DEVELOPMENT OF MATHEMATICAL CREATIVE INQUIRY LEARNING MODEL FOR SECONDARY SCHOOL MATHEMATICS LEARNING

By

NOR HANIZA BINTI ABDUL HAMID

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

January 2023

IPM 2023 4

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Doctor of Philosophy

DEVELOPMENT OF MATHEMATICAL CREATIVE INQUIRY LEARNING MODEL FOR SECONDARY SCHOOL MATHEMATICS LEARNING

By

NORHANIZA BINTI ABDUL HAMID

January 2023

Chair : Nurzatulshima binti Kamarudin, PhD
Institute : Mathematical Research

Inspiring creativity through the curriculum is the result of ongoing efforts in the 21st century's educational development of worldwide change. As shown in the 2013-2025 National Education Blueprints, efforts are underway in Malaysia to improve the quality of the students' creativity. The purpose of this study is to develop the Mathematical Creative Inquiry Learning Model for secondary school mathematics learning. The development of the model is aimed to support formal learning in aiding students to achieve both learning needs and learning outcomes through mathematical creative inquiry learning activities.

The study applies the Design and Development Research (DDR) approach, and the research is implemented in three phases; needs analysis, design and development, and evaluation. Phase 1 utilized the needs analysis using a survey questionnaire involving 120 secondary school Mathematics teachers to determine the need to develop the Mathematical Creative Inquiry Learning Model. Phase 2 obtained the views of 12 experts through the Nominal Group Technique (NGT) and the Interpretive Structural Modeling (ISM) method to design and develop the model. The evaluation phase included the use of the Fuzzy Delphi method (FDM), which involves 25 Mathematics teachers to evaluate the model. The threshold value (d) is determined to establish the consensus of the experts for all the arrangement of the learning elements.

The findings in Phase 1 revealed that the mathematics teachers agreed with all items regarding their views on creativity in mathematics learning (Mean = 4.42, SD = 0.691). The results also concluded that the mathematics teachers showed a high positive agreement on their views of all the creative learning elements in Mathematics based on the person (Mean = 4.35, SD = 0.774), process (Mean = 4.36, SD = 0.733), product (Mean = 4.28, SD = 0.848), and press (Mean = 4.26, SD = 0.845) perspectives. The overall findings for Phase 1 indicated a high

acceptance among Mathematics teachers to use the Mathematical Creative Inquiry Learning Model in their formal Mathematics syllabus (Mean = 4.52, SD = 0.608) and the need to develop the model. Findings from Phase 2 resulted in the model's design and development, consisting of 27 creative inquiry learning activities determined by a panel of experts. The experts also viewed that the activities could be grouped into six learning domains and four learning clusters to interpret the representation of the learning activities.

Finally, the findings from Phase 3 showed consensus agreement between the experts in terms of the arrangement of the learning activities, the suitability of the main domains, the cluster classification of the learning activities, and the overall evaluation of the model. The threshold value, d for all the items in this phase, is less than 0.2 and has more than 75 percent consensus between the experts. The model proposes how the mathematical creative inquiry learning activities could be incorporated into formal Mathematics learning to achieve the learning outcomes. Additionally, the research results may guide mathematics educators to integrate creativity inquiry learning activities among secondary school students.

Keywords: Design and Development Research, Mathematical Creative Inquiry Learning, Model, Creativity, 21st Century Learning.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PEMBANGUNAN MODEL PEMBELAJARAN INKUIRI KREATIF MATEMATIK UNTUK PEMBELAJARAN MATEMATIK SEKOLAH MENENGAH

Oleh

NORHANIZA BINTI ABDUL HAMID

Januari 2023

Pengerusi : Nurzatulshima binti Kamarudin, PhD
Institut : Penyelidikan Matematik

Pengilhaman kreativiti melalui kurikulum adalah hasil usaha berterusan dalam perubahan pembangunan pendidikan dunia bagi abad ke-21. Usaha sedang dilaksanakan di Malaysia untuk meningkatkan kualiti kreativiti pelajar seperti yang disasarkan dalam Pelan Pembangunan Pendidikan Malaysia 2013-2025. Tujuan kajian ini dijalankan adalah untuk membangunkan Model Pembelajaran Inkuiri Kreatif Matematik bagi pembelajaran matematik sekolah menengah. Pembangunan model ini bertujuan untuk menyokong pembelajaran formal dalam membantu pelajar mencapai kedua-dua keperluan pembelajaran dan hasil pembelajaran melalui aktiviti pembelajaran inkuiri kreatif matematik.

Kajian ini menggunakan pendekatan Penyelidikan Reka Bentuk dan Pembangunan (DDR), dan penyelidikan dilaksanakan dalam tiga fasa; analisis keperluan, reka bentuk dan pembangunan, dan penilaian. Fasa 1 melalui fasa analisis keperluan menggunakan kaedah soal selidik tinjauan yang melibatkan 120 orang guru Matematik sekolah menengah bagi menentukan keperluan untuk membangunkan Model Pembelajaran Inkuiri Kreatif Matematik. Fasa 2 bertujuan mendapatkan pandangan 12 pakar melalui kaedah Nominal Group Technique (NGT) dan Interpretive Structural Modeling (ISM) untuk mereka bentuk dan membangunkan model tersebut. Fasa penilaian pula merangkumi penggunaan kaedah Fuzzy Delphi Method (FDM), yang melibatkan 25 orang guru Matematik untuk menilai model yang telah dibina. Nilai ambang (d) ditentukan untuk memperolehi persetujuan semua pakar bagi penyusunan elemen pembelajaran.

Dapatan daripada Fasa 1 menunjukkan bahawa guru matematik bersetuju dengan semua item berkaitan pandangan mereka terhadap kreativiti dalam pembelajaran matematik (Min = 4.42, SD = 0.691). Hasil kajian juga merumuskan bahawa guru matematik menunjukkan persetujuan positif yang

tinggi terhadap pandangan mereka bagi semua elemen pembelajaran kreatif dalam Matematik berdasarkan persepsi individu (Min = 4.35, SD = 0.774), proses (Min = 4.36, SD = 0.733), produk (Min = 4.28, SD = 0.848), dan tekan (Min = 4.26, SD = 0.845). Dapatan keseluruhan bagi Fasa 1 menunjukkan penerimaan yang tinggi dalam kalangan guru Matematik untuk menggunakan Model Pembelajaran Inkuiri Kreatif Matematik dalam pembelajaran sukatan pelajaran Matematik formal (Min = 4.52, SD = 0.608) dan terdapat juga keperluan untuk membangunkan model tersebut. Dapatan kajian daripada Fasa 2 menghasilkan reka bentuk dan pembangunan model, yang merangkumi 27 aktiviti pembelajaran inkuiri kreatif yang telah ditentukan oleh panel pakar. Pakar juga menafsirkan bahawa aktiviti boleh dibahagikan kepada enam domain pembelajaran dan empat kelompok pembelajaran dalam mentafsir klasifikasi aktiviti pembelajaran.

Akhir sekali, dapatan daripada Fasa 3 menunjukkan persetujuan keseluruhan antara pakar dari segi penyusunan aktiviti pembelajaran, kesesuaian domain utama, klasifikasi kluster bagi aktiviti pembelajaran, dan penilaian keseluruhan untuk model. Nilai ambang (d) untuk semua item dalam fasa ini, adalah kurang daripada 0.2 dan mempunyai lebih daripada 75 peratus persetujuan keseluruhan antara pakar yang terlibat. Model ini mencadangkan bagaimana aktiviti pembelajaran inkuiri kreatif matematik boleh dilaksanakan dalam pembelajaran Matematik formal untuk mencapai hasil pembelajaran yang berkesan. Selain itu, hasil dapatan dapat membantu guru Matematik untuk mengintegrasikan aktiviti pembelajaran inkuiri kreatif di kalangan pelajar sekolah menengah.

Kata kunci: Penyelidikan Reka Bentuk dan Pembangunan, Pembelajaran Inkuiri Kreatif Matematik, Model, Kreativiti, Pembelajaran Abad ke-21.

ACKNOWLEDGEMENTS

Alhamdulillah, all praise to Allah, the Almighty, the Most Gracious, and the Most Merciful for giving me the blessing, the strength, and endurance to complete this study. I would like to express my deepest gratitude to my supervisor, Dr Nurzatulshima Kamarudin, for her generous guidance, help, team effort, patience, and moral support for this research study. In addition, my greatest gratitude and appreciation are addressed to my supervisory committee members, Dr Othman Talib and Professor Dr Zanariah Abdul Majid, for their valuable advice, guidance, comments, and suggestions on completing this study in time.

Furthermore, I would like to extend my sincere appreciation to my lecturers and facilitators; Dr Mohd Ridhuan Mohd Jamil, Professor Madya Dr Tajularipin Sulaiman, Professor Madya Dr Mohd Mursyid Arshad, Dr Hayrol Azril Mohamed Shaffril, Dr Normala Ismail, and Dr Abdul Muqsith Ahmad for their invaluable knowledge and encouragement. My gratitude also goes to all lecturers and staff of the Institute for Mathematical Research (INSPEM), UPM, for the help and assistance they have given to me. My sincere gratitude also goes to all the mathematics experts and the mathematics teachers who have devoted their time to this study.

My greatest thanks are devoted to my beloved husband, Putra Taqriz Mohd Arif, and my cute daughter, Putri Zaara, for always supporting and loving me in every condition from the beginning of this study. My special thanks also go to my dearest Papa, Encik Abdul Hamid Yup Aziz, Mama, Puan Noraini Mohd Saad, Walid, Dato Mohd Arif Othman, and Ummi, Datin Sharifah Baherah Syed Omar for their boundless love, encouragement, and continuous prayers. I also would like to thank my siblings, Rashidah, Fauzi, Sufian, Tasnim, Taqwiim, and Tashmil, who have provided ample support and assistance in completing this thesis.

Furthermore, sincere thanks to my HLP friends at Universiti Putra Malaysia for all the moments of joy we valued together from the first time when we registered as postgraduate students to this very second. In addition, I would like to take this chance to extend my appreciation to everyone who helped me complete my thesis but whose individual names cannot be mentioned here to acknowledge their support and assistance. Finally, I hope that anyone who reads this final research thesis will benefit from it.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the Degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Nurzatulshima binti Kamarudin, PhD
Senior Lecturer
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairman)

Othman bin Talib, PhD
Senior Lecturer
Faculty of Educational Studies
Universiti Putra Malaysia
(Member)

Zanariah binti Abdul Majid, PhD
Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

_____
ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 11 May 2023

Declaration by Members of the Supervisory Committee

This is to confirm that:

- the research and the writing of this thesis were done under our supervision;
- supervisory responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2015-2016) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Dr. Nurzatulshima binti Kamarudin

Signature: _____
Name of Member of Supervisory Committee: Dr. Othman bin Talib

Signature: _____
Name of Member of Supervisory Committee: Prof. Dr. Zanariah binti Abdul Majid

TABLE OF CONTENTS

		Page
ABSTRACT		i
ABSTRAK		iii
ACKNOWLEDGEMENTS		v
APPROVAL		vi
DECLARATION		viii
LIST OF TABLES		xiii
LIST OF FIGURES		xvii
LIST OF ABBREVIATIONS		xviii
CHAPTER		
1	**INTRODUCTION**	1
	1.1 Introduction	1
	1.2 Background of the Study	1
	1.3 Problem Statement	4
	1.4 Purpose of the Study	5
	1.5 Rationale of the Study	6
	1.6 Objectives of the Study	7
	1.7 Research Questions	7
	1.8 Significance of the Study	9
	1.9 Scope and Limitation of the Study	10
	1.10 Definitions of Terms	10
	1.11 Summary	13
2	**LITERATURE REVIEW**	14
	2.1 Introduction	14
	2.2 Concept and Definition of Creativity	15
	2.3 Perspective of Mathematical Creativity	18
	2.4 Creativity in Mathematics Education	19
	2.5 Fostering Creative Learning in Mathematics	22
	2.6 Creativity and Inquiry Learning	26
	2.7 Theoretical Framework of the Study	28
	2.7.1 Constructivist Learning Theory	29
	2.7.2 Four P's of Creativity	31
	2.7.3 Distinction of Mathematical Creativity	33
	2.7.4 Systems Model of Creativity	34
	2.7.5 Creative Learning Model	37
	2.7.6 Model of Inquiry	40
	2.7.7 Creative Inquiry Learning Activities	44
	2.7.8 Domains of the Mathematical Creative Inquiry Learning Model	47
	2.8 Gaps in the Literature	57
	2.9 Conceptual Framework	58
	2.10 Summary	61
3	**METHODOLOGY**	63
	3.1 Introduction	63
	3.2 Research Designs	63

	3.3	Phase 1: Needs Analysis	65
		3.3.1 Objectives	65
		3.3.2 Sample of the Study	66
		3.3.3 Procedure	67
		3.3.4 Instrument of the Study	67
		3.3.5 Data Analysis	68
	3.4	Phase 2: Design and Development	68
		3.4.1 Objectives	69
		3.4.2 Sample of the Study	69
		3.4.3 Nominal Group Technique (NGT)	70
		3.4.4 Interpretive Structural Modeling (ISM)	73
		3.4.5 Instrument of the Study	79
		3.4.6 Data Analysis	80
	3.5	Phase 3: Evaluation of the Model	80
		3.5.1 Objectives	80
		3.5.2 Sample of the Study	81
		3.5.3 Fuzzy Delphi Method (FDM)	81
		3.5.4 Instrument of the Study	84
	3.6	Ethical Issues of the Methodology	84
	3.7	Reliability and Validity	85
	3.8	Summary	86
4	**RESULTS AND DISCUSSION**		89
	4.1	Introduction	89
	4.2	Section A: Findings of Needs Analysis Phase	89
		4.2.1 Pilot Test	89
		4.2.2 Background of Respondents	90
		4.2.3 Teachers' Views Towards Creativity in Mathematics	92
		4.2.4 Teachers' Views on Creative Learning	95
		4.2.5 Teachers' Acceptance to Use Mathematical Creative Inquiry Learning Model	101
	4.3	Section B: Findings of Design and Development Phase	105
		4.3.1 Description of Panel of Experts	107
		4.3.2 Findings of the Design Phase of the Elements of the Mathematical Creative Inquiry Learning Model	109
		4.3.3 Findings of the Development Phase of the Elements of the Mathematical Creative Inquiry Learning Model	127
	4.4	Section C: Findings of Evaluation Phase	153
		4.4.1 Description of Panel of Experts	154
		4.4.2 Findings of the Evaluation of the Mathematical Creative Inquiry Learning Model for Secondary School Mathematics Learning	155
	4.5	Discussion of Findings	173
		4.5.1 Phase 1: Needs Analysis Findings	173
		4.5.2 Phase 2: Design and Development	177

