

DEVELOPING A TEACHER TRAINING PROGRAM FOR HIGH SCHOOL TEACHERS OF MATHEMATICALLY GIFTED LEARNERS IN SOUTH AFRICA

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Dissertation submitted in fulfillment of the requirements for the Degree

DOCTOR OF EDUCATION

In the

Faculty of Humanities

At the

Central University of Technology, Free State

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BLOEMFONTEIN
SEPTEMBER 2023

***“Where you have children who are particularly gifted, it would be criminal not to
want to develop their potential to the highest possible extent.” - Archbishop
Desmond Tutu***

Abstract

This study intended to develop a research informed teacher training program for teachers of mathematically gifted learners in South Africa, borrowing best practices as identified in exemplary institutions, international experts on gifted education, the literature and on local teachers' inputs. Data collection was done through document analysis of 7 programs from USA, Australia, Singapore as well as South Africa was done. A total of 21 trained experts on gifted education were interviewed in the USA and 121 untrained South African mathematics teachers responded to a questionnaire. The term untrained here is being used with specific reference to teachers who might have been trained as general practitioners but not as gifted education specialists. This triangulation of both methods and data then resulted in a teacher training program with 7 units being proposed.

Keywords: Mathematics education, inclusive classrooms, giftedness, talent, Teacher Training Program

Funding acknowledgement

This study is supported financially by the National Research Foundation (NRF) through Thuthuka Project – TTK150721128642, UNIQUE GRANT NO:99419. The results, conclusions and recommendations expressed in this study will be for the author and will not reflect the views of the National Research Foundation

Acknowledgements

I embarked on this project to make teachers, professionals and parents aware of gifted learners and how they should be supported to reach their full potential. The experience I gained from this study prepared me with the necessary tools to bring me one step closer to making that difference in gifted education to happen. I have met several people during my journey who made this process a success. Without their assistance, I could not have made this study a reality.

First, I would like to thank my project leader Professor Mike Mhlolo and my co-supervisor Doctor Lukanda Kalobo for each and every of their one-of-a-kind contribution. Prof. Mhlolo and Dr. Kalobo, you are unlike any supervisors and colleagues I have ever had. I thank you for your time and support you gave me. You guided me through thick and thin and the things that you taught me will remain in my heart. You offered me the opportunity to work more closely with you and made me feel welcome and comfortable. Your confidence in me from our first meeting is what honestly got me through.

I cannot continue with this acknowledgement without thanking my wife Sara Marumo and my son Marumo Marumo whom I regard them as my dear friends. I thank you for holding your horses and understanding over the previous years while I was busy with my studies. Your confidence in me to explore new things in life makes me to love both of you more and more.

My parents, Alfred and Dora Marumo and my in-laws, Madibuseng and the late Oom Frans Swartz – I do not know how to thank you on the level that you deserve. You worked hard and did not deny me with explore all the opportunities in the world. Your unconditional love keeps me wanting to make you proud.

Dedications

This thesis is dedicated to the entire Marumo family for their support they gave me during the journey of the study.

Declaration

I, Jack Mathoga Marumo, do hereby declare that this thesis submitted to the Central University of Technology, Free State for the Degree Doctor of Education, is my own work; and complies with the code of Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Central University of Technology, Free State; and has not been submitted before to any institution by myself or any person in fulfillment of the requirements for the attainment of any qualification.

Signature

Jack Mathoga Marumo

28-03-2024

Date

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CHAPTER 1: INTRODUCTION

1.1. Background and context

Prior to 1994, South Africa was one of the few sub-Saharan countries that paid particular attention to gifted education, but unfortunately such education was deliberately designed to benefit a minority of White learners in line with the apartheid view to education. Implementation of post 1994 reforms rejected gifted education as an elitist part of the legacy of the previous oppressive and exclusionary regime leading to the immediate closure of many centers for the gifted children (Oswald & De Villiers, 2013). The post-apartheid education system was designed with direct links to the Constitution of the Republic of South Africa wherein it states: “Education is the key because it empowers us to exercise our democratic rights, and shape our destiny, by giving us the tools to participate in public life, to think critically, and to act responsibly”. The subsequent Education White Paper 6 [Department of Education, (DoE, 2001:10)] outlined the government’s new policies for a single, undivided education system for all learners, including those with disabilities, in the hope that inclusive education would provide “a cornerstone of an integrated and caring society.” While this study acknowledges that there has been progress made since the end of apartheid in terms of widening access to education as well as other aspects, there are many debates that have arisen in response to access versus quality in educational reform especially in the wake of the fourth Industrial Revolution [4IR]. Gifted education in South Africa cannot be singled out from these broader post-democratic educational reforms as it is intricately intertwined therein. So, I start by briefly outlining the access issues that have emerged from inclusive education as it has been implemented in South Africa.

