

TABLE OF CONTENT

PREFACE	i
ACKNOWLEDGMENT.....	ii
ABSTRACT	iv
<i>ABSTRAK</i>	v
TABLE OF CONTENT	vi
LIST OF TABLE	ix
LIST OF FIGURE.....	x
LIST OF APPENDIX	xii
CHAPTER I INTRODUCTION	1
A. Background of Research	1
B. Problem Statement	8
C. Scope of Study	8
D. Aim of the Study	9
E. Significance of Study	9
F. Assumption	10
G. Hypotheses	10
H. Organizational Structure	11
I. Operational Definition	12
CHAPTER II LITERATURE REVIEW	13
A. Science, Technology, Engineering and Mathematics (STEM) education.....	13
B. Instructional Material in Science Instruction	16
C. Conceptual Understanding of Science	20
D. Engineering Design Process as A Tool to Generate Engineering Design Behaviors.....	25
E. Teamwork Skills	30

Ineu Gustiani, 2016

LEARNING SCIENCE THROUGH STEM BASE INSTRUCTIONAL MATERIAL: ITS EFFECTIVENESS IN IMPROVING STUDENTS CONCEPTUAL UNDERSTANDING AND ITS EFFECT TOWARDS ENGINEERING DESIGN BEHAVIORS AND TEAMWORK SKILLS

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

F. STEM integrated concept in simple machines.....	32
CHAPTER III RESEARCH METHODOLOGY	38
A. Method and Design of Research	38
B. Population and Sample	39
C. Research Instruments	39
D. Research Procedures	59
E. Scheme of Research	62
F. Data Processing Technique and Analysis	63
CHAPTER IV RESULT AND DISCUSSION	69
A. STEM based Instructional Material and Students’ Conceptual Understanding of Science	69
B. STEM based Instructional Material and Students’ Engineering Design Behaviors.....	77
1. Understand the Challenge	78
2. Build Knowledge and Do Research	83
3. Generate Ideas.....	86
4. Represent Ideas	90
5. Weigh Option and Make Decision.....	96
6. Conduct Experiment	99
7. Troubleshoot	103
8. Revise/Iterate	106
9. Reflect on Process	110
C. STEM based Instructional Material and Students’ Teamwork Skills	114
1. Contributing to the Team’s Work.....	117
2. Interacting with Teammates	119
3. Keeping the Team on Track	121

4. Expecting Quality	123
5. Having Relevant Knowledge, Skills and Abilities	125

CHAPTER V CONCLUSION, IMPLICATION AND

RECOMMENDATION	127
A. Conclusion	127
B. Implication	129
C. Recommendation	130
REFERENCES	131
APPENDICES	149

LIST OF TABLE

Table

2.1	Revised Version of Bloom's Taxonomy of Cognitive Understanding	24
2.2	Informed Design Patterns	28
3.1	Criteria of Test Item Validity.....	40
3.2	Recapitulation of Conceptual Understanding Instrument Validation.....	41
3.3	Blueprint of Conceptual Understanding Test	42
3.4	Reliability Criteria of Test	43
3.5	Difficulty Level of Test Item	44
3.6	Discrimination Power Index Criteria	45
3.7	Informed Design Learning and Teaching Matrix	46
3.8	Categorization of Students' Engineering Design Behavior	48
3.9	Rubric of Students' Engineering Design Behavior.....	49
3.10	CATME Likert-short Observation Sheet	53
3.11	Classification of N-Gain Interpretation.....	64
3.12	Students' Teamwork Skills Category	68
3.13	Students' ICC Category	68
4.1	Statistical Analysis of Students' Conceptual Understanding Test.....	70
4.2	Percentage of Students' Posttest Correct Answers based on Level of Cognitive	72

Ineu Gustiani, 2016

LEARNING SCIENCE THROUGH STEM BASE INSTRUCTIONAL MATERIAL: ITS EFFECTIVENESS IN IMPROVING STUDENTS CONCEPTUAL UNDERSTANDING AND ITS EFFECT TOWARDS ENGINEERING DESIGN BEHAVIORS AND TEAMWORK SKILLS