4.5.3 Phase 3: Evaluation Findings 181
4.5.4 Role of Learning Activities in the Mathematical Creative Inquiry Learning Model 182
4.5.5 Relationship of Mathematical Creative Inquiry Learning Activities to the System Model of Creativity, Creative Learning Model, and Model of Inquiry 187
4.5.6 Role of Relationships between Mathematical Creative Inquiry Learning Activities 191
4.6 Summary 194

5 SUMMARY, IMPLICATION, CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH 200
5.1 Introduction 200
5.2 Summary of the Study 200
5.3 Implications of the Study 203
5.3.1 Practical Implications of the Study 203
5.3.2 Theoretical Implications of the Study 205
5.3.3 Methodology Implications of the Study 208
5.4 Recommendations 209
5.5 Future Research of the Study 211
5.6 Conclusion 212

REFERENCES 215
APPENDICES 240
BIODATA OF STUDENT 279
LIST OF PUBLICATIONS 280

LIST OF TABLES

Table		Page
2.1	The Revised Cognitive Domain	23
2.2	The Attributes of Creativity to Assess Creativity Potential	33
3.1	Variable Fuzzy Scale	83
3.2	Summary of Design and Development Research Design	87
4.1	Cronbach's Alpha Value of Needs Analysis Survey Questionnaire of Mathematical Creative Inquiry Model	90
4.2	Highest Qualification	91
4.3	Teaching/Working Experience	92
4.4	Creativity is the use of Imagination that can be Adapted in Every Field of Mathematical Knowledge	93
4.5	Creativity is an Important Skill that Needs to be Enhanced in Mathematics Learning	93
4.6	Creativity is Developed by the Intellectual Abilities of Students	93
4.7	Creativity Provides Mathematics Learning Environment in Real-Life Application	94
4.8	Creativity Enhances Positive Attitude Towards Mathematics Learning	94
4.9	Creativity Allows Students to Think of New Ways to Solve Problems in Mathematics Learning	95
4.10	Teachers' Views on Creative Learning Elements in Mathematics (Person)	96
4.11	Teachers' Views on Creative Learning Elements in Mathematics (Process)	98
4.12	Teachers' Views on Creative Learning Elements in Mathematics (Product)	99
4.13	Teachers' Views on Creative Learning Elements in Mathematics (Press)	100

4.14	The Mathematical Creative Inquiry Learning Model is Needed to Allow Creative Learning Elements that Reflect the Way Mathematical Knowledge will be Used in Real-World Experiences	102
4.15	The Mathematical Creative Inquiry Learning Model is Needed to Help Students to Achieve Their Learning Task by Using Inquiry-Based Activities to Create Ideas in Mathematics Learning	102
4.16	The Mathematical Creative Inquiry Learning Model is Needed to Provide Multiple Stages of Creative Perspectives to Increase Students' Performances in Solving Mathematics Problems	103
4.17	The Mathematical Creative Inquiry Learning Model is Needed to Make Learning Mathematics More Interesting via Collaborative Work Among Students	103
4.18	The Mathematical Creative Inquiry Learning Model is Needed to be Used for Scaffolding Students' Development of Creativity in Mathematics Learning	104
4.19	The Mathematical Creative Inquiry Learning Model is Needed to Improve the Critical Thinking of the Students in Mathematics Problem-Solving	104
4.20	The Mathematical Creative Inquiry Learning Model is Needed to Provide Guidelines on the Elements of Creative Learning in Mathematics among Students	104
4.21	Procedures conducted based on Research Question	105
4.22	Description of the Panel of Experts of the Design and Development Phase	106
4.23	Models Used for the Design of the Mathematical Creative Inquiry Learning Model	111
4.24	Elements Combinations for the Design of the Mathematical Creative Inquiry Learning Model	112
4.25	Percentage of Mathematical Creative Inquiry Learning Activities Scores based on Findings of NGT	114
4.26	Ranking of Mathematical Creative Inquiry Learning Activities based on Findings of NGT	117
4.27	Models used for the Design of the Mathematical Creative Inquiry Learning Model	126

4.28	Findings of the Domains of the Mathematical Creative Inquiry Learning based on NGT	127
4.29	Description of the Domains in the Mathematical Creative Inquiry Learning Model	128
4.30	Structural Self-Interaction Matrix (SSIM)	138
4.31	The Reachability Matrix for the Mathematical Creative Inquiry Learning Activities	139
4.32	The Reachability Matrix of the Mathematical Creative Inquiry Learning Activities: Level 1	140
4.33	The Reachability Matrix of the Mathematical Creative Inquiry Learning Activities: Level 2	143
4.34	The Reachability Matrix of the Mathematical Creative Inquiry Learning Activities	146
4.35	Partition Level of The Reachability Matrix of the Mathematical Creative Inquiry Learning Activities	149
4.36	Description of Panel Experts of the Evaluation Phase	155
4.37	Findings of the Threshold Value ‘d’ for The Experts’ Views on The Suitability of the Arrangement of the Learning Activities of the Model using Microsoft Excel Template based on FDM	157
4.38	Experts’ Views on the Suitability of the of the Arrangement of the Learning Activities of the Model	158
4.39	Findings of the Threshold Value ‘d’ for The Experts’ Views on The Suitability of the Main Domains of the Model using Microsoft Excel Template based on FDM	164
4.40	Experts’ Views on The Suitability of the Main Domains of the Model	165
4.41	Findings of the Threshold Value ‘d’ for the Experts’ Views on the Suitability of the Cluster Classification of the Mathematical Creative Inquiry Learning Activities of the Model using Microsoft Excel Template based on FDM	168
4.42	Experts’ Views on the Suitability of the Cluster Classification of the Mathematical Creative Inquiry Learning Activities of the Model	169
4.43	Findings of the Threshold Value ‘d’ for the Experts’ Views on the Usability of the Mathematical Creative Inquiry	

Learning Model for Mathematics Learning using Microsoft Excel Template based on FDM 171

4.44 Experts' Views on the Usability of the Mathematical Creative Inquiry Learning Model for Mathematics Learning 172

4.45 Domains and Learning Activities of the Mathematical Creative Inquiry Learning Model 184

LIST OF FIGURES

Figure		Page
2.1	The Four P's of Creativity	17
2.2	Bloom's taxonomy of learning domains-Cognitive Taxonomy	23
2.3	System Creativity Model	34
2.4	Model of Creativity	36
2.5	Creative Learning Model	38
2.6	Model of Inquiry	41
2.7	Conceptual Framework	59
3.1	Phases of Design and Developmental Research (DDR)	64
3.2	Phase of the Needs Analysis	66
3.3	Flowchart of the process for the modified Nominal Group Technique	74
3.4	Flow diagram for the Interpretive Structural Modeling	76
4.1	Respondents' Gender for Needs Analysis Phase	91
4.2	The Interpretive Structural Modeling (ISM) based on the Mathematical Creative Inquiry Learning Activities for Secondary School Mathematics Learning	134
4.3	The Reviewed Mathematical Creative Inquiry Learning Activities for Secondary School Mathematics Learning	137
4.4	Driving Power and Dependence Power Matrix for the Mathematical Creative Inquiry Learning Activities	152
4.5	The Mathematical Creative Inquiry Learning Model for Secondary School Mathematics Learning	180

LIST OF ABBREVIATIONS

KSSM	Kurikulum Standard Sekolah Menengah
KSSR	Kurikulum Standard Sekolah Rendah
MCILM	Mathematical Creative Inquiry Learning Model
MOE	Ministry of Education of Malaysia
PISA	Programme for the International Students Assessment
STEM	Science, Technology, Engineering, and Mathematics
TIMMS	Trends in International Mathematics and Science Study
UPM	Universiti Putra Malaysia

CHAPTER 1

INTRODUCTION

1.1 Introduction

There This study relates mathematics education in Malaysia to the necessity to encourage creativity and develop mathematical creative inquiry learning activities for secondary school students. Another factor motivating this study is the issue that creativity in mathematical education is not well explored. Thus, the study aims to develop the Mathematical Creative Inquiry Learning Model for secondary school mathematics learning. This chapter outlines the main thrust of this research and is allocated into several sections. The first part is the introduction to the topics and the discussion of the information related to the background of the research study.

The research problems are described in this chapter and then linked to the purpose and rationale of developing the Mathematical Creative Inquiry Learning Model for secondary school mathematics students. These subchapters also demonstrate the necessity of this study that focuses on the study's objectives, followed by a discussion of research questions. The significance of the study, the study's scope, and its limitations are discussed in more detail in the following section. The chapter then proceeds to explain the conceptual and operational definitions of the key terms used in the study. Finally, this chapter concludes with a summary by emphasizing the importance of the Mathematical Creative Inquiry Learning Model and its incorporation within formal mathematics classroom learning.

1.2 Background of the Study

Malaysia is moving towards the development of its human capital in a bid to achieve the status of a developed nation (Ali et al., 2021; Wan et al., 2018). It is the intention of the government to improve the level of our education system to the international level to prepare for a better future and enhance economic growth. As a fundamental aspiration, Malaysia Education Blueprint 2013-2025 specifies a major change in producing a balanced education for students. A highly successful education system is essential to prepare the country for better performance at an international level.

The aspirations of each student are shared in accordance with a national philosophy of education which includes knowledge, thinking, leadership, bilingual skills, spirituality, ethics, and national identity (Ministry of Education, 2019). The students' thinking skills are the second aim of the Malaysia education plan. Each student will learn a wide range of cognitive abilities, including critical

thinking, creative, innovative, problem-solving, and reasoning (Ilha Villanova & Pina e Cunha, 2020; Yang & Homg, 2018). Thus, the development of creativity is a well-discussed topic in the education field including Malaysia, that should be enhanced among students. Students should be encouraged to think independently and use the Mathematical problems in real-life situations to stimulate their understanding and enhance their interest in learning the mathematics syllabus.

The improvement of the students' creativity and the quality of teaching are also one of the focuses in Mathematics learning and initiatives involve moving away from traditional learning that encourages students to memorize content for the purpose of scoring in testing for more creative understanding and conducting assessment in Mathematics (Abdul Hamid & Kamarudin, 2021). Consequently, the emphasis on creative learning in Mathematics will improve students' higher order thinking and critical skills. The school curriculum in Malaysia has been revised to focus more on creative activities to enhance creativity, innovation, problem-solving, and leadership among the students. The aspiration is part of the effort to lift global educational standards to an international level.

According to Benedek et al. (2020), educators play important roles in ensuring positive teaching practice. Educators organize, direct, assess teaching and become the facilitators where they decide what to teach, the strategies and techniques to adapt, the collection of syllabuses, and the assessment methods. Interesting and creative content should be promoted amongst students to participate in activities and various pedagogies to deliver lessons effectively. Nevertheless, the current education system remains committed to the conventional formal education approach, which has always been unidirectional and teacher-oriented, focusing on a standard curriculum and structured learning methods (Ying Qin & Md Nor, 2018). Therefore, a more creative learning model that incorporates creative learning in mathematics secondary school syllabus should be developed.

Creative inquiry learning is necessary because it allows mathematics educators to apply their theoretical knowledge in various contexts, narrowing the gap between theory and practice. One of the issues that mathematics teachers must address is bridging the gap between theories and the actual demands of creative learning (Abdul Hamid et al., 2021). Numerous mathematics educators are attempting to bridge the gap between theory and practice. Mathematics teachers will have intuitive abilities to integrate creative inquiry learning in the classroom by using learning activities that are relevant to practice (Johansen et al., 2022). According to Rubenstein et al. (2019), the strength of model development is that it bridges the gap between the theory and practice of creative inquiry learning.

It is crucial to create the Mathematical Creative Inquiry Learning Model to bridge the gap between creative inquiry theories and practices (Murcia et al., 2022). Additionally, this study aims to fill the research gap by allowing mathematics teachers to encourage the use of creative inquiry learning activities of the

developed model. It focuses on assisting students in improving their creative abilities, building the capacity to bridge theory and practice and preparing them for creative inquiry learning. This study is essential because it provides insights into the possibility of utilizing mathematical creative inquiry learning activities to foster higher-order thinking abilities, enhance pedagogical material knowledge, and build creative talents. This study develops the Mathematical Creative Inquiry Learning Model to engage students in creative inquiry practices.

This study proposes the development of the Mathematical Creative Inquiry Learning Model for secondary school mathematics learning to address the problems of enhancing creative skills and being sufficiently prepared for mathematics learning. Incorporating the creative inquiry learning activities of the developed model for secondary school mathematics learning is intended to improve creative abilities and pedagogical content understanding and bridge the theory and practice gap among mathematics teachers. This study is significant because it gives insight into the prospect for students to learn through creative inquiry learning, including the potential for developing creative and higher-order thinking skills and preparing students for 21st-century learning.

