



# THE IMPLEMENTATION OF SCIENCE CREATIVE **TEACHING DESIGN TOOL IN TEACHING AND LEARNING SCIENCE**

# NADIRA BINTI ISMAIL

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# SULTAN IDRIS EDUCATION UNIVERSITY

2019











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iv

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### ABSTRACT

This case study was conducted qualitatively to explore and understand the process through Science Creative Teaching Design (SCTD) implementation. Seven informants including two Science teachers and five form two students from selected boarding school were involved in this research. Data were collected through in-depth semistructured interviews, observations, document analysis and field notes. The data were further analyzed through coding, categorizing and sub- themes to develop the main themes. This research found that, SCTD tool was feasible for Science teachers, improves both teachers' and students' emotions against stressful and less innovative teaching and learning. Informants have practiced almost all suggested creative strategies, hence, demonstrated creative teaching and learning and active teaching. Thinking culture was found amongst students and teachers as they attained creative thinking characteristics such as cognitive flexibility, originality thinking, fluency thinking, elaboration thinking, evaluating own works and making decision. The students displayed higher order thinking skills such as analyzing, evaluating and creating and found to develop skill sets such as communication skills, self-confidence and team work skills. Thus, a novel framework of SCTD is successfully designed to enhance teaching and learning in Science. In conclusion, this research promotes a better understanding and exploration on creative teaching and learning through a systematic guide on design thinking and creative skills. This implies that, Science teachers may use SCTD tool to produce a high impact and interesting teaching and learning for the students.









### PELAKSANAAN SCIENCE CREATIVE TEACHING DESIGN DALAM PENGAJARAN DAN PEMBELAJARAN SAINS

### ABSTRAK

Kajian kes ini dijalankan secara kualitatif bagi meneroka dan memahami proses melalui pelaksanaan Science Creative Teaching Design (SCTD). Tujuh orang informan termasuk dua orang guru sains dan lima orang murid tingkatan dua telah dipilih dari sekolah berasrama penuh untuk kajian ini. Data kajian dikumpulkan melalui temu bual semi struktur secara mendalam, pemerhatian, analisis dokumen dan nota lapangan. Data seterusnya dianalisa melalui pengekodan, pengkategorian, pembentukan sub tema bagi pembinaan tema utama. Kajian ini mendapati, SCTD mencapai tahap kebolehlaksanaan untuk guru sains, menambah baik emosi guru dan pelajar terhadap tekanan dan pengajaran dan pembelajaran yang kurang inovatif. Informan telah mengamalkan hampir kesemua strategi kreatif yang dicadangkan dan mempamerkan pengajaran dan pembelajaran kreatif serta pengajaran aktif. Budaya berfikir didapati kalangan murid seperti dan guru apabila mereka memperolehi ciri pemikiran kreatif seperti fleksibiliti kognitif, keaslian pemikiran, kelenturan pemikiran, penghuraian pemikiran, menilai hasil kerja sendiri dan membuat keputusan. Pelajar juga memaparkan kemahiran berfikir aras tinggi seperti menganalisis, menilai dan merekacipta dan menunjukkan pembangunan set kemahiran seperti kemahiran komunikasi, keyakinan diri dan kemahiran kerja berkumpulan. Maka, satu kerangka baharu SCTD telah berjaya dibangunkan untuk meningkatkan pengajaran dan pembelajaran Sains. Kesimpulannya, kajian ini telah berjaya menggalakkan pemahaman pengajaran dan pembelajaran kreatif, melalui bimbingan secara sistematik dalam kemahiran pemikiran rekabentuk dan kemahiran kreatif. Implikasinya, guru Sains boleh menggunakan alat SCTD untuk menghasilkan pengajaran dan pembelajaran yang berimpak tinggi dan menarik kepada pelajar.