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

LIST OF FIGURE

FIGURE

2.1	First Class Lever	34
2.2	First Class Lever in Human Body.....	34
2.3	Second Class Lever	35
2.4	Second Class Lever in Human Body	35
2.5	Third Class Lever	36
2.6	Third Class Lever in Human Body	36
3.1	Quasi Experiment Pretest-Posttest Design.....	38
3.2	Non-STEM based Instructional Material.....	55
3.3	STEM based Instructional Material	57
4.1	Students' engineering design behavior profile on 1 st indicator.....	79
4.2	Students' engineering design behavior development on 1 st indicator.....	80
4.3	Students' engineering design behavior profile on 2 nd indicator.....	84
4.4	Students' engineering design behavior development on 2 nd indicator.....	85
4.5	Students' engineering design behavior profile on 3 rd indicator	87
4.6	Students' engineering design behavior development on 3 rd indicator	88
4.7	Students' engineering design behavior profile on 4 th indicator	91
4.8	Students' engineering design behavior development on 4 th indicator	92
4.9	Students' egg cracker design development of experiment group	93

Ineu Gustiani, 2016

LEARNING SCIENCE THROUGH STEM BASE INSTRUCTIONAL MATERIAL: ITS EFFECTIVENESS IN IMPROVING STUDENTS CONCEPTUAL UNDERSTANDING AND ITS EFFECT TOWARDS ENGINEERING DESIGN BEHAVIORS AND TEAMWORK SKILLS

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

4.10	Students' egg cracker design development of control group.....	95
4.11	Students' engineering design behavior profile on 5 th indicator	97
4.12	Students' engineering design behavior development on 5 th indicator	98
4.13	Students' engineering design behavior profile on 6 th indicator	100
4.14	Students' engineering design behavior development on 6 th indicator	101
4.15	Students' engineering design behavior profile on 7 th indicator	104
4.16	Students' engineering design behavior development on 7 th indicator.....	105
4.17	Students' engineering design behavior profile on 8 th indicator	107
4.18	Students' engineering design behavior development on 8 th indicator	108
4.19	Students' engineering design behavior profile on 9 th indicator	111
4.20	Students' engineering design behavior development on 9 th indicator	112
4.21	Rating Scale of Students' Teamwork Skills	114
4.22	Students' rating scale on contributing to the team's work.....	117
4.23	Students' rating scale on interacting with teammates	119
4.24	Students' rating scale on keeping the team on track.....	121
4.25	Students' rating scale on expecting quality	123
4.26	Students' rating scale on having relevant knowledge, skill and abilities ..	125

LIST OF APPENDIX

APPENDIX

A. SETS OF INSTRUCTION	149
1. Lesson Plan of STEM based Instructional Material Class	149
2. Lesson Plan of non-STEM based Instructional Material Class	158
3. Non-STEM based Instructional Material.....	164
4. Students' worksheet of non-STEM based Instructional Material	166
5. STEM based Instructional Material	167
6. Students' worksheet of STEM based Instructional Material	168
B. RESEARCH INSTRUMENT	170
1. Blueprint of Conceptual Understanding Test Item	170
2. Conceptual Understanding Test.....	179
3. Students' Engineering Design Behaviors Observation Sheet.....	188
4. Students' Teamwork Skills Observation Sheet	191
5. Blueprint of STEM-based Instructional Material Validation	195
6. STEM-based Instructional Material Validation.....	196
C. INSTRUMENT VALIDATION	204
1. Recapitulation of STEM-based Instructional Material Validation	204

Ineu Gustiani, 2016

LEARNING SCIENCE THROUGH STEM BASE INSTRUCTIONAL MATERIAL: ITS EFFECTIVENESS IN IMPROVING STUDENTS CONCEPTUAL UNDERSTANDING AND ITS EFFECT TOWARDS ENGINEERING DESIGN BEHAVIORS AND TEAMWORK SKILLS

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

2. Recapitulation of Conceptual Understanding Test Item Analysis	207
D. RESEARCH DATA	208
1. Recapitulation of Students' Conceptual Understanding Pretest, Posttest and N-Gain Scores.....	208
2. Recapitulation of Statistical Analysis of Students' Conceptual Understanding Test	211
3. Recapitulation of Students' Engineering Design Behaviors Observation	214
4. Recapitulation of Intraclass Correlation Coefficient of Teamwork Skills.....	246
5. Recapitulation of Students' Teamwork Skills Rating.....	247
E. DOCUMENTATION.....	249
1. Research Documentation	249
2. Letter of Research Permission	251