

Development of Diverse Research Innovative Mind-Set (Drims) Through Compacting and Holistic Curriculum among Malaysian Gifted Learners

Rorlinda Yusof¹, Siti Fatimah Mohd Yassin², AfifahMohamad Radzi³, SitiAishah Hassan⁴,
Nurulnisa Nor Azman⁵, AzrinaMd. Azhari⁶, Fazilah Idris⁷

Corresponding Author: AfifahMohamadRadzi

^{1,2,3,4,5,6}PusatPERMATApintar Negara, UniversitiKebangsaan Malaysia

²Fakulti Pendidikan, Universitikebangsaan Malaysia

⁷Pusat CITRA, UniversitiKebangsaan Malaysia.

Abstract

Innumerable education researchers around the world have shifted their focus to study the development of gifted and talented (GT) students in a country. GT population is seen as a human capital that will drive the excellence to be future world leaders, thinkers, researchers, and innovators. In the Malaysian context, GT is seen as an invaluable national asset that will mobilize the country's future economic development. The aim of this study is to develop a diverse research innovative mind-set through compacting and holistic curriculum among gifted learners in Malaysia. Preparing GT students with research innovative mind-set is crucial to enable them to compete in the global world, especially in the field of high-end technology. This is in line with Malaysia's urgent need to face developments in the fourth industrial revolution. The novelty of this study was found in the development of Compacting and Holistic Identity Curriculum Models for GT students. The transformation from gifted to a talented individual was developed through the process of honing intelligence that was done through a structured and systematic curriculum approach which can be replicated to any gifted and highly able students' program. Flexible and cross-cutting curriculum concepts help to support the achievement of holistic excellence; a balance of academic and wholesome personality development that is in line with the National Education Philosophy. GENIUS@Pintar Negara, UKM provides a comprehensive educational program for Malaysian GT students aged 11 to 17 years old since 2011. The GT students, considered as individual thinkers and natural problem solvers are exposed to a Compacting Curriculum with the emphasis on Science, Technology, Engineering, Mathematics (STEM) and Research. Since 2011, a total of 1200 GT students have undergone a challenging compacted curriculum and successfully contributed to a paradigm shift from the mediocre-minded to the great-minded researchers and inventors. The success of this compacting curriculum is proven through students' involvement in various fields of research and innovation competitions, both at national and international levels. Next, to produce GT students who are "humble", the compacting curriculum is combined with the integration of holistic-identity curriculum, emphasizing on the elements of Intellectual-identity (Ii), Emotional-identity (Ei), Physical-identity (Pi), Social-identity (Si), Spiritual-identity (Sp-i), Leadership identity (Li), Citizenship-identity (Ci) and Adversity-identity (Ai). The advantage of this integration model of the compacting and holistic-identity curriculum is the flexible approach considering

interest-based learning resulted in a self-research-innovative mind-set (SRIM) among GT students with a wholesome personality based on the National Education Philosophy. GLOCAL's approach (comprising of global thinkers with local values practices) in developing Gifted Malaysian students will produce young diverse Malaysian researchers and innovators among GT students with humanitarian characteristics that will benefit future society and the global world with a new discovery and cutting-edge research.

INTRODUCTION

The study of education at the world level began to pay attention to the development of human resources among gifted and talented (GT) students of the country. The GT population is seen as a human resource that will drive various aspects of the country's development in the future; research, leadership, and economics (Joseph Gulino 2019; Rachel Zorman 2019; Lisa Murley 2019; Karnes, F.A., Bean, S. M. 1990).

Since 2009, the GT education program in Malaysia has been led by the PERMATApintar Negara Centre, Universiti Kebangsaan Malaysia. This centre cares about the academic development and personality building of GT students in the country. In the Malaysian context, GT is seen as an invaluable national asset that will mobilize the country's future economic development. Through a unique and rigorous gifted curriculum, Malaysian GT students were developed. Preparing GT students with research innovative mind-set is crucial to enable them to compete in the global world, especially in the field of STEM and high-end technology innovation. This is in line with Malaysia's urgent need to face developments in the fourth industrial revolution. Therefore, the aim of this study is to develop a diverse research innovative mind-set through the compacting and holistic curriculum among gifted learners in Malaysia.