Specifically, creativity in mathematics is also measured as a binding force for the future and seen as one of the main priorities in a research area (Regier & Savic, 2020; Schoevers et al., 2020; Amponsah et al., 2019). All students can become creative in a conducive environment (Hieu et al., 2020; Kozlowski & Si, 2019). Educators should develop mathematical creativity in all students to excel in their fields of interest and lead the nations in progress. Enhancement in mathematical creativity requires motivation, encouragement, equity, and strong support for all students. Mathematics educators embrace the interpretation that mathematical creativity can be developed if the students are assisted with the right learning approaches.

A few studies have also been written about the different aspects of mathematical creativity: fluency, flexibility, uniqueness, and elaboration among students. Kandemir et al. (2019) proposed that environmental factors involve creative situations, social, natural, cultural, and organizational environments. The creative mathematical approach in a Mathematics classroom also creates an environment for creative thinking (Abdul Hamid et al., 2021). Studies should be done to explore the best model to improve students' mathematical creativity. The literature suggests that the accuracy of a student in mathematical computation with little emphasis on creativity is frequently used to measure student creativity in Mathematics.

Guiding students attached to mathematics and enhancing their mathematical creativity may change this tendency. Thus, this research attempts to develop a Mathematical Creative Inquiry Learning Model in Mathematics among secondary school students. Besides, the observation also influenced by the fact that the issue of creativity in mathematics education is not well explored (Wijaya et al., 2021). This study attempts to report this deficiency too. This study also relates

mathematical education in Malaysia to the necessity to encourage creativity and develop mathematical creative inquiry learning activities among secondary school students. The issue that creative inquiry learning activities in mathematical education is not well explored also gives reason for this study.

1.3 Problem Statement

There is a concern about Malaysian students' creativity performances at the international level, especially in Mathematics. This statement is supported by the Programme for the International Students Assessment (PISA) report and the Trends in International Mathematics and Science Study (TIMSS) report. Referring to TIMSS 2015, and 2019, the Malaysian students' performances were below the international average in Mathematics (Foy et al., 2020; TIMSS & PIRLS, 2016). It is stated that the students failed to meet the proficiency level in Mathematics and were also identified to have limited mastery of mathematical concepts that involve mathematical creativity and critical thinking skills.

According to the Malaysian Education Blueprint 2013-2025 report, this aspect is attributed to the facts and formulas of memory learning in Malaysian schools. There was also a lack of skills to solve mathematics problems with mathematical creativity, which could not be easily developed by collecting the facts and formulas (Kim How et al., 2022; Yuanita et al., 2018). The result shows that any creative intervention or approach that contributes to the increase of the mathematical skills would be strongly encouraged among students.

Teaching approaches that emphasize creativity in Mathematics problem solving can be implemented to advance the students' mathematical thinking abilities (Bahar & Maker, 2020; Nufus et al., 2018). Students are encouraged to think independently and use the mathematics problem in real-life situations to stimulate their imagination and improve their thinking skills. Educators could offer and support the students through investigations and gather all information about mathematical knowledge and strategies. This statement is a very vital phase and will stimulate the students' mathematical thinking too.

One of the aims of Malaysian education at all levels of schooling, especially in mathematics, is to improve creative thinking ability. Enhancement in students' thinking skills is the second aspiration indicated in the Malaysia Education Blueprint 2013-2025 (Ghazali et al., 2020). It outlines the necessity for each student to master a range of cognitive skills, including critical thinking, creative thinking, problem-solving, reasoning, and learning. The researcher is aware that creativity remains one the most important things to all disciplines and fields of work and study. However, not much research has been conducted to explore the importance of creativity through creative learning to enhance students' mathematical creativity in Malaysia.

Conradty et al. (2020) stated that limiting the use of creativity in the classroom reduces the natural curiosity of students and the enthusiasm for mathematics, creating a huge problem for educators in mathematics who are trying to instill these qualities themselves. Confining the topic of mathematics into conventional teaching methods ignores students who offer the highest potential for creativity advancement in mathematics. The literature proposes that precision of the computation of a student in Mathematics with less prominence on mathematical creativity and divergent thinking is often used to measure students' mathematical achievements. Such an approach diminishes students' natural interest in mathematics and restricts the use of in-class creativity. Keeping students engaged by valuing their mathematical creativity can reverse this trend.

Harris and De Bruin (2018) stated that although it is important to develop students' structured creative problem resolution skills at the secondary school level, it is also difficult for many educators to construct such a learning environment. The reason might be the lack of appropriate resources available as a guide for educators and research-based knowledge to develop a model for facilitating creative learning (Horng et al., 2016). Hosseini & Watt (2010) recommended that further research into the implementation of developing a mathematical creative inquiry model in the context of secondary school education should be proposed to address those issues. A creative pedagogical model is essential to fill a gap between mathematics and solving real problems. Thus, this study attempts to develop and study the mathematical creative inquiry learning model for secondary school mathematics learning.

In this study, a model for the implementation of creativity as a learning solution will be developed for the purpose of filling the study gap, which focuses on the idea of creativity as the learning method to support students in their Mathematics learning needs. The implementation model consists of creative learning activities in mathematics, linking the learning lesson, formal creative Mathematics learning strategies, resources, and evaluation method. Selecting the Mathematics creative inquiry earning activities will be assigned to a panel of experts. Nevertheless, it is not sufficient to classify the learning activities alone without assessing the relationships between them. The connection will direct both educators and learners through mutual experiences and collaborative interactions to achieve learning outcomes. Furthermore, the elements and learning activities will be selected according to creative learning in a classroom to assist students with mathematics knowledge needs. The model is also designed to demonstrate how creative inquiry learning can be related to combining formal and informal activities in Mathematics education.

1.4 Purpose of the Study

This study is aimed primarily at developing the Mathematical Creative Inquiry Learning Model for secondary school mathematics learning. The model is designed to develop a guideline on how mathematical creative inquiry learning can be incorporated in formal Mathematics in assisting students in their

Mathematics knowledge needs according to the mathematics syllabus outcomes through mathematical creative inquiry learning activities. The research emphasis on secondary school Mathematics syllabus for model development. The model development process is constructed using the design and development research (DDR) approach, which comprises three phases; needs analysis, design and development, and the evaluation stage. The model was developed with the help of expert decisions and opinions to decide the relationships in the model framework between the elements. Another team of experts were also consulted to evaluate the developed model.

1.5 Rationale of the Study

Creativity is considered as one of the most valued learning skills in the 21st century. The development of creativity is necessary for effective and high-level learning. The purpose of this study was to investigate how mathematical creative inquiry learning activities could be included as the learning guidelines in mathematics lessons for secondary school students. The difficulty to solve creative problems in Mathematics has been identified as one of the major issues among the students (Sesriani, 2022; Khalid et al., 2020). Several studies have indicated that students' lack of creative skills in solving mathematics problems relates to poor performance in mathematics achievement (Abdul Hamid et al., 2021).

The study focused on secondary school students due to increasing concerns regarding inadequate creativity skills in problem-solving, which the researchers have repeatedly emphasized (Kirisci et al., 2020; Bereczki & Kárpáti, 2018). This contribution aims to explain the study of creativity using the methods mentioned to gain a better understanding of creative learning in mathematics. Furthermore, the emphasis has been placed on focusing on the development of creativity from an educational perspective, beginning with the description, implications, and use of creative learning techniques in teaching and learning processes.

In this study, the Mathematical Creative Inquiry Learning Model was used as a potential solution to the problem of secondary mathematics competency because it is a lifelong learning activity for many and has become one of the main key application areas of creative inquiry learning (Wieser, 2020). Another study discovered that creative learning activities are more effective as a learning approach than the traditional learning technique (Indarasati et al., 2019). Aside from this, previous research has clearly shown that creative inquiry learning is important in mathematics teaching and learning. The most essential or relevant strategies found in the literature are briefly described, emphasizing their application in the model development process in this study.

Nurdiansyah et al. (2021) observed that creative inquiry learning improved students' mathematics problem-solving skills by incorporating creative learning activities in a mathematics lesson. The study also found that the inquiry learning

activities helped students enhance their understanding of the topic. Another fascinating study of secondary school students discovered that creative learning was crucial in their capacity to think and imagine (Henriksen et al., 2020; Harris et al., 2018) The critical aspect supporting the mutual interaction between inquiry and creativity acquisition and the efficiency of the Mathematical Creative Inquiry Learning Model in mathematics learning is the accessibility of the creative learning activities, which are easy to be conducted in the classroom.

The goal of mathematics learning should not be limited to the traditional teaching of basic ideas, principles, and theories to develop conceptual knowledge of the topics. According to Wright (2021), traditional teaching and learning methods have focused on memorizing materials, which has resulted in inaccuracies in creative thinking in the subject. The conventional mathematics teaching methods are often oriented toward teachers who attempt to cover a large amount of educational material in a short amount of time. Approaches to developing a model for practical comprehension that can be recalled and used in the future that allow students to participate in the lesson are required for conceptual understanding of mathematics concepts. As a result, the focus of this research was to develop the Mathematical Creative Inquiry Learning Model centred on creative inquiry learning activities that would help students improve in mathematics learning.

1.6 Objectives of the Study

The main aim of this study was to develop the Mathematical Creative Inquiry Learning Model for secondary school mathematics learning. The model development process involved three phases; needs analysis, design and development, and the evaluation stage. The following objectives are listed to achieve the main aim of the study:

i. To determine the needs of the development of the Mathematical Creative Inquiry Learning Model for secondary school Mathematics learning based on Mathematics teachers' views.
ii. To design and develop the Mathematical Creative Inquiry Learning Model for secondary school Mathematics learning established by experts' decisions and views.
iii. To evaluate the Mathematical Creative Inquiry Learning Model for secondary school Mathematics learning based on experts' views and opinions.

1.7 Research Questions

The model is designed to provide guidelines on how mathematical creative inquiry learning activities can be incorporated in formal Mathematics to help students improve their mathematics learning needs based on the mathematics

curriculum. The model is cultivated with the help of expert opinions and decisions to decide the relationships in the model framework between the learning activities. Another team of experts will also be consulted to evaluate the model. The research questions are elaborated based on design and development research (DDR). The model design process is developed using three procedures, the needs analysis phase, the design and development phase and the evaluation phase. This research will be led by the following research questions to support the achievement of the central purpose of the study:

For Phase 1 - Need Analysis Phase, in determining the needs of the mathematical creative inquiry learning model for secondary school mathematics learning based on the views of teachers, the phase is aimed to answer the following research questions:

i. What are the teachers' views on creativity in Mathematics learning?
ii. What are the teachers' views on creative learning elements in Mathematics?
iii. What is the teachers' level of agreement and acceptance to use the Mathematical Creative Inquiry Learning Model if it is incorporated into formal Mathematics learning?

For Phase 2 – The Design and Development Phase seeks to respond to these research questions to develop the Mathematical Creative Inquiry Learning model for secondary school mathematics learning:

i. What are the experts' views on the learning activities that should be comprised in the Mathematical Creative Inquiry Learning Model elements?
ii. What are the experts' views on the selection of creative inquiry main domains that should be included in the Mathematical Creative Inquiry Learning Model?
iii. What are the experts' views on the connections between the implementation of the creative inquiry elements in the Mathematical Creative Inquiry Learning Model?
iv. What are the experts' views on the classification of the learning activities in the Mathematical Creative Inquiry Learning Model?

At the concluding Phase 3 – Implementation and Evaluation Phase, the experts evaluate the mathematical creative inquiry learning model based on their opinions and is aimed to answer the subsequent research questions:

i. What are the experts' views on the suitability of the arrangement of the model's mathematical creative inquiry learning activities?
ii. What are the experts' views on the suitability of the main domains of the mathematical creative inquiry learning activities developed in the

Mathematical Creative Inquiry Learning Model for secondary school Mathematics learning?

iii. What are the experts' views on the suitability of the cluster classification of the mathematical creative inquiry learning activities of the Mathematical Creative Inquiry Learning Model for secondary school Mathematics learning?

iv. What are the experts' views on the usability of the Mathematical Creative Inquiry Learning Model for Mathematics Learning?

1.8 Significance of the Study

It is the sincere hope of the researcher that by carrying out this research, there is an insight into mathematical creative inquiry, which could improve the quality of mathematics performances as well as the education system which is relevant within the Malaysian. It is also wished that the level of the education system will be advanced by implementing the mathematical creative inquiry learning model in schools to overcome the weaknesses in mathematics education towards better performances in the next international assessment, especially in Mathematics.

It is also highly recommended that the mathematical creative inquiry learning model be incorporated in mathematics education since it can stimulate students' mathematical creativity, divergent thinking, motivation and enhance their interest in mathematics. The mathematical creative inquiry learning model emphasizes creative inquiry learning elements, activities, and learning strategies that include four distinctive aspects of students' mathematical creativity; fluency, flexibility, originality, and elaboration, all of which will are required to solve new Mathematics problems and develop higher-order thinking skills in the future. Students can be encouraged to think creatively and use mathematical issues in real-life situations to stimulate their understanding and improve their mathematics achievement.

This study is also very important for instructional designers and gives many insights into the design and development of the model. It aids other scholars who are interested on formulating methods for creating and implementing the Mathematical Creative Inquiry Learning Model into practice. Additionally, the research results may guide mathematics educators to provide different and creative instruction to improve students' creativity in the classroom. Educators can relate theoretical models to practical situations exposed to various creative techniques and integrate mathematically creative activities into teaching and learning. Educators who are equipped with the capability to use the pedagogical curriculum's content efficiently and adopt creative teaching skills will contribute to the growth of Malaysia's education system.

1.9 Scope and Limitation of the Study

The development of the mathematical creative inquiry learning model is designed as an example of how creativity could be integrated into formal learning for support for mathematics education in secondary schools. Hence, the development of the model was context-specific (Richey & Klien, 2014), where it will be developed for a particular group of secondary school teachers for a specific Mathematics subject. This study includes the mathematics teachers' views and opinions in determining the need to develop the implementation model in the requirement analysis phase. The research adopted the Nominal Group Technique (NGT) and the Interpretive Structural Modeling (ISM) in the design and development phase to identify the model elements and gain expert opinions using the Fuzzy Delphi Method (FDM) to evaluate the model. Therefore, the developed model depends on the selection and views of experts.