### **CONTENTS**

DECLARATION OF ORIGINAL WORK	ii
DECLARATION OF THESIS/DISSERTA	TION FORM iii
ACKNOWLEDGMENTS	iv
ABSTRACT	v
ABSTRAK	vi
CONTENTS	xi
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xiv
05-45068 LIST OF APPENDICES	Janku Bainun Abdul Jalil Shah 🏾 💙 PustakaTBainun 🖏 ptbu

### **CHAPTER 1 INTRODUCTION**

1	.1	Introduction	1
1	.2	Background of the Study	3
1	.3	Problem Statement	6
1	.4	Research Purposes	8
1	.5	Research Questions	8
1	.6	Significance of the Study	9
1	.7	Scope and Limitations of the Study	10
1	.8	Research Design	10
1	.9	Operational Definitions	10
1	.10	Summary	14
СНАРТ	ER 2	LITERATURE REVIEW	
2	.1	Introduction	15
		2.1.1 Science Education	16

Theories Underpinnings 2.2

17

		2.2.1 Constructivism	17
		2.2.2 Piaget Cognitive Theory	19
		2.2.3 Theory of Behaviourism	21
	2.3	Models	22
		2.3.1 Instructional Design Model	22
		2.3.2 Creativity Model	23
		2.3.3 Creative Teaching Model	25
	2.4	Teaching and Learning Process	26
		2.4.1 Relationship between Teaching and Learning with Cognitive Science	28
		2.4.2 Problems Related to Teaching and Learning	30
	2.5	Creativity	32
		2.5.1 Creativity in Education	35
		2.5.2 Creative Teaching	37
		2.5.3 Creative Teacher	38
		2.5.4 The Creative Thinking	40
05-4506832	g pust	2.5.4.1 Characteristics of Creative Thinking	41 ptbupsi
		2.5.4.2 Creative Thinking as a Process	44
		2.5.4.3 Creative Thinking Tools	47
	2.6	Design Thinking and Creativity	49
		2.6.1 Definition of Design Thinking	51
		2.6.2 The Nature of Design Thinking	53
		2.6.3 The Design Thinking Model	54
		2.6.4 The Importance of Design Thinking in Learning	57
		2.6.5 Design Thinking Skills	60
		2.6.5.1 21st Century Skills	61
		2.6.5.2 Higher Order Thinking Skills	63
		2.6.6 Strategies Integrating Creativity and Design Thinking in Teaching	64
	2.7	Research Theoretical Framework	69
	2.8	Summary	70
СН	APTER (	3 METHODOLOGY	
	3.1	Introduction	71



O5-4506832 Spustaka.upsi.edu.my



		3.1.1 1	Research Design	72
		3.1.2 J	Justification of Selecting Case Research	74
	3.2	The D and S	esign and Development of Research Instrument CTD Tool	76
		3.2.1 1	Research Instrument	76
			3.2.1.1 Interview Protocol	76
			3.2.1.2 Observation Protocol	77
			3.2.1.3 Document Analysis	79
			3.2.1.4 Researcher as the Research Instrument	79
			3.2.1.5 Validity of Research Instrument	80
			3.2.1.6 Reliability of Research Instrument	80
		3.2.2	The Design and Development of SCTD Tool	82
			3.2.2.1 Creo 1 Empathy	84
			3.2.2.2 Creo 2: Build Analogy	86
			3.2.2.3 Creo 3: Ideation	86
05-4506832	g pus		3.2.2.4 Creo 4: Synthesis and Justification	87 ptbupsi
			3.2.2.5 Creo 5: Application of Knowledge	88
			3.2.2.6 Validation and Reliability of SCTD Tool	93
	3.3	Before	e enter the field of research	94
		3.3.1 l i	Informant identification and consent to participate in this research	94
		3.3.2	The Research Informant	95
		3.3.3	Informant Criterion Selection	97
		3.3.4	Research Informant Details	99
	3.4	During	g the field research: Data Collection Procedure	100
		3.4.1	Real Study	100
		3.4.2	Semi-structured Interview	102
			3.4.2.1 Interview Management	106
		3.4.3	Observation	107
	3.5	Resea	rch Ethics	109
	3.6	Data A	Analysis and Interpretation	109
		3.6.1	Data Management	115