Although in other countries educational access may be discussed differently, issues of race remain at the forefront of education in South Africa. During the apartheid era, learners were placed in racially segregated schools a practice common in many African countries who were colonies then. Eliminating racism in educational access was going to be the first step in challenging the past apartheid practices given that the purpose of the Bantu Education Act was to make sure that black South Africans would only ever be

able to work as unskilled or semi-skilled labourers, even if they were intelligent enough to become skilled. In what are now considered as infamous words, the then Minister of Native Affairs, Dr Hendrik Verwoerd, explained government's new education policy to the South African Parliament.

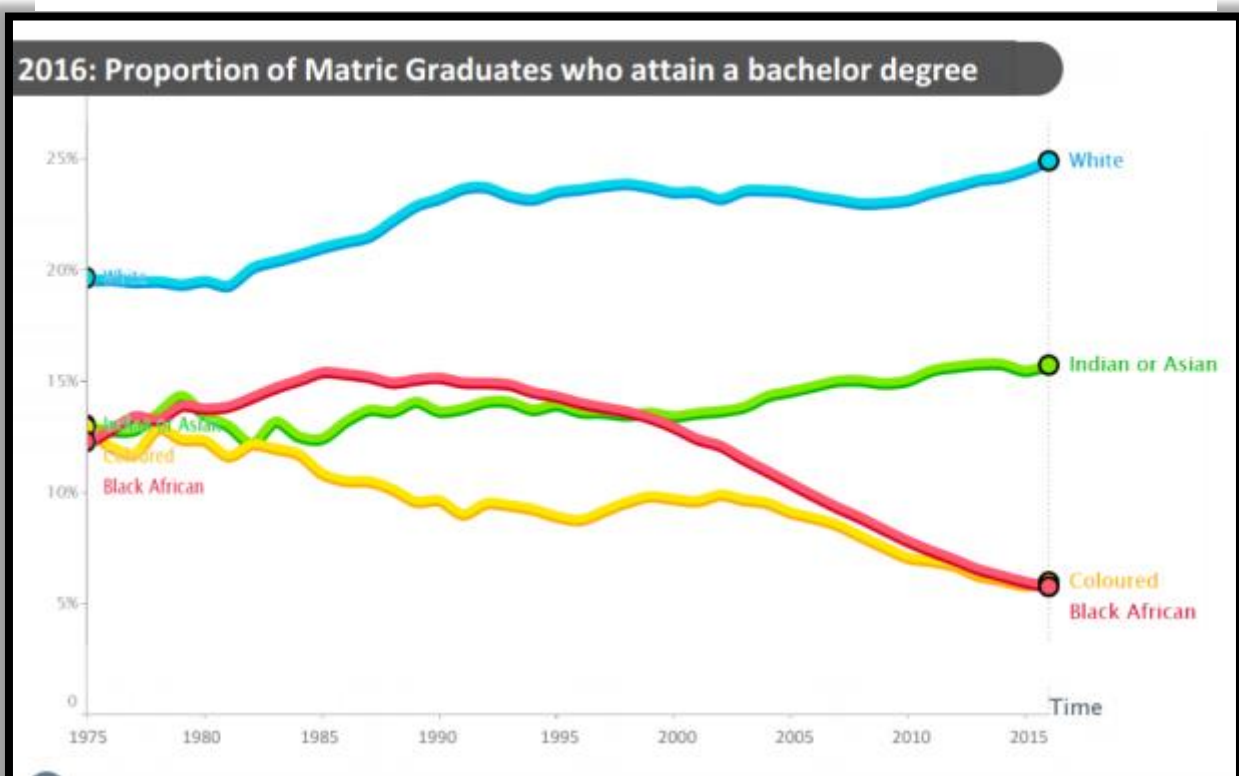
There is no space for him [the Native] in the European Community above certain forms of labour. For this reason, it is of no avail for him to receive training which has its aim in his absorption into the European Community, where he cannot be absorbed. Until now he has been subjected to a school system which drew him away from his community and misled him by showing him the greener pastures of European Society where he is not allowed to graze.