In addition, the results can differ if the study is performed with different types and numbers of experts in different contexts. The model should not, therefore, be generalized to suit all mathematics subjects in other secondary schools. This study, however, could be replicated in a similar creative mathematical model of learning tailored for different classes of students in each school and even numerous subjects. The study's other limitation is that the mathematical model of creative learning focuses on mathematical creative inquiry as the principal model of the elements. Other elements for the mathematical creative inquiry model may be links of other variables, including participants relationships, contexts, learning skills, and strategies.

1.10 Definitions of Terms

Creativity: Four different creativity perspectives have been the focus centres in this research, namely person, process, products, and press (Ilha Villanova et al., 2020). It is important to consider the four different aspects of creativity that will be emphasized in this research when attempting to understand the field of creativity. This distinction of creativity is also referred to as “the four P’s” when focusing on creativity.

Mathematical Creativity: In this study, three major components are generally described: fluency, flexibility, originality, and elaboration (Rubenstein et al., 2019; Leikin et al., 2019; Haylock, 1997; Torrence, 1967; Guilford, 1960).
Fluency: Fluency is described as the number of relevant ideas, and it shows the ability to produce several different responses (Lev-Zamir et al., 2013; Torrance, 1967). The total fluency value is calculated by a total of the correct answers they have given based on a particular problem. In a mathematical context, fluency is illustrated as the number of relevant and accurate responses given by the students based on a given mathematical problem.

Flexibility: Flexibility refers to the number of categories or classes represented in a respondent's pool of ideas or responses (Leikin et al., 2019; Torrance, 1967). The overall flexibility score is determined by the total number of various categories created in the answers. The comparative score is calculated in the same way that the relative score for fluency is calculated. In the context of this research, flexibility is described as the different categories in the answers given by the students for a given mathematical problem.

Originality: Originality is the uniqueness or novelty of a student's solutions compared to other responses (Arifin et al., 2021; Leikin et al., 2019; Torrance, 1967) can be defined as originality. Students who solve problems using an original method would score higher in this category. For this research, originality is described as the uniqueness of the students' answers in a given mathematical problem compared to other students' responses.

Elaboration: Elaboration describes the number of details given by respondents (Rubenstein et al., 2019; Torrance, 1967). It is also related to the explanation of the solution to a given problem. In the context of this research, elaboration is illustrated as the amount of description given by students in their answers for a given problem in mathematics.

Inquiry Learning: Inquiry learning is an approach that emphasizes the importance of the student's involvement in the learning process (Krogh et al., 2020). Students must investigate the topic, ask questions, and exchange ideas rather than have the teacher tell them what they need to know. Group discussion and guided learning are two techniques used in inquiry learning. Students learn through experience rather than memorizing information and content. This situation enables them to expand their understanding through discovery, exploration, and discussion. Students are actively involved in the learning activities and have the opportunity to explore deeper into a topic and benefit from their perspectives, views, and experiences.

Learning Model: A learning model is a collection of methods and actions involved in acquiring new skills and knowledge to promote and support learning. This idea is a simplified representation of an educational process or system. It generally demonstrates what it offers the students, the role of the authority in this process, and the roles of the moderators to positively reflect the educational contents of the model. It also provides all the materials needed for the activities and describes the assessment and learning environment.

Mathematical Creative Inquiry Learning Model: The model can be incorporated in a mathematics classroom lesson to improve the development of the four mathematical creativity dimensions among the students: fluency, flexibility, originality, and elaboration in an intervention group (Torrance, 1967). Activities emphasizing the components of mathematical creativity in terms of fluency, flexibility, originality, and elaboration will be incorporated and guided in

a mathematics lesson. Students will also be encouraged to think independently and use the mathematics problem in real-life situations to stimulate their imagination and improve their higher-order thinking skills (Barak & Yuan, 2021). Support to guide the students through inquiries, investigations, and a collection of information about mathematical knowledge and strategies will be given to the students. Students will be asked to make efforts in sharing and compare mathematical solutions and justify the solutions to reflect their mathematical ideas.

Creative Learning: Creative learning focuses on learner-centred. Learners are encouraged to experiment and explore different learning ways in creative education. The ultimate purpose of creative learning is to help students realize their full potential in learning (Hieu et al., 2020; De Souza et al., 2018). Students should become aware of their learning process and the factors that may influence their performances in achieving the learning goals. To overcome established barriers in their learning process, they must go through a series of experiments and explorations. Creative learning can be enhanced and developed when the learner is confronted with new problems one after another, with feedback and full direct instruction in the learning process.

Conventional Learning: The traditional learning approach focuses on chalk and talk teaching and mathematics work drilling. Traditional methods like the use of chalk and talk will be used for teaching mathematics. Textbooks and traditional instructional practices formed the fundamental of the conventional approach of learning. The students will also be divided into small groups for discussion with the help of recognized learning materials according to the syllabus.

Collaborative Learning: A collaborative learning approach incorporates students collaborating on learning activities or tasks in groups to ensure everyone is involved. The group of students may work on distinct projects that contribute to a common conclusion, or they may collaborate on a single activity. In order to promote more effective collaboration, several collaborative learning methodologies put pairings, groups, or teams of mixed ability to work with one another. This approach is a learning process in which students work in groups to gain information. Students could actively share information, ideas, observations, and reflections to acquire knowledge and resolve issues.

Problem-solving: Problem-solving is the process of finding a solution to any problem. These phases begin with recognizing the problem and discovering the source of the problem. After identifying a problem and its underlying cause, the following stage is to choose potential solutions and implement them. Collectively, these processes are known as the problem-solving process. This study uses problem-solving to produce an effective solution to students' specific Mathematics creative problems. These processes include analysis, identification, and interpretation of the elements in the problem context.

Cognitive skills: Thinking human beings usually have reasoning abilities that are used to learn and do things, make meanings, determine, and think about creative ideas. Cognitive skills are the fundamental thinking skill that the brain employs to think, analyze, comprehend, memorize, and explain. Each of the cognitive abilities contributes to the development of new knowledge. Cognitive skills assist you in interpreting data, understanding learning goals, paying attention during a crucial meeting, and many other tasks. These abilities assist in the recall of earlier information that may be relevant to the learning objectives and the construction of new and old ideas.

1.11 Summary

Overall, Chapter 1 outlines the primary focus of this research, which is the introduction of the topic followed by the relevant background that demonstrates the necessity for this study. This chapter justifies the study of creative inquiry learning by emphasizing its incorporation within formal mathematics classroom learning. The study on the development of the Mathematical Creative Inquiry Learning Model is justified by the growing utilization of creative inquiry in mathematics learning. However, it is suggested that the goal should not only be based primarily on incorporating the Mathematical Creative Inquiry Learning Model into formal education. The developed model is better considered as learning support through mathematical creative inquiry learning activities for secondary school mathematics learning. Instead of seeing it as a replacement for the traditional learning approach, mathematical creative inquiry learning is framed to enhance classroom instruction. The problem statement is discussed in more detail in the following section of this chapter, followed by a discussion of the purpose of the study. This chapter contributes to the formulation of the research objectives, which are systematically directed to the development of the model. The research questions are also described in the following sections. This subchapter is then linked to the next section, which highlights the significance of the study, and the next section provides the scope and limitations of the study. The final part of the chapter outlines the definition of the key terms used in the study. This idea made it easier to explain how the model should be used as a guideline for utilizing creative inquiry learning for secondary school mathematics.

REFERENCES

Abdullah, N., Mustafa, Z., Hamzah, M., Dawi, A. H., Mustafa, M. C., Halim, L., Saleh, S., & Che Abdul Khalil, C. S. H. A. (2021). Primary school science teachers' creativity and practice in Malaysia. *International Journal of Learning, Teaching and Educational Research*. https://doi.org/10.26803/IJLTER.20.7.19

Abdul Hamid, N., & Kamarudin, N. (2021). Assessing Students' Mathematics Achievement and Mathematical Creativity using Mathematical Creative Approach: A Quasi-Experimental Research. *Asian Journal Of University Education, 17*(2), 100-112. doi:10.24191/ajue.v17i2.13399

Aguilera, D., & Ortiz-Revilla, J. (2021). Stem vs. Steam education and student creativity: A systematic literature review. *Education Sciences*. https://doi.org/10.3390/educsci11070331

Alarabiat, A., & Ramos, I. (2019). The delphi method in information systems research (2004-2017). *Electronic Journal of Business Research Methods*. https://doi.org/10.34190/JBRM.17.2.04

Alberta Learning. (2004). *Focus on Inquiry: A Teacher's Guide to Implementing Inquiry-Based Learning*. Alberta: Learning Resources Centre.

Ali, G., Jaaffar, A. R., & Ali, J. (2021). STEM Education in Malaysia: Fulfilling SMEs' Expectation. In *Modeling Economic Growth in Contemporary Malaysia*. https://doi.org/10.1108/978-1-80043-806-420211005

Allen, J., Dyas, J., Jones, M. (2004). Building consensus in health care: a guide to using the nominal group technique. *British Journal of Community Nursing*, 9(3), 110 -114.

Amabile, T.M. (1996). *Creativity in context*. Boulder. CO: Westview Press.

Amponsah, S., Kwesi, A. B., & Ernest, A. (2019). Lin's creative pedagogy framework as a strategy for fostering creative learning in Ghanaian schools. *Thinking Skills and Creativity*, *31*, 11–18. https://doi.org/10.1016/j.tsc.2018.09.002

Amran, M. S., Kutty, F. M., & Surat, S. (2019). Creative Problem-Solving (CPS) Skills among University Students. *Creative Education*. https://doi.org/10.4236/ce.2019.1012229

Anderson, L., & Krathwohl, D.A. (2001). T*axonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational* Objectives. New York: Longman.

Aralas, D. (2008). Mathematical Creativity and its Connection with Mathematical Imagination. In E. Velikova & A. Andžans (Eds.), Proceedings of the Discussion Group 9: Promoting Creativity for All Students in Mathematics

Education. *The 11th International Congress on Mathematical Education* (pp. 23-32). University of Rousse, Bulgaria.

Abdullah, N., Mustafa, Z., Hamzah, M., Dawi, A. H., Mustafa, M. C., Halim, L., Saleh, S., & Che Abdul Khalil, C. S. H. A. (2021). Primary school science teachers' creativity and practice in Malaysia. *International Journal of Learning, Teaching and Educational Research*. https://doi.org/10.26803/IJLTER.20.7.19

Abdul Hamid, N., & Kamarudin, N. (2021). Assessing Students' Mathematics Achievement and Mathematical Creativity using Mathematical Creative Approach: A Quasi-Experimental Research. *Asian Journal Of University Education, 17*(2), 100-112. doi:10.24191/ajue.v17i2.13399

Aguilera, D., & Ortiz-Revilla, J. (2021). Stem vs. Steam education and student creativity: A systematic literature review. *Education Sciences*. https://doi.org/10.3390/educsci11070331

Alarabiat, A., & Ramos, I. (2019). The delphi method in information systems research (2004-2017). *Electronic Journal of Business Research Methods*. https://doi.org/10.34190/JBRM.17.2.04

Alberta Learning. (2004). *Focus on Inquiry: A Teacher's Guide to Implementing Inquiry-Based Learning*. Alberta: Learning Resources Centre.

Ali, G., Jaaffar, A. R., & Ali, J. (2021). STEM Education in Malaysia: Fulfilling SMEs' Expectation. In *Modeling Economic Growth in Contemporary Malaysia*. https://doi.org/10.1108/978-1-80043-806-420211005

Allen, J., Dyas, J., Jones, M. (2004). Building consensus in health care: a guide to using the nominal group technique. *British Journal of Community Nursing*, 9(3), 110 -114.

Amabile, T.M. (1996). *Creativity in context*. Boulder. CO: Westview Press.

Amponsah, S., Kwesi, A. B., & Ernest, A. (2019). Lin's creative pedagogy framework as a strategy for fostering creative learning in Ghanaian schools. *Thinking Skills and Creativity*, *31*, 11–18. https://doi.org/10.1016/j.tsc.2018.09.002

Amran, M. S., Kutty, F. M., & Surat, S. (2019). Creative Problem-Solving (CPS) Skills among University Students. *Creative Education*. https://doi.org/10.4236/ce.2019.1012229

Anderson, L., & Krathwohl, D.A. (2001). T*axonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational* Objectives. New York: Longman.

Aralas, D. (2008). Mathematical Creativity and its Connection with Mathematical Imagination. In E. Velikova & A. Andžans (Eds.), Proceedings of the Discussion Group 9: Promoting Creativity for All Students in Mathematics

Education. *The 11th International Congress on Mathematical Education* (pp. 23-32). University of Rousse, Bulgaria.

Arifin, S., Zulkardi, Putri, R. I. I., & Hartono, Y. (2021). On creativity through mathematization in solving non-routine problems. *Journal on Mathematics Education*. https://doi.org/10.22342/JME.12.2.13885.313-330

Assmus, D., & Fritzlar, T. (2022). Mathematical creativity and mathematical giftedness in the primary school age range: an interview study on creating figural patterns. *ZDM - Mathematics Education*. https://doi.org/10.1007/s11858-022-01328-8

Atmojo, I. R. W., & Sajidan. (2020). Effectiveness of CEL-badis learning model on students' creative-thinking skills: Case on the topic of simple food biotechnology. *International Journal of Instruction*, *13*(3), 329–342. https://doi.org/10.29333/iji.2020.13323a

Attri, R., Dev, N., & Sharma, V. (2013). Interpretive structural modelling (ISM) approach: an overview. *Research Journal of Management Sciences*.