3.7	Trustworthiness and Credibility of Data	116
	3.7.1 Avoiding the Researcher Bias	121
3.8	Conclusion	122

## **CHAPTER 4 FINDINGS**

4.1	Introd	uction	123
4.2	Inform	nant Background	124
	4.2.1	Informant Profile	124
4.3	Resea	rch Question 1: Experiences during SCTD Implementation	125
	4.3.1	Pre-SCTD Implementation	126
		4.3.1.1 Summary of Analysis for Pre-SCTD implementation	132
	4.3.2	Attitude	133
	4.3.3	Feedback using SCTD	140
	4.3.4	Summary of Experiences during SCTD Implementation	147
4.4 pusta	Resea during	rch Question 2: The teaching and learning process s SCTD implementation	151 <sub>ptbupsi</sub>
	4.4.1	Self-designed lesson plan	152
	4.4.2	Empathy	156
	4.4.3	Analogy	163
	4.4.4	Ideation	166
	4.4.5	Synthesis and Justification	168
	4.4.6	Application of Knowledge	173
	4.4.7	Summary of Analysis Finding on Teaching and Learning Process during SCTD Implementation	175
4.5	Reseat on Sci	rch Question 3: Effect of SCTD implementation ience Teaching and Learning	180
	4.5.1	Attained Creative Thinking Skills	181
	4.5.2	Attained Higher Order Thinking Skills	191
	4.5.3	Attained Character Development	196
	4.5.4	Attained Student Teacher Relationship	201
	4.5.5	Attained Development in Teaching and Learning	204
	4.5.6	Summary of Analysis Findings on Effect of SCTD Implementation on Teaching and Learning	208

0





4.6	SCTD Conceptual Framework	212
4.7	Summary	214
CHAPTER	5 DISCUSSION, CONCLUSIONS AND RECOMMENDATION	ONS
5.1	Introduction	215
5.2	Discussions	215
5.3	Conclusion	224
5.4	Implication 229	
	5.4.1 Implication on the Theory	229
	5.4.2 Implication on the Development of Science Teaching and Learning Process	230
	5.4.3 Implication on Students Learning in Science	231
	5.4.4 Implication on Thinking Culture	231
5.5	Recommendations	232
5.6	Summary	233
REFEREN	CES	234

05-4506832 Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah

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## O5-4506832 Of pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi xii

## LIST OF TABLES

	Table No.		
	2.1	Summary of Creativity Model	24
	3.3	Summary of Creo in SCTD Tool	89
	3.4	Example of Creative Teaching Design Lesson Plan : Sample 1	90
	3.5	Example of Creative Teaching Design Lesson Plan : Sample 2	91
	3.7	Data Collection Procedure	102
	3.8	Interview and Observation Schedule	104
	3.9	Data Analysis Procedure	115
	3.10	Techniques Used to Enhance Trustworthiness in the Research	116
05-45068:	4.1	Informant Profile of Teachers	124
	4.2	Informants Profile of Students	125
	4.3	Main Themes and Sub-Themes for Research Question 1	126
	4.5	Summary of Analysis for Pre-SCTD Implementation	152
	4.6	Summary of Analysis Feedback Using SCTD	148 ptbups
	4.8	Main Themes and Sub-Themes for Research Question 2	151
	4.18	Summary of Analysis Teaching and Learning Process during	176
		SCTD Implementation	
	4.20	Main Themes and Sub-Themes for Research Question 3	180
	4.27	Summary of Analysis Findings on Effect SCTD Implementation on	208
		Teaching and Learning	