PROBLEM STATEMENT

Giftedness is a natural potential possessed by GT students. Past research has shown that intelligence is inherited and it needs to be honed and stimulated to highlight giftedness in children and transform them to become talented. According to Gagne (2007), a gifted individual possesses an outstanding ability and is able to use it well. Gifted individuals need to be stimulated with various enrichment activities to push their potential to the optimum level (Renzuli 1977, 1997). The ability to provide learning support environment in line with the abilities possessed will highlight the excellence of gifted individuals because they already have three main characteristics, namely above average intelligence, creativity, and commitment. This means that GT students need learning that can challenge the level of cognitive ability and meet the tendencies of self-interest. The harmony of these two features will drive a commitment to consistently complete the tasks performed or achieve the desired aim. On the other hand, learning the usual norms will result in these GT students becoming bored, disinterested, or withdrawal which can eventually lead to the issue of underachievers. Underachiever or low achievement is one of the psychological issues experienced by gifted and talented students (Silverman, 1994). The American Psychiatric Association (2000) found that gifted students facing psychological stress may experience sudden or sudden underachiever issues. Studies have found that underachiever gifted students show

discrepancies in terms of self-potential and actual production or in other words, these students fail to show academic performance matching their potential or intelligence (Davis, Rimm, & Siegle, p. 288).

Accordingly, François Gagné and Joseph Renzulli, the gifted and talented field experts have provided a model to clarify why these extraordinary natural abilities of intelligent students do not always precipitate excellent academic performance. These experts agreed that natural abilities are a necessity but not enough for superior academic achievement. Gifted students need stimulation and motivation, commitment, and high creativity (Renzulli, 1982) as a catalyst that will keep them from facing obstacles, boredom, and failure (Gagne 1997).

According to Windfree (2020), among the contributing factors to the occurrence of underachievers among gifted students are **emotional factors** (stress to succeed, anxiety over failure, low self-esteem) and **environmental factors** (cultural influences and lack of support for learning environment that challenges cognitive potential to fully develop). Therefore, to meet the educational / learning needs of these gifted and talented students, a systematic education system that is in line with the challenges of their cognitive level needs to be developed. In addition, the need for a flexibility in the system must also be considered to meet the needs and tendencies of diverse intelligence. According to Gagne (2014) in the DMGT Model, two main factors that act as a catalyst for transforming gifted to talented are, first: the environment that includes physical, cultural, family, and social background, and second is intrapersonal factors that include the aspects of personal traits such as physical, mental (personality, resilience) and goal management comprising self-awareness of one's strengths and weaknesses, motivation and volition (seriousness of the will / desire). Both catalysts need to go through a systematic and continuous nurturing developmental process to drive and highlight the intelligence of gifted students in making them fully talented individuals (full potential).

In the context of gifted and talented education in Malaysia, GENIUS@Pintar Negara Centre, Universiti Kebangsaan Malaysia provides a comprehensive gifted education program for gifted and talented students. The goal of this program is to be a source of inspiration for Science, Technology, Engineering and Mathematics (STEM) and Research in the field of gifted and talented education. The vision of this centre is to cultivate the inquisitive mind of intelligent and talented individuals in a balanced manner that will ultimately contribute as a world leader, thinker, innovator and appreciate the values of universal humanity. Accordingly, a challenging curriculum has been prepared to meet the cognitive needs of selected GT students attending this program, a secondary education that emphasizes research and development of character / personality. This program aims to produce thinkers who have the mind-set / thinking as researchers and innovators; enabling them to embrace research and innovation as their life culture as future leaders of the country. The findings of this study aim to answer the questions:

1. What are the types of curriculum that can shape the mind-set as a Researcher and Innovator (R&I)
2. How is the process of forming the R&I mind-set patterns done?

3. What is the output of the implementation of compacting curriculum and holistic identity Development Model on gifted and talented students?

METHODOLOGY

This study was conducted based on the document analysis on general gifted and talented curriculum, research curriculum, and Holistic Identity Model. It applies qualitative method for the data collection process, involving protocol tools such as document analysis and observations. Most studies involving the curriculum implementation process apply the qualitative methods and protocols including document analysis, class observations, and interviews to obtain data (Bekalo & Welford, 2000; Brown, 2002; Brown, 2009; Wiseman & Brown, 2003). On top of that, observation on the real learning environment among gifted and talented students was explored. The aspects of research and innovation involve the general features of the gifted and talented education curriculum (compacting, acceleration, and enrichment), and the specific curriculum on research and Holistic-identity Development. A total of 1200 gifted and talented students aged from 11 to 17 years from 2011 to 2020 have gone through the curriculum provided throughout the learning process in this program.

