 : Students Transfer the Information From the Question to a Plain Paper Using Sca-Vec Ruler	208
Photo 6.7 : All Data From the Question Being Transferred to Scaled Diagram Using Sca-Vec Ruler	209
Photo 6.8 : Students Try to Find 'Displacement' Made by Rose	209
Photo 6.9 : Displacement Made by Rose	210



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LIST OF ABBREVIATIONS

21CL	- 21 st Century Learning
BP	- <i>Bidang Pembelajaran</i>
CCM	- Conceptual Change Model
CDC	- Curriculum Development Centre
CI	- Concept Inventories
CIPP	- Context-Input-Process-Product
CLIS	- Children's Learning Science
CS	- Curriculum Specification
DEM	- Discrepancy Evaluation Model
DEM	- Discrepancy Evaluation Model
DPLI-SR	- Post Graduate Diploma in Primary Teaching
DSTI1	- <i>Dasar Sains, Teknologi, dan Inovasi Negara Pertama</i>
ED	- Engineering Design
EPC	- Higher Educational Planning Committee
EPRD	- Educational Planning and Research Department
FCI	- Force Concept Inventory
FPN	- <i>Falsafah Pendidikan Negara, FPN</i>
FSP	- Human Sciences Faculty
GFE	- Goal Free Evaluation
HEPC	- Higher Educational Planning Community
HOTS	- Higher Order Thinking Skills
IAE	- Interview About Events
IAI	- Interview About Instances
IPG KPP	- <i>Institut Perguruan Kampus Pulau Pinang</i>

JPNS	- <i>Jabatan Pendidikan Negeri Sabah</i>
KBSM	- <i>Kurikulum Bersepadu Sekolah Menengah Sains</i>
KPM	- <i>Kementerian Pendidikan Malaysia</i>
KSSM	- <i>Kurikulum Standard Sekolah Menengah</i>
KRK	- <i>Kelas Rancangan Khas</i>
KSSR	- <i>Kurikulum Standard Sekolah Rendah</i>
LA	- Learning Area
LO	- Learning Objective
MBMMBI	- <i>Memartabatkan Bahasa Malaysia dan Mengukuhkan Bahasa Ingeris</i>
MEDP 2013-2025	- Malaysian Educational Development Plan 2013-2025
MI	- Multiple Intelligences
MOE	- Ministry of Education
MOSTI	- Ministry of Science, Technology, and Innovation
MP1	- First Malaysian Plan
MP2	- Second Malaysian Plan
NGSS	- Next Generation Science Standard
NSTIP	- National Science, Technology, and Innovation Policy
OECD	- Organisation of Economic Co-operation and Development
OP	- <i>Objektif Pembelajaran</i>
PAK-21	- <i>Pembelajaran Abad Ke-21</i>
PDP	- Professional Development Program
PBS	- <i>Pentaksiran Berasaskan Sekolah, PBS</i>
PISA	- Programme for International Student Assessment
PMR	- <i>Penilaian Menengah Rendah</i>
POE	- Predict Observe Explain

PPD	-	<i>Pejabat Pendidikan Daerah</i>
PPK	-	<i>Pusat Pengembangan Kurikulum</i>
PPSMI	-	<i>Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris</i>
PT3	-	<i>Penilaian Tingkatan Tiga</i>
QDA	-	Qualitative Data Analysis
SBA	-	School Based Assessment
SPM	-	<i>Sijil Pelajaran Malaysia</i>
SSeM	-	<i>Sekolah Seni Malaysia</i>
STEM	-	Science, Technology, Engineering, and Mathematics
STI	-	Science, Technology and Innovative
TED	-	Technology, Entertainment, Design
TIMSS	-	Trends in International Mathematics and Science Study
UPSI	-	<i>Universiti Pendidikan Sultan Idris</i>
WWII	-	Second World War
MS	-	Mechanics Survey

LIST OF APPENDICES

	Page
Appendix A : Parental Consent and Students' Assent Form	245
Appendix B : Mechanics Survey 1, MS1	247
Appendix C : Mechanics Survey 2, MS2 (Bilingual Version)	252
Appendix D : STEM-based Learning Activities, STEM-bLA	262
Appendix E : Interview Protocol	278
Appendix F : <i>Borang Penilaian Kesahan Item Soalan Item MS1 dan MS2</i>	283
Appendix G : <i>Borang Penilaian Kesahan Kandungan</i>	284
Appendix H : <i>Borang Persetujuan Pakar Terhadap Tema Data Kualitatif</i>	288
Appendix I : Approval From MOE	299
Appendix J : Approval from JPNS	300
Appendix K : Approval from PPDT	301
Appendix L : Approval From MS1, MS2 Designer	302
Appendix M : Approval from STEM Expert	303
Appendix N : Interview Transcript Examples	304
Appendix O : Student'S Writing Responses	324
Appendix P : Field Notes Transcript Example	334
Appendix Q : Scalar-Vector, <i>Ska-Vek</i> Ruler	339
Appendix R : Researcher's List of Paper Presented	340