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



## LIST OF FIGURES

No. Figures		
2.2	Theoretical Framework	70
3.1	Hannafin and Peck Design Model (1988)	83
3.2	The Design and Development of SCTD Tool	83
3.6	Steps To Use SCTD Tool in Teaching and Learning	92
4.4	Previous Lesson Plan By Teacher B	127
4.7	Experiences During SCTD Implementation	150
4.9	Teacher A Lesson Plan Using SCTD	154
4.10	Hands-on Activity	162
4.11	The Using of Analogy By Teacher A	164
4.12	Teacher A Practiced Mind Map.	169
4.13	Challenge Assumption Exercise Task	169
4.14	Teacher A Combined Strategies	171
4.15	Question Using Visualization Technique	172
4.16	Making Relation Strategy	174
4.17	Making Relation Question	175
4.19	Teaching and Learning Process Using SCTD	179
4.21	Students' Work Using Mind Map	185
4.22	Students' Analysing Ideas	191
4.23	Students Presented Ideas Using Flow Chart	193
4.24	Students Evaluated Ideas	194
4.25	Students' Work of Creating Model	196
4.26	Students Presented Ideas To Other Groups	198
4.28	Development of Students and Teacher Teaching and Learning Skills	211
4.29	SCTD Conceptual Framework	213



## LIST OF ABBREVIATIONS

- **BLOSSOM** Blended Open Source Science or Math Studies
- CPS Creative Problem Solving
- **EPRD** Educational Planning and Research Division
- FPK Falsafah Pendidikan Kebangsaan
- KPM Kementerian Pelajaran Malaysia
- **KSSM** Kurikulum Standard Sekolah Menengah
- PISA Programme For International Students Assessment
- PMR Penilaian Menengah Rendah
- PT3 Pentaksiran Tingkatan 3

SGM Standard Guru Malaysia 🥂 PustakaTBainun SBP Sekolah Berasrama Penuh

- SCTD Science Creative Teaching Design
- **STEM** Science, Technology Engineering, Mathematics
- STEM Pedagogical Content Knowledge STEM PCK
- TIMSS Trend In International Mathematics and Science Study
- **UPSR** Ujian Penilaian Sekolah Rendah
- ZPD Zone of Proximal Development





xiv





## LIST OF APPENDICES

	А	Validation of SCTD Tool by Science teachers
	В	Validation of SCTD Tool by Creativity Expert
	С	Validation of SCTD Tool by Science Education Expert
	D	Consent Letter from EPRD
	E	Consent Letter from Perak State Education Department
	F	Participant Consent Letter
	G	Participant Consent Letter to be Video Taped and Audio Taped
	Н	Observation Protocol
	I	Interview Protocol
05-4506832	J pustaka.up K	Validation of Observation Protocol and Interview Protocol Teachers' Previous Lesson Plan (Before SCTD)
	L	Researchers' Field Notes
	М	Teachers' Reflection
	Ν	Teachers' Lesson Plan (Using SCTD)
	0	Data Findings Table





XV





## **CHAPTER 1**

## **INTRODUCTION**



Science is about what we see, hear and touch compared to personal opinion and assumption. It is also derived based on the facts through experiments and observation (Chalmers, 2013; Feynman, 1969). It is extended from the sophisticated techniques in daily life includes medicine, engineering and other practical technology that lead to research and development (Taber & Akpan, 2016; Ziman, 2002). Science education is a dominant field of practices with science that being taught and learnt through formal and informal approaches (Taber & Akpan, 2016). Furthermore, it is concerned of nature of the world which is in the curriculum (Barnes, 1961). It is significant part of the science strategy and required to achieve the future needs of the country (Croxford, 2002).