Ayele, M. A. (2016). Mathematics teachers' perceptions on enhancing students' creativity in mathematics. *Mathematics Education*, *11*(10), 3521–3537.

Aziz, S. N., & Suparman. (2020). Design of mathematical e-module based on inquiry learning model to stimulate the creative skills. *International Journal of Scientific and Technology Research*, *9*(3), 4806–4812.

Aziza, M. (2018). An analysis of a teacher's questioning related to students' responses and mathematical creativity in an elementary school in the UK. *International Electronic Journal of Elementary Education*. https://doi.org/10.26822/iejee.2018438138

Bahar, A. K., & Maker, C. J. (2020). Culturally Responsive Assessments of Mathematical Skills and Abilities: Development, Field Testing, and Implementation. *Journal of Advanced Academics*. https://doi.org/10.1177/1932202X20906130

Baharin, N., Kamarudin, N., & Manaf, U. K. A. (2018). Integrating STEM Education Approach in Enhancing Higher Order Thinking Skills. *International Journal of Academic Research in Business and Social Sciences*, *8*(7). http://doi: 10.6007/ijarbss/v8-i7/4421

Bahrum, S., Wahid, N., & Ibrahim, N. (2017). Integration of STEM Education in Malaysia and Why to STEAM. *International Journal of Academic Research in Business and Social Sciences.* http://dx.doi.org/10.6007/IJARBSS/v7-i6/3027

Baker, M.T., Rudd, R.D., & Pomeroy, C., (2001). Tapping into the creative potential of higher education : A theoretical perspective. *Journal of Southern Agricultural Education Research*. http://www.aged.tamu.edu/conferences/Proceedings/index.html

Bakırcı, H., & Kırıcı, M. G. (2021). The effect of STEM supported research-inquiry-based learning approach on the scientific creativity of 7th grade students. Journal of Pedagogical Research. https://doi.org/10.33902/jpr.2021067921

Bammer, M., Benge, M., & Warner, L. (2022). Conducting the Needs Assessment #9: The Nominal Group Technique. *EDIS*. https://doi.org/10.32473/edis-wc410-2022

Barak, M., & Yuan, S. (2021). A cultural perspective to project-based learning and the cultivation of innovative thinking. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100766

Barana, A., Boetti, G., & Marchisio, M. (2022). Self-Assessment in the Development of Mathematical Problem-Solving Skills. *Education Sciences*. https://doi.org/10.3390/educsci12020081

Barraza-García, Z. M., Romo-Vázquez, A., & Roa-Fuentes, S. (2020). A theoretical model for the development of mathematical talent through mathematical creativity. *Education Sciences*. https://doi.org/10.3390/educsci10040118

Barron, F. (1995). The Disposition towards Originality. *Journal of Abnormal Psychology*, *5*(1), 478-485.

Beghetto, R. A., & Karwowski, M. (2017). *Toward untangling creative self-beliefs. The creative self: Effect of beliefs, self-efficacy, mindset, and identity*. Elsevier Inc. http:// doi.org/10.1016/B978-0-12-809790-8.00001-7.

Belbase, S., Mainali, B. R., Kasemsukpipat, W., Tairab, H., Gochoo, M., & Jarrah, A. (2021). At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: prospects, priorities, processes, and problems. *International Journal of Mathematical Education in Science and Technology*.

Ben-Horin, O., Chappell, K. A., Halstead, J., & Espeland, M. (2017). Designing creative inter-disciplinary science and art interventions in schools: The case of Write a Science Opera (WASO). *Cogent Education*, *4*(1). https://doi.org/10.1080/2331186X.2017.1376926

Benedek, M., Bruckdorfer, R., & Jauk, E. (2020). Motives for Creativity: Exploring the What and Why of Everyday Creativity. *Journal of Creative Behavior*. https://doi.org/10.1002/jocb.396

Bereczki, E. O., & Kárpáti, A. (2018). Teachers' beliefs about creativity and its nurture: A systematic review of the recent research literature. In *Educational Research Review*. https://doi.org/10.1016/j.edurev.2017.10.003

Capone, R., & Lepore, M. (2022). From Distance Learning to Integrated Digital Learning: A Fuzzy Cognitive Analysis Focused on Engagement, Motivation,

and Participation During COVID-19 Pandemic. *Technology, Knowledge and Learning*.

Care, E., Kim, H., Vista, A., & Anderson, K. (2018). Education system alignment for 21st century skills: Focus on assessment. *Center for Universal Education at the Brookings Institution*

Carney, O., McIntosh, J., & Worth, A. (1996). The use of the Nominal Group Technique in research with community nurses. *Journal of Advanced Nursing*, 23(5), 1024-1029.

Catarino, P., Vasco, P., Lopes, J., Silva, H., & Morais, E. (2019). Cooperative learning on promoting creative thinking and mathematical creativity in higher education. *REICE. Revista Iberoamericana Sobre Calidad, Eficacia y Cambio En Educacion*. https://doi.org/10.15366/reice2019.17.3.001

Cavallo, A.M.L. & Laubach, T.A. (2001). Students' Science Perceptions and Enrollment Decisions in Differing Learning Cycle Classrooms. *Journal of Research in Science Teaching*, 38(9), 1029-1062.

Chang, P. L., Hsu, C. W., & Chang, P. C. (2011). Fuzzy Delphi method for evaluating hydrogen production technologies. *International journal of hydrogen energy*, *36*(21), 14172-14179

Chen, C. (2012). The application of interpretive structural modeling method to develop verity design solution of case host preference-based products: A case study of Razor. *Journal of Theoretical and Applied Information Technology*.

Chen, R. H. (2021). Fostering students' workplace communicative competence and collaborative mindset through an inquiry-based learning design. *Education Sciences*. https://doi.org/10.3390/educsci11010017

Cheng, C. H., & Lin, Y. (2002). Evaluating the best main battle tank using fuzzy decision theory with linguistic criteria evaluation. *European Journal of Operational Research,* 142(1), 174-186. http://www.science direct. com/science/article/pii/S0377221701002806

Cheung, S. K. S., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: challenges and opportunities. In *International Journal of Educational Technology in Higher Education*. https://doi.org/10.1186/s41239-021-00254-1

Chu, H. C., & Hwang, G.J. (2008). A Delphi-Based Approach To Developing Expert Systems With The Cooperation Of Multiple Experts. *Expert Systems With Applications, 34*, 2826-2840. doi: 10.1016/j.eswa.2007.05.034

Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2021). *21st century skills development through inquiry-based learning from theory to practice*. Springer International Publishing.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. London, UK: Routledge.

Conole, G. (2010). *Designing for Learning in an Open World*, New York: Springer Books.

Conradty, C., Sotiriou, S. A., & Bogner, F. X. (2020). How creativity in STEAM modules intervenes with self-efficacy and motivation. *Education Sciences*. https://doi.org/10.3390/educsci10030070

Conradty, C., & Bogner, F. X. (2019). From STEM to STEAM: Cracking the Code? How Creativity & Motivation Interacts with Inquiry-based Learning. *Creativity Research Journal*. https://doi.org/10.1080/10400419.2019.1641678

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches.* Sage publications.

Csikszentmihalyi (1999) *Implications of a Systems Perspective for the Study of Creativity*, in R. J. Sternberg (ed.) Handbook of Creativity. New York, NY: Cambridge University Press.

Curriculum Development Centre (2019). *Spesifikasi Kurikulum Matematik Tingkatan 4.* Putrjaya: Kementerian Pelajaran Malaysia.

Dalkey, N. & Helmert, O. (1963). An experimental application of the Delphi method to the use of experts. *Management Science,* 9(3), *458-467.*

Dang, V. H. (2015). The Use of Nominal Group Technique: Case Study in Vietnam. W*orld Journal of Education*. 5(4), 14-25. http://doi.10.5430/wje.v5n4p14

De Leon-Pineda, J. L., & Prudente, M. (2022). Using online journals to improve the teaching of reflection among preservice math teachers. *Reflective Practice*. https://doi.org/10.1080/14623943.2022.2029737

De Souza, L. J., Dal Belo Carneiro Leão, A. L., Carmona, V. C., Ruas, R. L., Carneiro-Da-Cunha, J. A., & Nassif, V. M. J. (2018). A scale proposal for higher education creativity in the classroom. *International Journal of Business Innovation and Research*, *16*(2), 208–226. https://doi.org/10.1504/IJBIR.2018.091917

Delbecq, A. L., Van de Ven, A. H., & Gustafson, D. H. (1975). *Group techniques for program planning: a guide to nominal group and Delphi process*. Glenview, IL: Scott, Foresman and Company.

Delp, P., Thesen, A., Motiwalla, J., & Seshardi, N. (1977). *Systems tools for project planning. Bloomington*, Indiana: International Development Institute. ISBN: 0-892-49021-7.

Deslandes, S.F., Corina Helena Figueira Mendes, C.H.F., Pires, T.O., & Campos, D.S. (2010). Use of the Nominal Group Technique and the Delphi Method to draw up evaluation indicators for strategies to deal with violence against children and adolescents in Brazil. *Rev. Bras. Saúde Matern.Infant.*,10(1), 29-37.

Dewey, J. (1963). E*xperience and Education*. The Kappa Delta Pi Lecture series: New York, NY: Macmillan Publishing Company.

Dewi, P. U. K., Mahayukti, G. A., & Sudiarta, I. G. P. (2019). The effect of treffinger learning model on problem solving ability viewed from students logical mathematical intelligence. *Math Didactic: Jurnal Pendidikan Matematika*. https://doi.org/10.33654/math.v5i2.650

Diedrich, J., Jauk, E., Silvia, P. J., Gredlein, J. M., Neubauer, A. C., & Benedek, M. (2018). Assessment of real-life creativity: The inventory of creative activities and achievements (ICAA). *Psychology of Aesthetics, Creativity, and the Arts*. https://doi.org/10.1037/aca0000137

Dobbie, A., Rhodes, M., Tysinger, JW. & Freeman, J. (2004). Using a Modified Nominal Group Technique as a Curriculum Evaluation Tool. *Family Medicine*, 36(6), 402-406.

Dwijanto, Tayani, M., & Veronica, R. B. (2019). The mathematical creative thinking ability viewed from learning interest in eleventh grade of vocational high school by using treffinger model assisted by problem card. *Unnes Journal of Mathematics Education*.

Elgrably, H., & Leikin, R. (2021). Creativity as a function of problem-solving expertise: posing new problems through investigations. ZDM - Mathematics Education. https://doi.org/10.1007/s11858-021-01228-3

English, L. D., & King, D. (2019). STEM Integration in Sixth Grade: Desligning and Constructing Paper Bridges. *International Journal of Science and Mathematics Education*, *17*(5), 863–884. https://doi.org/10.1007/s10763-018-9912-0

Erhard, W., Jensen, M. C., & Granger, K. L. (2011). Introduction to Being a Leader and the Effective Exercise of Leadership: An Ontological Model (PDF File of PowerPoint Slides). *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1392406

Ernest, P. (2021). Social Constructivism as a Philosophy of Mathematics. In *The Philosophy of Mathematics Education*. https://doi.org/10.4324/9780203497012-4

Fan, S. C., Yu, K. C., & Lin, K. Y. (2021). A Framework for Implementing an Engineering-Focused STEM Curriculum. *International Journal of Science and Mathematics Education*. https://doi.org/10.1007/s10763-020-10129-y

Fetterly, J.M. (2010). *Attitude, Gender and Socio-Economic Status as correlates of mathematical creativity of secondary school students in Uganda*. (Unpublished PH.D. Thesis). Makerere University.

Foy, P., Fishbein, B., Von Davier, M., & Yin, L. (2019). Implementing the TIMSS 2019 Scaling Methodology. *Methods and procedures: TIMSS*.

Gardner, H. (2008). *Five minds for the future*. Boston, MA: Harvard Business Press.

Georgiou, H., Turney, A., Matruglio, E., Jones, P., Gardiner, P., & Edwards-Groves, C. (2022). Creativity in Higher Education: A Qualitative Analysis of Experts' Views in Three Disciplines. *Education Sciences*. https://doi.org/10.3390/educsci12030154

Getzels, J.W. J., & Jackson, P.W. (1962). *Creativity and intelligence*. New York: Wiley. Jersey: Prentice Hall.

Ghazali, N. H. C. M., Abdullah, N., Zaini, S. H., & Hamzah, M. (2020). Student Teachers' Conception of Feedback Within An Assessment For Learning Environment: Link to Pupil Aspiration. *Jurnal Cakrawala Pendidikan*, *39*(1), 54-64.

Gipps, C. (1994). *Beyond Testing: Towards a Theory of Educational Assessment*, Falmer: Routledge

Glancy, Aran W. and Moore, T. J. (2013). Theoretical Foundations for Effective STEM Learning Environments. *School of Engineering Education Working Papers. Paper 1*.

Gorvet, R., & Liu, N. (2007). Using Interpretive Structural Modeling To Identify And Quantify Interactive Risks. *2007 ASTIN Colloquium, 36*, 1-11.

Greiff, S., Niepel, C., & Wustenberg, S. (2015). 21 st century skills: Recent advancements and international developments. Special Issue. *Thinking Skills and Creativity*, 8, 1–3.

Gube, M., & Lajoie, S. (2020). Adaptive expertise and creative thinking: A synthetic review and implications for practice. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100630

Guenther, A., Eisenbart, B., & Dong, A. (2021). Creativity and successful product concept selection for innovation. *International Journal of Design Creativity and Innovation*. https://doi.org/10.1080/21650349.2020.1858970

Guilford, J.P. (1960). Basic conceptual problems in the psychology of thinking. *Annals of New York Academy of Sciences*, *91*(1), 6-21.