Through the above discussion, most studies related to the implementation process generally apply qualitative research method that involves a comprehensive description and in-depth understanding of the phenomena studied. According to Creswell (2007), one of the characteristics of qualitative methods is "the problems need to be explored to obtain a deep understanding" (p. 54), and this method can produce a research that has a holistic truth by exploring phenomena from various dimensions.

RESULT

Gifted and talented education employs a challenging curriculum in line with the needs of cognitive abilities for GT students. In general, the curriculum used in developing diverse Research and Innovators mind-set involves the aspects of (a) compacting curriculum, (b) acceleration, and (c) enrichment (PERMATA Pintar Guidebook 2018).

(a) **Curriculum compacting** is a practical and easy method to end the boredom of learning among gifted and talented students in a classroom. This method allows teachers to streamline the regular curriculum by ensuring mastery of students' basic skills and providing time for more challenging enrichment and / or acceleration activities. It is a technique for differentiating instructions that allow teachers to make adjustments to the curriculum for students who have mastered the material to be learned, and subsequently replace content that students already know with new content or offer some enrichment activity options, or other activities that can stimulate and increase students' potential. This compacting curriculum is created to meet the needs of (1) students who already know the content to be taught before it is taught; (2) The existing curriculum in the mainstream is relatively simple for gifted and talented students; (3) the quality of the curriculum and the use of textbooks that do not challenge the cognitive abilities of gifted and talented students; (4) meeting the learning needs of gifted and talented students which cannot be fulfilled by the existing curriculum taught in the classroom; (5) giving students more time to perform more challenging learning activities; (6) improving students' achievement and boosting their potential to a higher level.

The use of a compacting curriculum also allows teachers to (1) teach according to the rhythm and steps of students; (2) speed up learning for gifted and talented students who already know most of the content, and (3) slow down learning for those who need guidance. In addition, the compacting curriculum emphasizes on the accountability of education. In short, this compacting curriculum is implemented in the context of flexibility according to the needs and differences of gifted and talented students.

(b) **Acceleration.** Acceleration refers to ways to match the student's ability and level of motivation with the content of advanced lessons. Acceleration should be done in accordance with internationally established guidelines. Among the different options for acceleration include early admission, skipping classes, subject acceleration, telescoping, radical acceleration, curriculum compression and early termination.

The telescoping curriculum is a form of acceleration and occurs when a student (or a group of students) can complete a few years learning according to the school curriculum in a shorter time. For example, Forms 1, 2, 3, 4 and 5 are completed in a total of three or four instead of five years.

Radical acceleration on the other hand, is an intervention that addresses the needs of students who are able to learn at a very fast pace through a prescribed school curriculum. It is defined as any acceleration procedure that allows students to finish high school three or more years earlier than usual (to meet their high cognitive needs).

Curriculum compression can be done by teachers according to the process of (1) define the goals and learning outcomes of a topic, (2) determine the content that has been mastered and has not been mastered by students, (3) identify the level of students' ability, (4) identify students who have mastered the content and can further increase their mastery to higher content, and (5) provide opportunities for students to be accelerated or enriched.

Ultimately, acceleration benefits gifted and talented students both academically and socially. In contrast, failure to accelerate talented students can result in boring learning habits, apathy, lack of motivation, and maladjustment between cognitive needs / abilities and learning

(c) **Enrichment curriculum**

Enrichment programs should be offered to gifted and talented students to develop or nurture their giftedness and talent, hone their intelligence holistically and foster their lifelong learning. The enrichment curriculum will develop high-level thinking skills through various learning activities outside the syllabus or learning topics in stimulating students' interest in any field of knowledge and improving their deep understanding and skills (deep learning) to suit their ability. Through enrichment, while complementing the regular curriculum, students will continue to learn in a more student-centred environment. The Triad Enrichment Model developed by Joseph Renzulli in 1977 was specially designed to be applied to gifted and talented students. The triad is divided into three stages known as Type I Enrichment (Type 1), Type II (Type 2) and Type III (Type 3). These stages combine to create a student-centred model with a focus on students' engagement and motivation. This triad is driven based on the

importance and direction to determine students' own preferred learning. Learning through these enrichment activities will challenge students to boost critical and creative thinking as well as improve their problem-solving skills. This triad affects the learning of all students, enriches life, and develops their confidence.

2. How is the process of forming a Diverse Research and Innovator Mind-set (DRIMS) among Gifted and talented students done?