The importance of science education to be taught in curriculum are based on intrinsic value, citizenship arguments and utilitarian arguments (Wellington, 2001). However, the difficulties of learning science due to science itself and the way of teachers deliver the knowledge (Johnstone, 1991). Furthermore, busy teachers have little time to do their own research, access limit to the research literature and lack of knowledge and skills in research methods (Taber & Akpan, 2016). Moreover, teachers are lack of initiative in reflects their own teaching and learning process. Teachers are also did not emphasized on the reasoning skills and inquiry skills in science educations (Nachiappan, Osman, Hassan, Jamil, Hussein, Othman & Suffian, 2018). Teachers should know what they will teach and how to taught science (Wellington, Science education required active learning in order to engage the students' 2001). understanding and the explorations of the history, theory, processes, context, and 05-45068 practices. (Glaze, 2018). Try Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah

The decreasing result in science has led to the problem of requirement in recruiting the high-tech workforce (Reilly, 2018). Malaysia has faced a serious shortage of human capital in science fields as the target for students enrolling in the stream is not being met annually at the school and tertiary levels. Based on the Science and Technology Human Capital Report and Science Outlook 2015 by Akademi Sains Malaysia, the country needs at least 270,000 science students sitting the Sijil Pelajaran Malaysia (SPM) examination annually, however there are only about 90,000 now compare to 500,000 students entering Form Four every year.







The Higher Education Ministry told the New Straits Times that 270,000 students, or approximately 60 per cent, of the annual cohort taking up science would be ideal. Therefore, Malaysian science education is aiming at making science more appealing to students so that it indirectly inviting more students to pursue their studies in science related areas to realize the goal of becoming an industrialized country (Saat, 2012). Accordingly, through the Malaysian Education Blueprint (2013-2025) the education system is transforming to create generation that able think creatively, innovatively and critically. The report of the Malaysia Education Blueprint 2013-2025 showed that most teaching and learning in school did not adequately engaged the students to think constructively (Teh, Isa, & Omar, 2018). Hence, in order to implement the transformation, the academic professionals applied the principle of design thinking in order to improve engagements of the students in the passive teaching 05-45068 and learning process (Das, Nguyen, Nguyen & Thomas, 2018). However, in order to the pair of the second se enhance the creative and innovative of the students, the teachers should be exposed to the tools that able to support the teaching and learning process. Thus, there are requirement of the integration of design thinking and creative thinking tools in order to enhance the teaching and learning process of Science.

#### 1.2 **Background of the Study**

There are several issues arose in the science of education which are the preparation and training of pre-service and in-service science teachers and should emphasized on the cognition and motivation of the science education (Anderman, Sinatra & Gray, 2012). Furthermore, the issues linger in teaching and learning topics-such as lesson and







curriculum development, student motivation and engagement or disciplinary issues. It also involves the school climate, relationships with parents or community and others. Such problems of practice are varied, cross-disciplinary, human-centered and rarely solved through simple or linear solutions (Bullough, 2012). Thus, teacher needs to think creatively in teaching and learning to encounter these problems.

Educational conversation emphasized on the need for creative teachers, but the it doesn't continue in their practices (Henriksen & Mishra, 2015). There is a possibility that, most teachers do not receive courses or chances to engage or nurture their creativity (Henriksen, 2011). The present educational policy is often limiting and disheartening to teacher creativity (Henriksen & Mishra, 2015). Teachers often feel uncertain about their own creative potentials. Thus, it becomes challenging to determine and conduct creative solutions to problems on teaching practices. While challenges and myths increase around creativity, most researchers have discussed possible solutions toward creative thinking via design thinking. Design thinking is an interdisciplinary domain that includes approaches, tools, and thinking skills that help designers come up with more and promising ideas toward creative solutions (Kelley & Kelley, 2013). Therefore, design thinking should be introduced in science education.

The declining interest of students in science may stunt the efforts to improve the quality of scientific teaching and creativity brought to a broader concern (Daud et al., 2016). Thus, it is an urge for the Science teachers to attract more students to learn and study science.









According to Nor Shai'rah (2015) the level of readiness of Science teachers is moderate and suggested that more pedagogical guidelines should be introduced as teachers plays an important role to bring along the curriculum planned (Fullan, 2001).