Haase, J., Hoff, E. V., Hanel, P. H. P., & Innes-Ker, Å. (2018). A Meta-Analysis of the Relation between Creative Self-Efficacy and Different Creativity Measurements. *Creativity* Harpe, B. and Peterson, F. (2008). 'A Model for

Holistic Studio Assessment in the Creative Disciplines', in *ATN Assessment 08: Engaging Students with Assessment*, Adelaide, Australia

Harris, A., & De Bruin, L. R. (2018). Secondary school creativity, teacher practice and STEAM education: An international study. *Journal of Educational Change*. https://doi.org/10.1007/s10833-017-9311-2

Harvey, N. & Holmes, C.A. (2012). Nominal group technique: An effective method for obtaining group consensus. *International Journal of Nursing Practice*, 18, 188 -194. http://doi.10.1111/j.1440-172X.2012.02017.x.

Haylock, D. (1997). Recognizing mathematical creativity in schoolchildren. *ZDM Mathematics Education*, *27*(2), 68-74.

Henriksen, D., Richardson, C., & Shack, K. (2020). Mindfulness and creativity: Implications for thinking and learning. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100689

Hidajat, F. A. (2021). Students creative thinking profile as a high order thinking in the improvement of mathematics learning. *European Journal of Educational Research*. https://doi.org/10.12973/EU-JER.10.3.1247

Hieu, N. T., Huy, L. M., Phat, H. M., Anh, N. N. P., & Wong, W.-K. (2020). Decision sciences in education: The STEMtech model to create stem products at high schools in Vietnam. *Advances in Decision Sciences*, *24*(2), 1–51.

Hocevar, D. (1981). Measurement of Creativity: Review and Critique. *Journal Of Personality Assessment*, Vol. 45, Issue 5, 450-64.

Horng, J.S., Hu, D.C., Tsai, C.Y., Yang, T.C., & Liu, C.H. (2016). Exploring the relationship between proactive personality, work environment and employee creativity among tourism and hospitality employees. *International Journal of Hospitality Management*, 54, 25– 34. https://doi:10.1016/j.ijhm.2016.01.004.

Horton, J.N. (1980). Nominal group technique: A method of decision-making by committee. *Anaesthesia*. 35, 811-814

Hosseini, A.S., & Watt, A.P. (2010). The effect of a teacher, professional development in facilitating students' creativity. *Educational Research and Reviews*, *5*(8), 432-438.

Hsu, C. C., & Sandford, B. A. (2007). The Delphi technique: making sense of consensus. *Practical Assessment, Research & Evaluation,* 12(10), 1-8.

Hundschell, A., Razinskas, S., Backmann, J., & Hoegl, M. (2022). The effects of diversity on creativity: A literature review and synthesis. In *Applied Psychology*. https://doi.org/10.1111/apps.12365

Huo, K. (2020). Performance incentives, divergent thinking training, and creative problem solving. *Journal of Management Accounting Research*. https://doi.org/10.2308/jmar-52479

Ibrahim, A., Aulls, M. W., & Shore, B. M. (2017). Teachers' Roles, Students' Personalities, Inquiry Learning Outcomes, and Practices of Science and Engineering:The Development and Validation of the McGill Attainment Value for Inquiry Engagement Survey in STEM Disciplines. *International Journal of Science and Mathematics Education*, *15*(7), 1195–1215. https://doi.org/10.1007/s10763-016-9733-y

Ilha Villanova, A. L., & Pina e Cunha, M. (2020). Everyday Creativity: A Systematic Literature Review. *Journal of Creative Behavior*, *0*, 1–23. https://doi.org/10.1002/jocb.481

Indarasati, N. A., Abadi, A., & Lukito, A. (2019). Enhancing Students' Creative Thinking through Inquiry-Based Learning Integrating Mathematical Tools. *International Journal of Trends in Mathematics Education Research*. https://doi.org/10.33122/ijtmer.v2i2.113

Ingold, T., & Hallam, E. (2021). Creativity and cultural improvisation: An introduction. In *Creativity and Cultural Improvisation*. https://doi.org/10.4324/9781003135531-1

Ismael, N. & Elias, S. (2006). Inquiry-based learning: A new approach to classroom learning. *English Language Journal*, 2(1), 13-22.

Ismailov, M. (2021). Virtual exchanges in an inquiry-based learning environment: Effects on intra-cultural awareness and intercultural communicative competence. *Cogent Education*. https://doi.org/10.1080/2331186X.2021.1982601

Ismayilova, K., & Bolander Laksov, K. (2022). Teaching Creatively in Higher Education: The Roles of Personal Attributes and Environment. *Scandinavian Journal of Educational Research*. https://doi.org/10.1080/00313831.2022.2042732

Jacobs, J. M. (1996). *Essential assessment criteria for physical education teacher*
education programs: A Delphi study (Unpublished doctoral dissertation). West Virginia University, Morgantown.

Jawad, L. F., Majeed, B. H., & Alrikabi, H. T. S. (2021). The Impact of Teaching by Using STEM Approach in The Development of Creative Thinking and Mathematical Achievement Among the Students of The Fourth Scientific Class. *International Journal of Interactive Mobile Technologies*. https://doi.org/10.3991/ijim.v15i13.24185

Jazby, D. (2021). Conceptualising mathematics teacher noticing as a perception/action cycle. *Mathematics Education Research Journal*. https://doi.org/10.1007/s13394-021-00392-9

Jiang, J. P., Hu, J. Y., Zhang, Y. B., & Yin, X. C. (2022). Fostering college students' critical thinking skills through peer assessment in the knowledge building community. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2022.2039949

Johansen, A., Mogstad, E., Gajić, B., & Bungum, B. (2022). Incorporating creativity in science and mathematics teaching: Teachers' views on opportunities and challenges. *Nordic Studies in Science Education*. https://doi.org/10.5617/NORDINA.8620

Joklitschke, J., Rott, B., & Schindler, M. (2022). Notions of Creativity in Mathematics Education Research: a Systematic Literature Review. International Journal of Science and Mathematics Education. https://doi.org/10.1007/s10763-021-10192-z

Kandemir, M. A., Tezci, E., Shelley, M., & Demirli, C. (2019). Measurement of Creative Teaching in Mathematics Class. *Creativity Research Journal*, *31*(3), 272–283. https://doi.org/10.1080/10400419.2019.1641677

Kaplan, D. E. (2019). Creativity in Education: Teaching for Creativity Development. *Psychology, 10,* 140-147. https://doi.org/10.4236/psych.2019.102012

Kaplan, L. M. (1971). *The use of the Delphi method in organizational communication: A case study*. Columbus: Ohio State University.

Kattou, M., Kontoyianni, K., Pitta-Pantazi, D., & Christou, C. (2013). Connecting mathematical creativity to mathematical ability. ZDM—*The International Journal on Mathematics Education*, *Vol. 45*. https://doi:10.1007/s11858-012-0467-1.

Kaufman, J. C. (2018). Finding Meaning with Creativity in the Past, Present, and Future. *Perspectives on Psychological Science*. https://doi.org/10.1177/1745691618771981

Keetanjaly, A., Abdul Kadir, S., Su Luan, W., & Abdullah, A. (2019). The role of creativity in principals' leadership practices towards parental involvement: The mediating role of school practices and school climate. *International Journal of Educational Management*. https://doi.org/10.1108/IJEM-11-2018-0348

Kevin A. Artuz, J., & B. Roble, D. (2021). Developing Students' Critical Thinking Skills in Mathematics Using Online-Process Oriented Guided Inquiry Learning (O-POGIL). *American Journal of Educational Research*. https://doi.org/10.12691/education-9-7-2

Khalid, M., Saad, S., Abdul Hamid, S. R., Ridhuan Abdullah, M., Ibrahim, H., & Shahrill, M. (2020). Enhancing creativity and problem-solving skills through creative problem solving in teaching mathematics. *Creativity Studies*. https://doi.org/10.3846/cs.2020.11027

Kim, S., Choe, I., & Kaufman, J. C. (2019). The development and evaluation of the effect of creative problem-solving program on young children's creativity and character. Thinking Skills and Creativity. https://doi.org/10.1016/j.tsc.2019.100590

Kim, S. H., & Soojin K. (2010). The effectss of mathematical modelling on creative production, Ability and self-directed learning attitude. *Asia Pacific Education Review*, *11*(2), 109-120

Kim How, R. P. T., Zulnaidi, H., & Abdul Rahim, S. S. (2022). HOTS in Quadratic Equations: Teaching Style Preferences and Challenges Faced by Malaysian Teachers. *European Journal of Science and Mathematics Education*, *10*(1), 15-33.

Kong, S. F., & Matore, M. E. E. M. (2022). Can a science, technology, engineering, and mathematics (Stem) approach enhance students' mathematics performance? *Sustainability (Switzerland)*. https://doi.org/10.3390/su14010379

Konstantinidou, E., Gregoriadis, A., Grammatikopoulos, V., & Michalopoulou. M. (2014). Primary physical education perspective on creativity: the nature of creativity and creativity fostering classroom environment. *Early Child Development and Care*, 184:5, 766-782. https://doi.10.1080/03004430.2013.818989

Kozlowski, J. S., & Si, S. (2019). Mathematical creativity: A vehicle to foster equity. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2019.100579

Kirisci, N., Sak, U., & Karabacak, F. (2020). The effectiveness of the selective problem-solving model on students' mathematical creativity: A Solomon four-group research. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100719

Krogh, S. L., Morehouse, P., & Morehouse, P. (2020). Inquiry-Based Learning. In *The Early Childhood Curriculum*. https://doi.org/10.4324/9780429280764-6

Kumar, N., Kumar, S., Haleem, A., & Gahlot, P. (2013). Implementing lean manufacturing system: ISM approach. *Journal of Industrial Engineering and Management*. https://doi.org/10.3926/jiem.508

Kuo, H. C. (2011). Toward a synthesis framework for the study of creativity in education: An initial attempt. *Educate~*, *11*(1), 65-75.

Kupers, E., Lehmann-Wermser, A., McPherson, G., & van Geert, P. (2019). Children's Creativity: A Theoretical Framework and Systematic Review. In *Review of Educational Research* (Vol. 89, Issue 1). https://doi.org/10.3102/0034654318815707

Larraz-Rábanos, N. (2021). Development of Creative Thinking Skills in the Teaching-Learning Process. In *Teacher Education - New Perspectives*. https://doi.org/10.5772/intechopen.97780

Lebuda, I., Zielińska, A., & Karwowski, M. (2021). On surface and core predictors of real-life creativity. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2021.100973

Lee, K. H., Moon, S. J., & Noh, J. W. (2022). Integration of mathematical creativity into everyday classes through dynamics between divergent and convergent thinking. *ZDM - Mathematics Education*. https://doi.org/10.1007/s11858-021-01307-5

Leikin, R., Berman, A., & Koichu, B. (2019). Exploring Mathematical Creativity Using Multiple Solution Tasks. In *Creativity in Mathematics and the Education of Gifted Students*. https://doi.org/10.1163/9789087909352_010

Leikin, R., Berman, A., & Koichu, B. (2019). Exploring Mathematical Creativity Using Multiple Solution Tasks. In *Creativity in Mathematics and the Education of Gifted Students*. https://doi.org/10.1163/9789087909352_010

Leung, A. (2018). Exploring STEM Pedagogy in the Mathematics Classroom: a Tool-Based Experiment Lesson on Estimation. *International Journal of Science and Mathematics Education*. https://doi.org/10.1007/s10763-018-9924-9

Lev-Zamir, H. & Leikin, R. (2013). Saying versus doing teachers' conception on creativity in elementary mathematics teaching. *ZDM Mathematics Education*, 45, 295-308.

Levav-Waynberg, A., & Lekin, R. (2012). The role of multiple solution tasks in developing knowledge and creativity in geometry. *The Journal of Mathematical Behaviour*, 31(1): 73-90. http://dx.doi.org/10.1016/j.jmathb.2011.11.001

Levenson, E. S., & Molad, O. (2022). Analyzing collective mathematical creativity among post high-school students working in small groups. *ZDM - Mathematics Education*. https://doi.org/10.1007/s11858-021-01321-7

Liu, C., Zowghi, D., Kearney, M., & Bano, M. (2021). Inquiry-based mobile learning in secondary school science education: A systematic review. In Journal of Computer Assisted Learning. https://doi.org/10.1111/jcal.12505

Liu, C. Y., Lin, W. W., & Wu, C. J. (2022). Understanding the properties and processes of a creative teacher team. *International Journal of Educational Research*. https://doi.org/10.1016/j.ijer.2021.101909

Liu, J., Sun, M., Dong, Y., Xu, F., Sun, X., & Zhou, Y. (2022). The Mediating Effect of Creativity on the Relationship Between Mathematic Achievement and Programming Self-Efficacy. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2021.772093

Lomax, P. & McLeman, P. (1984). The uses and abuses of nominal group technique in polytechnic course evaluation. *Studies in Higher Education*, 9(2), 183-190. http://doi.10.1080/03075078412331378834.

Lord, T. R. (1999). A Comparison Between Traditional and Constructivist Teaching in Environmental Science. *Journal of Environmental Education*. Vol. 30, No. 3:22-28.

Lou, S. J., Chou, Y. C., Shih, R. C., & Chung, C. C. (2017). A study of creativity in CaC 2 steamship-derived STEM project-based learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(6), 2387–2404.

Ludwig, B. G. (1994). *Internationalizing Extension: An exploration of the characteristics evident in a state university extension system that achieves internationalization* (Unpublished Doctoral dissertation). Ohio State University,Columbus.http://etd.ohiolink.edu/view.cgi/Ludwig%20Barbara%20G.pdf? osu1 146146542.