Most of the indicators showing how racial issues in education have been dealt with post democracy, focus on how government has provided access to physical structures especially in the primary and secondary schooling. For example, learner-educator ratio (LER), learner-school ratio (LSR), educator-school ratio (ESR), gross enrolment ratio (GER) and gender parity index (GPI) in ordinary schools have all been used to tell a success story of the South African education system post 1994. While the experience of race in the primary and secondary school setting might provide a relatively accurate reflection of how the country has tackled the race issue, Attwell & Lavin (2007) caution that there are specific ways in which higher education participation changes the lives of students. Hence there are calls for placing a greater emphasis on college readiness in public education. These calls are a response to the perceptions that most public schools, particularly high schools, pay insufficient attention to the post-secondary success of students. Advocates of college readiness and the related concept of “college and career readiness” would contend that the purpose of public education is to look beyond secondary schooling graduation rates to the knowledge, skills, work habits, and character traits students actually need to succeed in adult life. While many of these debates centre on different interpretations of *equity* [what is fair and just] and *equality* [what is distributed equally], one of the indicators of equity proposed by Fiske & Ladde (2005) is educational adequacy. According to Fiske & Ladde (2005) equity defined as educational adequacy shifts attention to educational outcomes and, in particular, to the minimum acceptable - or adequate - level of education necessary to assure that all

citizens, whether they be black or white, can participate fully in the political and economic life of the country. One way to determine the adequacy of the educational system is to look at student's college readiness.

When the apartheid government came into power in 1948 it formalised race-based participation in higher education. It passed the Extension of University Education Act of 1959 which 'formally restricted entry to universities according to race and paved the way for racially and ethnically based universities to serve the needs of the "separate development" policy at the core of apartheid ideology'. So, as a starting point it is important to understand the extent to which post democratic education has addressed or reversed that practice. **Figure 1.1** shows the percentage of South African students per race group that have gone on to obtain a bachelor's degree after matriculating from 1975 to 2015.

Figure 1.1 Learner participation by race 1975 - 2015 [Source: Statistics South Africa: Available at <https://www.southafricanmi.com/education-statistics.html>]



It is clear that white students make up the highest percentage of students who obtain a bachelor's degree. What is more worrisome to see is the widening of the gap as a result

of the decline in the percentage of Coloured and Black African students obtaining bachelor's degrees after high school. It is against such stark access disparities that the 1995 White Paper 1 on educational transformation, described the devastating racial issues of apartheid on education as some pernicious legacy that needed urgent attention. Though the 1995 White Paper aimed at closing such gaps, there is ample evidence to show that those groups of learners who were previously marginalized during the apartheid era, and who a democratic education purported to serve, continue to be outperformed by the previously advantaged learners (Kahn, 2019) - evoking another form of 'covert' exclusion.

Besides looking at educational adequacy through college readiness, access to education can also be analysed in terms of skills that matter. In their document entitled: *The state of mathematics, science and technology in our schools*, the Department of Basic Education (DBE 2018) admits that South Africa suffers from the twin scourges of high unemployment and a shortage of critical skills needed to drive economic growth and social development. The skills shortage underpins many of the challenges which government faces with regards to service delivery and the expansion of decent work for a rising proportion of the population. In the wake of the fourth industrial revolution [4IR] there is a change of heart in the way inclusive education is generally viewed. At attaining democracy, it was considered as a solution for addressing the apartheid legacy but today the general view is that inclusive education has left the nation's learners with insufficient skills to function in a modern economy. Studies indeed confirm this as noted for example in the diagnostic report by the Presidential Commission on the Fourth Industrial Revolution [PC4IR] (2020). With reference to the demands of the 4IR, the commission warned that the jobs that are now emphasized are those that are at the centre of controlling machines i.e., jobs that are founded on science, technology, engineering, and mathematics competencies. Similarly, Hanushek & Wöeßmann (2008, 2009) used data on economic growth to analyze the period (1960– 2000) and concluded that the measure of the quality of education is a simple average of the mathematics and science scores, interpreted as a proxy for the average educational performance of the whole labor force. While there are many ways in which to measure a school's improvement with respect to mathematics over the years, a fundamental question is