Hence, creative teaching strategies is needed by Science teachers' due to some researchers debates that problem arises in science field coming from low quality teachers (Hagedorn & Purnamasari, 2012). Therefore, Science teachers should be prepared with effective teaching instruction at basic level comprises content, pedagogy and conceptualization on science education in Malaysia.

Moreover, the Malaysia PISA result in scientific literacy inconsistent from 2009 (422), 2012 (420) and 2015(443) yet it is still under the OECD average (PISA 2015-Programme For International Student Assessment). The TIMSS results for Malaysia were also inconsistent from 1999 (492), 2003 (510), 2007 (471), 2011(426) until 2015 (471). Hence, it showed that Malaysia had increased in TIMSS 2015 in all categories.

> This may be caused by most students experienced that science is difficult topics (Shirazi 2017; Lindahl, 2003; Lyons, 2006; Jenkins and Nelson, 2005). Interest of the students in learning Science were changed significantly even though the science content taught in school has not changed significantly over time (Millar, 2006). Young peoples' interest is related with their previous experience and their best preferred for further studies (Jidesjö & Danielsson, 2016). However, individual influences of the students have gave impact towards their perception and experiences in learning science (Shirazi, 2017). The important factor in obtaining the students' interest in science, the way of teachers emerged with their students compared to subject content knowledge





(Maltese and Tai, 2010). The students will love the subject if they love the teachers. This is due to the conventional approach that leads to the lack of interest and motivation of the students in learning Science (Shirazi, 2017).

#### 1.3 **Problem Statement**

In this globalization era, students should be able to prepare themselves with 21st century skills needed which concurrent with the need of the 4<sup>th</sup> Industrial Revolution. Various approach in different learning disciplinary through design thinking expected as powerful tool (Mishra, Koehler, & Henriksen, 2011). Even tough through design thinking creativity can be developed, but the concepts are still difficult to understand by teachers. Teachers are still lacking in experiencing the design process and unfamiliar with design thinking concepts (Krajcik, & Delen, 2017). Practical and realistic creative thinking strategies should be introduced to the teachers to support design thinking integration. Therefore, the first step of this research would be the development of design thinking and creative thinking strategies which is referred as Science Creative Teaching Design (SCTD) tool. Then, the experiences during the SCTD implementation should be explored.

Creative teaching has positive impact on students' performances in secondary schools particularly in science. The role that a teacher plays in fostering creativity in her classroom is undeniable, it is important that their teaching should be unite with appropriate teaching techniques (Hooda & Devi, 2017). In science education, various types of creativity can be utilized as it is an interdisciplinary way of thinking in teaching





(Kuhn et al., 2014). Ways of thinking in teaching can be displayed into lesson preparation and the process of teaching and learning. Unfortunately, the low level of Science teacher's knowledge on thinking skills led to their inability to evaluate students' thinking skills (Zulkpli, Mohamed & Abdullah, 2017). Yet there is a limited evidence on how a Science teacher able to foster their creativity through creative teaching strategy. Therefore, the second focus would be the exploration on how does teaching and learning process during the implementation of the proposed idea which integrate design thinking and creative thinking strategies into teaching and learning. A better understanding on the implementation of SCTD in teaching and learning can explain how it contribute to creative teaching.

Through many researches on design thinking, skills sets found such as STEM S 05-4506 literacy and 21<sup>st</sup> century skills developed in students and teachers. There's a positive correlation found between design thinking education with students' self-esteem (Broussard, Murphy, & Fu, 2017). Yet, there's a need to explore more skills set that may emerge from the research proposed ideas. Therefore, the third focus would be the investigation on the integration of design thinking and creative strategies for creative thinking through the implementation of SCTD tool may enhance the teaching and learning amongst the teachers and students.