In line with the vision of the GT education program at this centre i.e. to be a source of inspiration for STEM in the education of GT students, further making them thinkers and innovators who will be world leaders, then the effort to stimulate the natural intelligence of these GT students begins with systematic planning to form a mind-set or thinking as a researcher and innovator. Based on the analysis of curriculum documents, the effort to shape the pattern of thinking of this researcher & innovator occurs in **seven steps (Figure 1.0)**; namely (i) identifying students' ability and inquisitive mind through identification program e.g. IQ tests, (ii) triggering research and innovative interest through enrichment programs, (iii) cultivating interest and triggering mind-set through compacting curriculum and holistic self-identity model, (iv) strengthening interest and research mind-set through a structured continuous research curriculum from form / foundation one until form five / level two (Figure 2.0), (v) nurturing researchers and innovators' mind-set through a diverse research and innovative program, (vi) exploring various research through participation in national and international competitions, and (vii) sustaining researchers' mind-set through involvement in research study at the university level. These seven steps of forming a pattern of thinking as a researcher and innovator will produce gifted and talented students who can cultivate the minds of researchers and innovators throughout their life.



Figure 1.0 Steps on DRIMS development

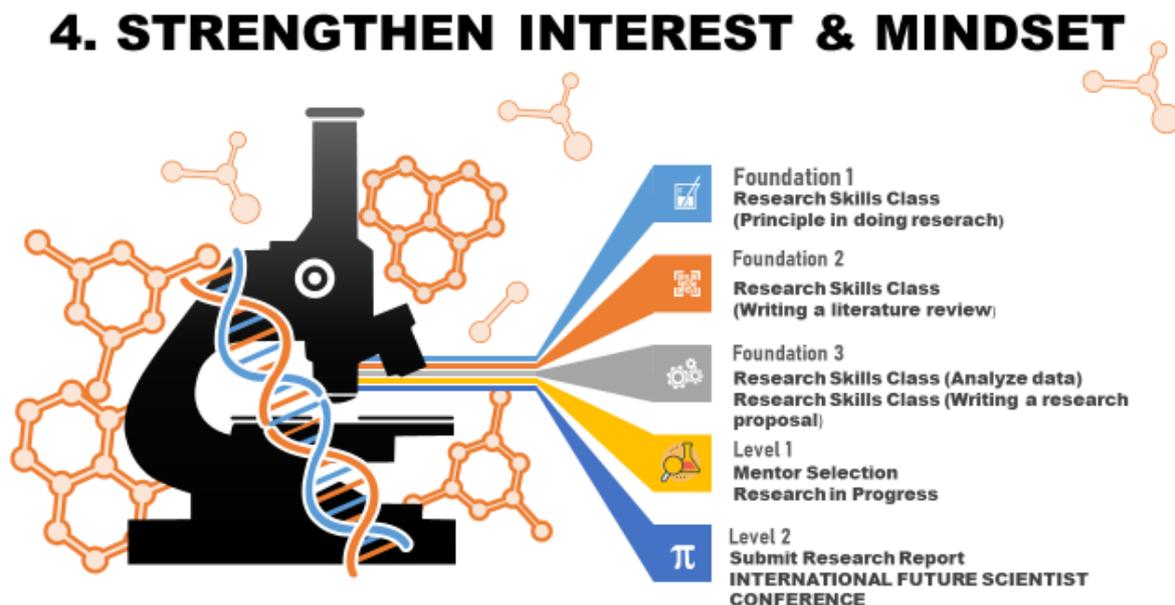


Figure 2.0: A structured Research Curriculum from Foundation 1/form 1 to Level 2/Form 5

3. What is the proof of the results / output of the implementation of the curriculum on gifted and talented students?

The success of the compacting and holistic curriculum in shaping the mind-set of a gifted student as a researcher and innovator is proven through their involvement in various research and innovation competitions whether at the secondary, national or international levels. The results of documentation analysis of the research and mentoring program of gifted and talented students at the GENIUS@PintarCentre, UKM found that 218 research projects (done in group) from 2012 to 2019 (Table 1.0) were conducted by GT students in the field of Fundamental Sciences, Applied Sciences, and Social Sciences. The results of the research were published in the annual proceedings of the Future Scientists Conference Proceedings. Table 2.0 shows the participation of Gifted and talented students in diverse research and innovation competitions.

Table 1.0 Research data and publications in Future Scientists Conference by Gifted and Talented students.