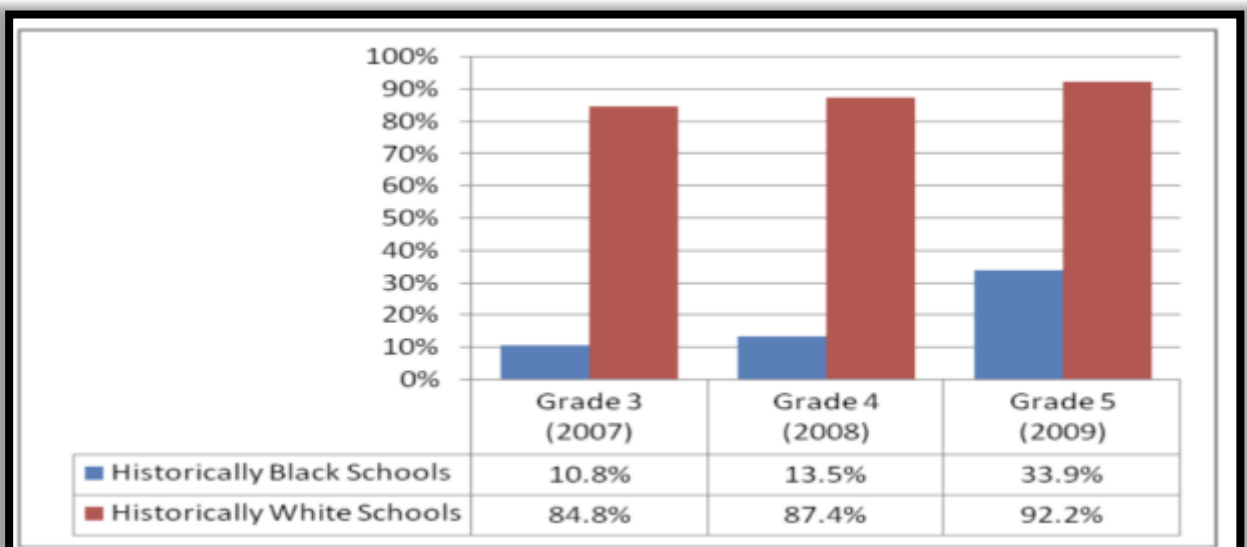
one of breadth versus depth, or what Hanushek & Wößmann (2009: 22) refer to as 'rocket scientists versus education for all'. **Figure 1.2** highlights some indicators of both aspects i.e., the average performance >50% as well as the top end performance >80%.

Figure 1.2 Learner participation [000s] and performance [%] in mathematics 2008 – 2021
[Source: own compilation from various documents]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Wr	302	304	263	225	226	242	226	264	266	245	234	222	233	259
>50%	21,1	17,7	19,1	18,5	22,7	26,1	22,3	20,3	21,2	22,2	21,7	20,3	22,3	23,1
>80%	4,3	2,9	3,6	2,5	2,9	3,4	3,2	2,9	3,0	2,7	2,5	2,0	3,2	2,9

Figure 1.2 shows that since 2008 the pass rates in mathematics, with just a 50% score, has never gone beyond 27%. Critics therefore argue that mathematics is elusive and according to the PC4IR (2020) this puts South Africa in a position where regardless of the high number of youths the country has, not enough are eligible to be skilled in these critical fields to meet the 4IR skills demand. While this can be said for the country as a whole, further analysis shows that apartheid fault lines remain stubbornly in place not only in our education system in general but in subjects that matter in the 21st century knowledge-based economy. A look at **Figure 1.3** shows clearly how poor performance in mathematics plays out when analysed by race.