> There is a need to develop a novel SCTD framework based on the design thinking and creativity principle. This framework might be able to give an alternative towards creativity in teaching and learning. This research could also help the educators, curriculum developers plan effective creative and innovative teaching and learning activities to increase student's interests to STEM education. Science teachers need to





be creative in teaching and learning activities to create an attractive and intriguing learning environment. As a result, it can boost the interest and creativity in science subjects amongst school students.

#### **Research Purposes** 1.4

Based on the problem statements, the purpose of this research is:

- a) To investigate Science teacher and students' experiences during the Science Creative Teaching Design (SCTD) tool implementation.
- To understand teaching and learning processes that occur during Science b) Creative Teaching Design (SCTD) tool implementation.
- c) To explore how Science Creative Teaching Design (SCTD) tool implementation may enhance teaching and learning.

#### 1.5 **Research Questions**

The research questions were derived from the research purposes as follow:

- a) What are the experiences during Science Creative Teaching Design (SCTD) tool implementation?
- b) How teaching and learning process occur during the Science Creative Teaching Design (SCTD) tool implementation?
- c) How Science Creative Teaching Design (SCTD) tool may enhance science teaching and learning?





#### 1.6 Significance of the Study

This research provided a useful guide to nurture teachers' creativity in designing science lesson plan before teaching and learning. It will make Science teachers think like a designer of their own teaching and learning. Teachers will believe they have the creativity capacity or tools to address them well in teaching and learning. Though creativity and design are messy and iterative, this research offer thinking tools, skills, and practices that support and scaffold teaching and learning in science subject. Teachers given the support of such skills opens design pathways toward creative thinking around problems faced in practice.

Through this research, students and teachers able to experience creative teaching in science education hence increases students' interest in STEM education. Instead of understanding on science knowledge, students expected to nurture their creativity and develop other related skills such as higher order thinking skills and 21<sup>st</sup> century skills. This will surely prepare the students in facing the challenging and demanding job skills requirement in future.

> The policymaker able to benefit from this research by exploring in depth the creativity amongst the Science teachers and students. Hence, this study is an initial step toward a rich picture of the creative learning that unfolds in giving educational practitioners design thinking skills and opportunities. This research could also help the educators, curriculum developers plan effective creative and innovative teaching and learning activities to increase student's interests to STEM education. Science teachers need to be creative in teaching and learning activities to create an attractive and





intriguing learning environment. As a result, it can boost the interest and creativity in science subjects amongst school students.

#### 1.7 Scope and Limitations of the Study

This research has the following limitations. The result can only be generalized to the population under discussion that is the Science teachers and students in selected boarding school in Perak. This is because the researcher intention is to understand and describe the experience and takeaways of design thinking integration with creative thinking tools in science teaching. This research is also focusing the aim a thoughtful view of design in education that has value to consider across contexts. Therefore, using 05-4506 small sample is a function of this focused look where participants as an educational professional speak to their experiences and common theme transfer across a range of contexts.

#### 1.8 **Research Design**

This research is using qualitative case study research design.

#### 1.9 **Operational Definitions**

In this research, the definition of following term discussed as below:



) 05-4



- 11
- a) Science: Science is a derivation of the facts through experiments and observation (Chalmers, 2013; Feynman, 1969). In the context of the Malaysian curriculum, Science encompasses three core Science subjects and four elective Science subjects. The core science subjects are primary school science, lower secondary science and upper secondary science. The elective Science subjects consist of Biology, Physics, Chemistry and Additional Science. In this study, the researcher focused generally in lower secondary science for the form two students.
- b) Teaching and Learning Process: Teaching and learning process consist whether the teacher is responsible to transmit the knowledge, students only absorb the information given by the teacher and students are able to reproduce the material or teacher facilitate the students and the students are able to transform the knowledge and constructs the knowledge by their own (Kember, 2001). In this study, the researcher focused on the teacher facilitate the students and the students are able to transform the knowledge and constructs the knowledge by their own in Science.
- c) **Creative Thinking**: Creative thinking is a process of thinking a novelty idea thoroughly and diversified (Hidayat, Susilaningsih & Cepi, 2018; Mali & Kumar 2017; Mali & Kumar, 2017a; Nurjaman & Sari, 2017) generating and extending ideas, suggesting hypotheses, applying imagination and looking for alternative's innovative outcomes in any activity (Fisher, 2006) and solving problems with different ideas and different thinking (Mali & Kumar, 2017).