Mandal, A., & Deshmukh, S. G. (1994). Vendor Selection Using Interpretive Structural Modelling (ISM). *International Journal of Operations & Production Management*, 14, 52-59.https://doi.org/10.1108/01443579410062086

Manurung, E. M., Purwadi, Y. S., & Sugiharto, I. B. (2022). Digital Learning Process: Challenges for Specific Creativity. *Electronic Journal of E-Learning*. https://doi.org/10.34190/ejel.20.2.2107

Mardianti, I., Masriyah, M., & Wijayanti, P. (2018). *Students' Creative Thinking Process based on the Wallas Stage in Solving Mathematical Modeling Problems*. https://doi.org/10.2991/miseic-18.2018.38

Marie, S. B. (2018). Effective STEM Outreach for Indigenous Community Contexts – Getting it Right, One Community at a Time ! *International Journal of Innovation in SCience and Mathematics Education*, *26*(2), 14–34.

Marshall, J. & Horton, R. (2011). The Relationship of teacher-facilitated, inquiry-based instruction to student higher-order thinking. *School Science and Mathematics*, 93-101.

Mason, J. (2007). 'Can Contemporary Art Methods Facilitate Designers' Creativity?', *Creativity*, (Ph.D Thesis), Loughborough University.

Matraeva, A. D., Rybakova, M. V., Vinichenko, M. V., Oseev, A. A., & Ljapunova, N. V. (2020). Development of creativity of students in higher educational institutions: Assessment of students and experts. *Universal Journal of Educational Research*. https://doi.org/10.13189/ujer.2020.080102

Maulana, D. F., Wardono, Marwoto, P., & Mariani, S. (2019). The ability of mathematical literacy on learning treffinger realistic assistance schoology. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1321/3/032132

Maulidia, F., Johar, R., & Andariah, A. (2019). A Case Study Of Students' Creativity In Solving Mathematical Problems Through Problem Based Learning. *Infinity Journal*. https://doi.org/10.22460/infinity.v8i1.p1-10

Mayer, R. (1999) 'Fifty Years of Creativity Research', in Sternberg, R. (ed.), *Handbook of Creativity*. New York: Cambridge University Press.

McGunagle, D., & Zizka, L. (2020). Employability skills for 21st-century STEM students: the employers' perspective. *Higher Education, Skills, and Work-Based Learning*. https://doi.org/10.1108/HESWBL-10-2019-0148

McMillan, S.S., King, M., Tully, M.P. (2016). How to use the nominal group and delphi techniques. *International Journal of Clinical Pharmacy*. 38, 655-662. http://doi: 10.1007/s11096-016-0257-x

Mehta, R., & Dahl, D. W. (2019). Creativity: Past, present, and future. *Consumer Psychology Review*. https://doi.org/10.1002/arcp.1044

Ministry of Education, (2019). Malaysia Education Blueprint 2013-2025, Ministry of Education (n.d.), *Pleminery report.* http://www.moe.gov.my/userfiles/file/PPP/Preliminary-Blueprint-Eng.pdf

Minner, D., Levy, A., & Century, J. (2010). Inquiry-based science instruction—What is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, 47, 474–496. http://doi: 10.1002/tea.20347

Mohajan, H. K. (2017). Two Criteria for Good Measurements in Research: Validity and Reliability. *Annals of Spiru Haret University. Economic Series*. https://doi.org/10.26458/1746

Mohd Ridhuan Mohd Jamil; Zaharah Hussin, Z; Nurul Rabihah Mat Noh; Ahmad Arifin Sapar; & Norlidah Alias (2013). Application of Fuzzy Delphi Method in educational research. In Saedah Siraj, Norlidah Alias, Dewitt, D. & Zaharah Hussin (eds). *Design and Developmental Research: Emergent trends in educational research.* Kuala Lumpur: Pearson.

Moirano, R., Sánchez, M. A., & Štěpánek, L. (2020). Creative interdisciplinary collaboration: A systematic literature review. *Thinking Skills and Creativity*, *35*(August 2019). https://doi.org/10.1016/j.tsc.2019.100626

Monrat, N., Phaksunchai, M., & Chonchaiya, R. (2022). Developing Students' Mathematical Critical Thinking Skills Using Open-Ended Questions and Activities Based on Student Learning Preferences. *Education Research International*. https://doi.org/10.1155/2022/3300363

Moore, T. J., Johnson, E. & Peters-Burton, E. (2016), STEM road map: *A frameworkfor integrated STEM education* (pp. 13-22). NY: Routledge Taylor & Francis Group

Muhammad Hafizi, M. H., & Kamarudin, N. (2020). Creativity in mathematics: Malaysian perspective. *Universal Journal of Educational Research*, *8*(3), 77–84. https://doi.org/10.13189/ujer.2020.081609

Muhammad Ridhuan Tony Lim, A. (2014). *Development of Activity-Based mLearning Implementation Model for Undergraduate English Language Learning.* PHD Thesis, Universiti Malaya, Kuala Lumpur.

Muhammad Ridhuan Tony Lim Abdullah, Saedah Siraj, & Zaharah Hussin. (2014). Interpretive structural modeling of mlearning curriculum implementation model of English language communication skills for undergraduates. TOJET: The Turkish Online Journal of Educational Technology, 13(1).

Mullen, R., Kydd, A., Fleming, A., & McMillan, L. (2021). A practical guide to the systematic application of nominal group technique. *Nurse Researcher*. https://doi.org/10.7748/nr.2021.e1777

Mullis, I. V. S., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2020). *TIMSS 2019 International Results in Mathematics and Science.* Retrieved from Boston College, TIMSS & PIRLS International Study Center. http://doi://timssandpirls.bc.edu/timss2019/international-results/

Murcia, K., Joubert, M.M., Campbell, C., Wilson, S. (2022). Introduction. In: Murcia, K.J., Campbell, C., Joubert, M.M., Wilson, S. (eds) *Children's Creative Inquiry in STEM*. Sociocultural Explorations of Science Education, vol 25. Springer, Cham. https://doi.org/10.1007/978-3-030-94724-8_1

Murray, T. J., Pipino, L. L., & Van Gigch, J. P. (1985). A pilot study of fuzzy set modification of delphi. *Human Systems Management, 5*(1), 76-80. https:/doi: 10.3233/HSM-1985-5111

Murry, J., W. , & Hammons, J., O. (2017). D*elphi: A Versatile Methodology for Conducting Qualitative Research*. (4), 423. https://doi: 10.1353/rhe.1995.0008

Nakano, T. de C., & Wechsler, S. M. (2018). Creativity and innovation: Skills for the 21st century. *Estudos de Psicologia (Campinas)*. https://doi.org/10.1590/1982-02752018000300002

Nasir, N. A. M., Salleh, M. F. M., Rasid, N. S., Ismail, M. H., & Abdullah, N. (2017). Intellectual science and mathematics program: Improving students' interest in learning science and mathematics. *Advanced Science Letters*, *23*(4), 3268–3272. https://doi.org/10.1166/asl.2017.7734

Ndiung, S., Dantes, N., Ardana, I. M., & Marhaeni, A. A. I. N. (2019). Treffinger creative learning model with RME principles on creative thinking skill by considering numerical ability. *International Journal of Instruction*, *12*(3), 731–744. https://doi.org/10.29333/iji.2019.12344a

Nizham, H., Suhendra, S., & P., B. A. (2017). Improving ability mathematic literacy, self-efficacy and reducing mathematical anxiety with learning Treffinger model at senior high school students. *International Journal of Science and Applied Science: Conference Series*. https://doi.org/10.20961/ijsascs.v2i1.16696

Nufus, H., Duskri, M., & Bahrun, B. (2018). Mathematical Creative Thinking and Student Self-Confidence in the Challenge-Based Learning Approach. JRAMathEdu (Journal of Research and Advances in Mathematics Education). https://doi.org/10.23917/jramathedu.v3i2.6367

Nurdiansyah, S., Sundayana, R., & Sritresna, T. (2021). Kemampuan Berpikir Kritis Matematis serta Habits Of Mind Menggunakan Model Inquiry Learning dan Model Creative Problem Solving. *Mosharafa: Jurnal Pendidikan Matematika*.

Nurzatulshima Kamarudin, TzeJiun, L., Othman Talib & Aminuddin Hassan (2017). Enhancing higher order thinking skills via inquiry-based laboratory practices among science students. *Man in India*. 97, 185-194.

Oh, K. H. (1974*). Forecasting through hierarchical Delphi* (Unpublished doctoral dissertation). The Ohio State University, Columbus. http://etd.ohiolink.edu/view.cgi/Oh Keytack.pdf?osu1285088173

Olsen, J., Lew, K., & Weber, K. (2020). Metaphors for learning and doing mathematics in advanced mathematics lectures. *Educational Studies in Mathematics*. https://doi.org/10.1007/s10649-020-09968-x

O'Neil, M.J. & Jackson, L. (1983). Nominal Group Technique: A process for initiating curriculum development in higher education. *Studies in Higher Education*, 8(2), 129- 138. http://doi.10.1080/03075078312331378994

Orak, S. D., & Al-Khresheh, M. H. (2021). In between 21st century skills and constructivism in elt: Designing a model derived from a narrative literature review. In *World Journal of English Language*. https://doi.org/10.5430/wjel.v11n2p166

Park, D. Y., Park, M. H., & Bates, A. B. (2018). Exploring Young Children's Understanding About the Concept of Volume Through Engineering Design in a STEM Activity: A Case Study. *International Journal of Science and Mathematics Education*, *16*(2), 275–294. https://doi.org/10.1007/s10763-016-9776-0

Pereira, M. (2001). *Pedagogical Principles in Web-based Learning*. ZurichHonggerberg: Swiss Federal Institute of Technology.

Perry, J. & Linsley, S. (2006). The use of the nominal group technique as an evaluative tool in the teaching and summative assessment of the inter-personal skills of student mental health nurses. *Nurse Education Today*, 26, 346- 353. http://doi. 10.1016/j.nedt.2005.11.004

Philip Carter (2005). *The Complete Book of Intelligence Test. http://www.up.98ia.com/images/evn06w98f28vwgb0ljf.pdf*

Piaget, J. (1968). *Genetic epistemology*. Retrieved from http://www.marxists.org/reference/subject/ philosophy/works/fr/piaget.

Pill, J. (1971). The Delphi method: Substance, context, a critique and an notated bibliography. *Socio-Economic Planning Science,* 5, 57-71.

Pitta-Pantazi, D., Kattou, M., & Christou, C. (2018). *Mathematical Creativity: Product, Person, Process and Press*. https://doi.org/10.1007/978-3-319-73156-8_2

Pollard, V., Hains-Wesson, R., & Young, K. (2018). Creative teaching in STEM. *Teaching in Higher Education*, *23*(2), 178–193. https://doi.org/10.1080/13562517.2017.1379487

Puspitasari, L., In'am, A., & Syaifuddin, M. (2019). Analysis of Students' Creative Thinking in Solving Arithmetic Problems. *International Electronic Journal of Mathematics Education*, 14(1), 49-60.

Rahayuningsih, S., Sirajuddin, S., & Ikram, M. (2021). Using open-ended problem-solving tests to identify students' mathematical creative thinking ability. *Participatory Educational Research*. https://doi.org/10.17275/per.21.66.8.3

Rahman, N. A., Rosli, R., Rambely, A. S., & Halim, L. (2021). Mathematics teachers' practices of stem education: A systematic literature review. In *European Journal of Educational Research*. https://doi.org/10.12973/EU-JER.10.3.1541

Ramli, N. F., & Talib, O. (2017). Can Education Institution Implement STEM ? From Malaysian Teachers ' View. *International Journal of Academic Research in Business and Social Sciences*, *7*(3), 721–732.

Reiter-Palmon, R., Forthmann, B., & Barbot, B. (2019). Scoring divergent thinking tests: A review and systematic framework. *Psychology of Aesthetics, Creativity, and the Arts*, *13*(2), 144.

Regier, P., & Savic, M. (2020). How teaching to foster mathematical creativity may impact student self-efficacy for proving. *Journal of Mathematical Behavior*. https://doi.org/10.1016/j.jmathb.2019.100720

Richardson, C., & Mishra, P. (2018). Learning Environments that Support Student Creativity: Developing the SCALE. *Thinking Skills and Creativity*, 27, 45-54. https://doi.org/10.1016/j.tsc.2017.11.004

Richey, R. C., & Klein, J. D. (2014). Design and development research. In *Handbook of research on educational communications and technology* (pp. 141- 150). Springer New York

Rifka Wulandari, W., Azizahwati, A., & Ma'ruf, Z. (2020). Effectiveness of Treffinger Model Application to Improve Student Learning Outcomes of Senior High School on Optical Materials. *Jurnal Geliga Sains: Jurnal Pendidikan Fisika*. https://doi.org/10.31258/jgs.8.1.17-23

Rhodes, M. (1961). Analysis of Creativity Can it be taught? *The Phi Delta Kappan*, *42*(7), 305–310.

Rubenstein, L. D., Callan, G. L., Ridgley, L. M., & Henderson, A. (2019). Students' strategic planning and strategy use during creative problem solving: The importance of perspective-taking. *Thinking Skills and Creativity*, *34*.

Rubio, D. M. G., Berg-Weger, M., Tebb, S. S., Lee, E. S., & Rauch, S. (2003). Objectifyng content validity: Conducting a content validity study in social work research. *Social Work Research*. https://doi.org/10.1093/swr/27.2.94

Runco , M.A. & Jaeger, G.J. (2012). The Standard Definition of Creativity. *Creativity Research Journal*, *24*(10), 92-96. https://doi.10.1080/10400419.2012.650092

Runco, M.A. (2010). Creativity research: a historical view. In J.C. Kaufman & R.J. Sternberg, (Eds.), *The Cambridge Handbook of Creativity* (pp. 3-19). Cambridge: Cambridge University Press.

Sail, M., Rahim, Md. Aroff, A.R., Abu Samah, A., Hamzah, A., Mohd Noah, S. and Kasa, Z. (2007). *Handbook on Social Skills and Social Values in Technical Education and Vocational Training*, Department of Skills Development, Ministry of Human Resources, Putrajaya.