No	Years	Total research and Proceeding publication	
		Numbers	%
1	2019	23	10
2	2018	16	7.34
3	2017	22	10.09
4	2016	30	13.76

5	2015	26	11.93
6	2014	21	9.63
7	2013	17	7.80
8	2012	63	28.90
Total		218	100

NO	TYPE OF COMPETITION	YEAR	CATEGORY	LEVEL
1	Research program Collaboration with UPM	2019	Research	National
2	Asia-Pacific Forum for Science Talented: Nurturing Leadership for Future Scientists (APFst), Taiwan	2019	Research	International
3	World of Robotics National Championship (WRCPRO)	2018 - 2019	Innovation	International
4	FIRST LEGO League Malaysia	2018-2020	Innovation	National
5	National Robot Competition	2019 and 2020	Innovation	National
6	International Technology Exhibition (ITEX)	2018-2019	Research and Innovation	International
7	International Young Scientist Conference (ICYS)	2019	Research and Innovation	International
8	TunkuKurshiah Model United Nations Conference 2019	2019	Research	National
9	Petronas University Open Championship	2019	Research	National
10	International Future Scientist Conference	2019 and 2020	Research	International
11	School Camp for Advanced Reasoning Skills Kuala Lumpur	2019	Research	National
12	Essay Competition for Perdana Global Peace Foundation	2019	Research	International
13	AviatarHackathon	2019	Innovation	National
14	Malaysian Technology Expo (MTE)	2018 - 2020	Research and Innovation	International
15	Malaysian Technology Expo Special Edition COVID 19	2020	Innovation	International
16	Petronas University Open Championship	2019	Research	National
17	Youth Industry Bootcamp Central Region	2019	Innovation	National

18	International STEM Olympiad ISTEMO	2018	Research	International
19	Economic and Social Council	2018	Research	National
20	International Robot Competition	2018 - 2019	Innovation	International
21	IIUM Robotic Competition 2018	2018-2019	Innovation	National

Table 2.0 Diverse Research and Innovation Competitions Joined by Gifted Students at GENIUS@Pintar Negara UKM (2019 and 2020)

Apart from building the mind-sets of researchers and innovators, the Holistic Self-Development Model has been built and implemented to produce GT students who are resilient, confident, and have high leadership skills. The holistic Self-Development Model includes seven components of identity namely; Identity Intellectual-identity (Ii), Emotional-identity (Ei), Physical-identity (Pi), Social-identity (Si), Spiritual-identity (Sp-i), Leadership identity (Li), Citizenship-identity (Ci), and Adversity-identity (Ai). The integration of compressed curriculum and value integration through the Holistic Identity Model has resulted in gifted and talented students embracing thinking as researchers and innovators while at the same time having a holistic / balanced / wholesome personality in line with the National Education Philosophy and the mission of gifted and talented education program.

IMPLICATIONS AND CONTRIBUTIONS

Malaysia needs thinkers and researchers for the future development of the country. In line with the country's need to prepare the country's human capital to face the 4th Industrial Revolution (IR 4.0), GENIUS @ Pintar Negara Centre, UKM introduces gifted and talented education program that supports the national development efforts through the preparation of the gifted and talented educational curriculum model in general (Compacting Curriculum and Holistic Self-Development Model) and the specific curriculum of the On-going Research Mentoring Program for high school students. The novel of this study lies in the feasibility of the Compacting, Acceleration and Enrichment curriculum as well as the Holistic Identity Development Model which is the catalyst in shaping thinking as a researcher and innovator (R&I) especially in the field of STEM. In addition, the establishment of structured steps in the process of triggering, building and strengthening the mind-set / pattern of thinking as a researcher and innovator is also easy to understand. The steps to build this R&I mind-set can be easily followed or emulated by any educational program at all levels, whether high school or university level.

The advantages of integrating the Compacting, Acceleration, and Enrichment (CAE) curriculum and the Holistic Identity Model prove the feasibility of a more flexible learning pedagogy. This flexible approach enables learning according to students' ability and inclination; eventually stimulating their cognitive ability and increasing their interest

throughout the learning process. This will result in a tendency to conduct a diverse analysis (a Diverse Research and Innovative Mind-set (DRIM) among students, while producing students with a holistic personality parallel with the National Education Philosophy. In addition, the implementation of GLOCAL (Global thinkers with Local values practices) in developing gifted Malaysian students will help produce future young great Malaysian researchers and innovators among GT students with humanitarian characteristics who will later benefit future society and the global world with a new discovery and cutting-edge research.

The implications of this study towards educational programs by the Ministry of Education and private schools are through providing research curriculum course, beginning by forming the research mind-set as a measure to strengthen the culture of researchers from school to university level.

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