- d) **Design Thinking:** Design thinking is the cognitive processes of design work (Cross, 2011) and the thinking skills and practices designers use to create ideas and practical engagement with problem solving (Melles, Anderson, Barrett & Thompson-Whiteside, 2015).
- e) Science Creative Teaching Design (SCTD): A tool composed of several creative strategies consist of creative thinking tools which integrate with design thinking concept to assist Science teacher in order to enhance the creative thinking among the students. Details of the Science Creative Teaching Design (SCTD) are provided in Chapter 3.
- f) Creative Teaching: Creative teaching consisted of several teaching techniques aimed to help students to study teaching materials in a way which the student can transfer the knowledge to solve new problems Mayer (1983), that can foster students' creativity (Palaniappan, 2009), engage students (Morris, 2006) yet make learning more interesting and effective.
- g) Creative Teacher: Creative teacher is a person that uses to design instruction strategies to enhance learning and motivates students (Palaniappan, 2009) and willing to try new approaches and ideas varying from some traditional educational beliefs to improve practice (Torrance, 1995).
- h) Lesson Plan: Lesson plan is a guide class learning document that consisted of detailed description of the subject or course instruction or learning trajectory for a lesson. The lesson plans are the brief outlines of the procedural aspects in planning the lesson evaluated by the school administrators (Danielson &





McNeal, 2000; Halverson, Kelley, & Kimball, 2004; Kyle, 1980). Lesson plan is focused on day-to-day teaching practice that developed by the teachers on the pedagogical knowledge and decision of the teacher (Jacobs, Martin & Otieno, 2008). McCutcheon (1980) indicated that lesson plans is the planning book consist of reference in textbooks, homework to be assigned to students and objectives of learning during the teaching and learning process. In this study, lesson plan specifies the planning of the teachers to be taught during teaching and learning process based on the SCTD tools.

**Boarding School:** Boarding schools (Sekolah Berasrama Penuh: SBP) in i) Malaysia are schools at which the students are fully residential in hostels. They have fixed schedules for students' activities from early morning until bedtime. (Najihah Mustaffa, Zaleha Ismail, Zaidatun Tasir, Mohd Nihra Haruzuan Mohamad Said, 2017). Boarding school entry is under the management of the Ministry of Education (Kementerian Pelajaran Malaysia: KPM). It is based on excellent academic achievement in the Ujian Penilaian Sekolah Rendah (UPSR) to enter at Form One level and in the Penilaian Menengah Rendah (PMR) or Pentaksiran Tingkatan 3 (PT3) to enter at Form Four level and is supported by co-academic or co-curriculum (Ilias, 2012; Khalidah et al., 2014; Muhriz et al., 2011). Many researchers use the term 'boarding school' (Sekolah Berasrama Penuh) (Ghani et al., 2010; Ghani, Siraj, Mohd and Elham, 2011; Ghani, Siraj, Kassim, Kenayathulla, Marzuki and Elham, 2013; Abdullah, 2009). In this research, the researcher will use the term 'boarding school' because this is the term used by the Ministry of Education (Kementerian Pelajaran Malaysia: KPM).





#### 1.10 **Summary**

In this chapter, concludes the research background that brings to the research problems. From the issues arises in science education there an urge needs to have a better and indepth understanding on the matters highlighted. Creativity plays an important element as the core in our educational systems. This research provided the understanding on integrating design thinking and creative strategies into the science education.







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