Salleh, M. J., & Hatta, M. (2018). Best Practices of Promoting a Positive School Learning Climate among Principals of Cluster Secondary Schools Towards Realization of Education Blueprint 2013-2025 Malaysia. *Advances in Social Sciences Research Journal*, *5*(8).

Sánchez, A., Font, V., & Breda, A. (2021). Significance of creativity and its development in mathematics classes for preservice teachers who are not trained to develop students' creativity. *Mathematics Education Research Journal*. https://doi.org/10.1007/s13394-021-00367-w

Savage, J., & Healy, J. (2019). Creative teaching design in STEM: Using graduate learning outcomes to distribute students' existing knowledge in first-year biology practical work groups. *Journal of University Teaching and Learning Practice*, *16*(3).

Savic, M., El Turkey, H., Tang, G., Karakok, G., Cilli-Turner, E., Plaxco, D., & Omar, M. (2017). Pedagogical practices for fostering mathematical creativity in proofbased courses: Three case studies. A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, & S. Brown (Eds.). *Proceedings of the 20th annual conference on research in undergraduate mathematics education*, 1418–1424

Sawyer, K. (2019). The Development of Creativity. *Empirical Studies of the Arts, Empirical Studies of the Arts,* 0(0), 1–9. https://doi.10.1177/0276237419868958

Schoevers, E. M., Kroesbergen, E. H., & Kattou, M. (2020). Mathematical Creativity: A Combination of Domain-general Creative and Domain-specific Mathematical Skills. *Journal of Creative Behavior*. https://doi.org/10.1002/jocb.361

Schoevers, E.M., Leseman, P.P.M., Slot, E.M., Bakker, A., Keijzer, R, Kroesbergen, E. (2019). Promoting pupils' creative thinking in primary school mathematics: A case study, *Thinking Skills and Creativity* (2019), https://doi.org/10.1016/j.tsc.2019.02.003

Sesriani, Y. (2022). The Effect of Models Creative Problem Solving and Problem Based Learning to Improvability Problem Solving Students. In *Journal of Mathematics Education and Application (JMEA)*.

Sharma, R. (2011). Effect of School and Home Environments on Creativity of Children. *Journal of Educational Studies, Trends and Practices,* 1(2).

Siburian, J., Corebima, A. D., Ibrohim, & Saptasari, M. (2019). The correlation between critical and creative thinking skills on cognitive learning results. *Eurasian Journal of Educational Research*. https://doi.org/10.14689/ejer.2019.81.6

Sirajudin, N., Suratno, J., & Pamuti. (2021). Developing creativity through STEM education. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1806/1/012211

Slavit, D., Nelson, T. H., & Lesseig, K. (2016). The Teachers' Role in Developing, Opening, and Nurturing an Inclusive STEM-focused School. *International Journal of STEM Education*, *3*(1), 7. https://doi.org/10.1186/s40594-016-0040-5

Smith, K. L., Rayfield, J., & Mckim, B. R. (2015). Effective Practices in STEM Integration: Describing Teacher Perceptions and Instructional Method Use. *Journal of Agricultural Education*, *56*(4), 183–203.Tan, L. H. & Leong, P. (2003). *Professional Development of ITE Teachers Through Learning Circles.* Teachers Education Institute 2003 Conference, Arizona.

Spitzer, M. W. H. (2022). Just do it! Study time increases mathematical achievement scores for grade 4-10 students in a large longitudinal cross-country study. *European Journal of Psychology of Education*. https://doi.org/10.1007/s10212-021-00546-0

Sriraman, B. (2005). Are Mathematical Giftedness and Mathematical Creativity Synonyms? A theoretical analysis of constructs. *Journal of Secondary Gifted Education*, *17*(1), 20-36.

Stavridi, S. (2016). Interactive visual art learning in the development of young children's creativity. *7th International Multi-Conference on Complexity, Informatics and Cybernetics, IMCIC 2016 and 7th International Conference on Society and Information Technologies, ICSIT 2016 - Proceedings*, *2*(December), 110–115.

Steinmayr, R., & Spinath, B. (2009). The importance of motivation as a predictor of school achievement. *Learning and Individual Differences, 19*(1), 80-90.

Sternberg, R.J. (2006). The Nature of Creativity. *Creativity Research Journal*, *18*(1), 87-98. https://doi.10.1207/s15326934crj1801_10.

Sternberg, R. J., & Karami, S. (2022). An 8P Theoretical Framework for Understanding Creativity and Theories of Creativity. *Journal of Creative Behavior*. https://doi.org/10.1002/jocb.516

Stylianidou, F., Glauert, E., Rossis, D., Compton, A., Cremin, T., Craft, A., & Havu-Nuutinen, S. (2018). Fostering Inquiry and Creativity in Early Years STEM Education: Policy Recommendations from the *Creative Little Scientists* Project. *European Journal of STEM Education*. https://doi.org/10.20897/ejsteme/3875

Suherman, Vidákovich, T., & Komarudin. (2021). STEM-E: Fostering mathematical creative thinking ability in the 21st Century. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1882/1/012164

Suyitno, A. (2020). Growth of student mathematical creativity as part of 4C competence for entering the 21st century. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1567/2/022100

Suyundikova, M. K., Zhumataeva, E. O., Suyundikov, M. M., & Snopkova, E. I. (2021). Prerequisites defining the trajectory of creative thinking. *Obrazovanie i Nauka*. https://doi.org/10.17853/1994-5639-2021-3-75-100

Tabach, M., & Friedlander, A. (2013). School mathematics and creativity at the elementary and middle grades level: How are they related? *ZDM - The International Journal on Mathematics Education*, *45*(2), 227-238.

Tan, C., & Huet, I. (2021). The design of an active learning strategy to promote collaborative and research-based learning in project management education. *International Journal of Innovation and Learning*. https://doi.org/10.1504/IJIL.2021.116566

Telegina, N. V., Drovosekov, S. E., Vasbieva, D. G., & Zakharova, V. L. (2019). The use of project activity in teaching mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, *15*(8). https://doi.org/10.29333/ejmste/108439

Teodoridis, F., Bikard, M., & Vakili, K. (2019). Creativity at the Knowledge Frontier: The Impact of Specialization in Fast- and Slow-paced Domains.

Administrative Science Quarterly. https://doi.org/10.1177/0001839218793384

Thakkar, J. J. (2021). Interpretive Structural Modelling (ISM). In *Studies in Systems, Decision and Control*. https://doi.org/10.1007/978-981-33-4745-8_18

Thibaut, L., Knipprath, H., Dehaene, W., & Depaepe, F. (2019). Teachers' Attitudes Toward Teaching Integrated STEM: the Impact of Personal Background Characteristics and School Context. *International Journal of Science and Mathematics Education*, *17*(5), 987–1007. https://doi.org/10.1007/s10763-018-9898-7

Torrance, E.P. (1962). *Guiding creative talent*. Englewood Cliffs, NJ, Prentice Hall.

Torrance, E.P. (1967). *Understanding the fourth grade slump in creative thinking: Final report*. Final report. Athens: Georgia University (ERIC).

Treffinger, D. J., Isaken, S. G., & Firestein, R. L. (1992). Theoretical Perspectives on Creative Learning and Its Facilitation: An Overview. *The Journal of Creative Behaviour*, 17, 9-17. http://dx.doi.org/10.1002/j.2162-6057.1983.tb00970.x

Tubb, A. L., Cropley, D. H., Marrone, R. L., Patston, T., & Kaufman, J. C. (2020). The development of mathematical creativity across high school: Increasing, decreasing, or both?. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100634

Tudor, R. (2008) 'The Pedagogy of Creativity: Understanding Higher Order Capability Development in Design and Arts Education', in: *Proceedings of the 4th International Barcelona Conference on Higher Education Vol. 4. Higher education, arts and creativity*, Barcelona: Global University Network for Innovation.

Ulger, K. (2018). The effect of problem-based learning on the creative thinking and critical thinking disposition of students in visual arts education. *Interdisciplinary Journal of Problem-Based Learning*. https://doi.org/10.7771/1541-5015.1649

Valgeirsdottir, D., Onarheim, B., & Gabrielsen, G. (2015). Product creativity assessment of innovations: considering the creative process. *International Journal of Design Creativity and Innovation*, *3*(2), 95-106. https://doi.10.1080/21650349.2014.954626

Vygotsky, L.S. (1978). *Mind in society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.

Wahid, N. T. A., & Talib, O. (2017). STEM Integration in Classroom Practices in Mara Junior Science College (MJSC). *International Journal of Academic Research in Business and Social Sciences*, *7*(4), 1030–1041.

Walia, C. (2019). A Dynamic Definition of Creativity. *Creativity Research Journal*. https://doi.org/10.1080/10400419.2019.1641787

Wan, C. Da, Sirat, M., & Razak, D. A. (2018). Education in Malaysia Towards a Developed Nation. *Yusof Ishak Institute*.

Wang, F. & Hannafin, M.J. (2005). *Design-based research and technology-enhanced learning environments.* ETR&D, Vol. 53, No. 4, 2005, pp. 5–23, ISSN 1042–1629.

Warfield, J. N. (1982). *Interpretive structural modeling. In Group Planning and Problem-Solving Methods in Engineering* (Vol. SMC3). Wiley: New York, NY, USA: Olsen, S.A., Ed.

Wenger, E. (2009). A social theory of learning. *Contemporary theories of learning*, 209-218.

Weinhandl, R., & Lavicza, Z. (2021). Real-World Modelling to Increase Mathematical Creativity. *Journal of Humanistic Mathematics*. https://doi.org/10.5642/jhummath.202101.13

Wieser, D. (2020). Integrating technology into the learning process of higher education: A creative inquiry. *Industry and Higher Education*. https://doi.org/10.1177/0950422219895773

Williams, K. J. H., Lee, K. E., Hartig, T., Sargent, L. D., Williams, N. S. G., & Johnson, K. A. (2018). Conceptualising creativity benefits of nature experience: Attention restoration and mind wandering as complementary processes. *Journal of Environmental Psychology*. https://doi.org/10.1016/j.jenvp.2018.08.005

Williams, P.L., White, N., Klem, R., Wilson, S.E., & Bartholomew, P. (2006). Clinical education and training: Using the nominal group technique in research with radiographers to identify factors affecting quality and capacity, *Radiography*, 12, 215-224. https://doi.10.1016/j.radi.2005.06.001.

Witkin, B.R. (1997). Needs assessment kits, models, and tools. *Educational Technology*,17(11), 5-18.

Wohler, J., & Reinhardt, R. (2021). The users' perspective on how creativity techniques help in the idea generation process—A repertory grid study. *Creativity and Innovation Management*. https://doi.org/10.1111/caim.12424

Wright, P. (2021). Transforming mathematics classroom practice through participatory action research. *Journal of Mathematics Teacher Education*. https://doi.org/10.1007/s10857-019-09452-1

Wu, T. T., & Wu, Y. T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2020.100631

Xu, T., & Zhang, B. (2021). Improving thinking skills in early childhood using effective teaching strategies. *Aggression and Violent Behavior*. https://doi.org/10.1016/j.avb.2021.101704

Yahaya, N., Rasul, M. S., Mohamad Yasin, R., & Sulaiman, M. (2020). Nominal Group Technique Application Towards The Formation Of Social Skills And Values Elements For Apprenticeship Competency Models . *Journal of Technical Education and Training*, *12*(1). https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/3239

Yang, Z., & Homg, M. (2018). Latest Policies of Basic Education Reform in Malaysia: Background, Contents and Features of "Malaysia Education Blueprint 2013-2025 (Preschool to Post-Secondary Education)". *International and Comparative Education*, (1), 5.

Yazgan-Sag, G., & Emre-Akdogan, E. (2016). Creativity from two perspectives: Prospective mathematics teachers and mathematician. *Australian Journal of Teacher Education*, *41*(12), 25–40. https://doi.org/10.14221/ajte.2016v41n12.3

Yildiz, C., & Guler Yildiz, T. (2021). Exploring the relationship between creative thinking and scientific process skills of preschool children. *Thinking Skills and Creativity*. https://doi.org/10.1016/j.tsc.2021.100795

Yildiz Durak, H. (2020). The Effects of Using Different Tools in Programming Teaching of Secondary School Students on Engagement, Computational Thinking and Reflective Thinking Skills for Problem Solving. *Technology, Knowledge and Learning*. https://doi.org/10.1007/s10758-018-9391-y

Ying Qin, T., & Md Nor, M. (2018). Exploring issues on teaching and learning in Malaysian Private Preschools. *Malaysian Online Journal of Educational Management*. https://doi.org/10.22452/mojem.vol6no2.4

Yore, Larry, D. (2001). What is Meant by Constructivist Science Teaching and Will the Science Education Community Stay the Course for Meaningful Reform?. *Electronic Journal of Science Education.* Vol. 5, No. 4.

Yuanita, P., Zulnaidi, H., & Zakaria, E. (2018). The effectiveness of Realistic Mathematics Education approach: The role of mathematical representation as mediator between mathematical belief and problem solving. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0204847

Yuliani, T., Noer, S. H., & Rosidin, U. (2018). Guided Discovery Worksheet for Increasing Mathematical Creative Thinking and Self-Efficacy. *International Journal of Trends in Mathematics Education Research*, 1(1), 30-34.

Zagami, J., Bocconi, S., Starkey, L., Wilson, J. D., Gibson, D., Downie, J., Malyn-Smith, J., & Elliott, S. (2018). Creating Future Ready Information Technology Policy for National Education Systems. *Technology, Knowledge and Learning*. https://doi.org/10.1007/s10758-018-9387-7

Ziatdinov, R., & Valles, J. R. (2022). Synthesis of Modeling, Visualization, and Programming in GeoGebra as an Effective Approach for Teaching and Learning STEM Topics. In *Mathematics*. https://doi.org/10.3390/math10030398