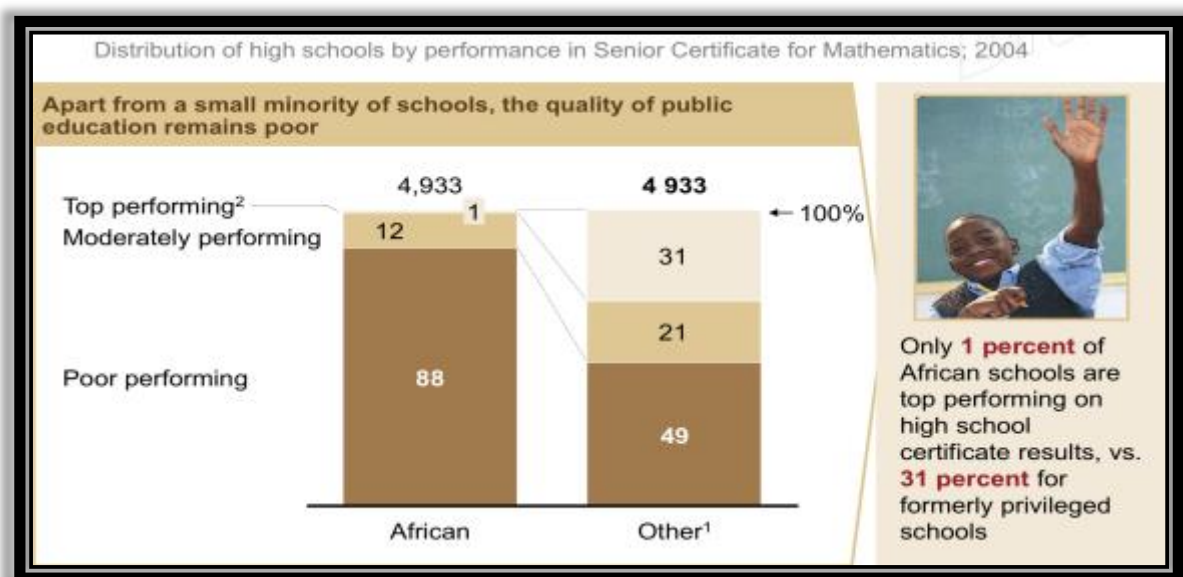
Figure 1.3 Proportions of children achieving above 5% on the NSES numeracy test [DBE, 2018]



The figure demonstrates that in South Africa, there is a wide gap in mathematics achievement between the Historically Black Schools and the Historically White Schools. According to DBE (2018) this suggests that there is a high level of inequality that is unique to South Africa. A final point to consider in this section is that performance in lower grades is strongly deterministic of ultimate educational outcomes. For example, Reddy et al., (2012) tracked students that participated in TIMSS in Grade 8 to when they reached matric, if indeed the learners reached matric. The conclusion from the analysis was that Grade 8 mathematics and science achievement is strongly predictive of whether children reached matric and how well they performed in matric.

This conclusion is further confirmed when we look nationally at the top 500 performing schools in mathematics. A disaggregating of performance by race [Figure 1.4] shows that 88% of African schools are poor performing in mathematics.

Figure 1.4 Distribution of performance in Grade 12 Mathematics 2004 [Source:NPC, 2011]



Beyond matric, similar racial differences in mathematics performance have been well documented at university level (Shay et al., 2019) further confirming the view that performances at lower grades are strongly deterministic of ultimate educational outcomes.

As can be seen from all these figures, it can be argued that while overt exclusion might have been addressed in post democratic education, this has only been replaced by covert exclusion. The pain of this covert exclusion is more agonizing particularly in the learning and teaching of mathematics given that apartheid education considered it 'absurd' to teach a Bantu child mathematics. Poor student performance, particularly in mathematics, is widely acknowledged as being a key hurdle to economic and social development in South Africa. The low numbers of black African students achieving sufficiently high scores in mathematics to enter university studies requiring minimum levels of mathematics competencies continues to worry policymakers.

As a way of addressing this crisis, the Department of Basic Education [DBE, 2018] said:

Today many countries place a strong policy emphasis on improving MST learning in the education system. South Africa is not alone in experiencing a skills shortfall in the area of MST. The obvious solution is to improve the MST foundations laid in schools, increase the number of learners leaving school with an MST specialization and provide additional learning opportunities for exceptionally gifted children and youths.

Judged by this and many other statements, there seems to be an unequivocal logic in the view that in a crisis such as the South African one, talent identification and nurturing is the way to go. Evidence shows that similar logic was applied in Singapore hence gifted education is what drives Singapore's success story (Lee, 2006). Although current research in South Africa continues to blame the demise of gifted education in mathematics and science [here in referred to as mathematical sciences] on apartheid, this study argues that stakeholders have now made a u-turn and now consider it as a key strategy towards the solution to the conundrum or the "mess that won't quit" i.e., the ever-elusive poor performance in mathematical sciences.

This u-turn towards gifted education can be traced back to the time when the Hon Thabo Mbeki took over as the South African president. For example, in his State of the Nation Address [SONA] during the opening of Parliament in 2001, he emphasised the centrality of mathematics and science as part of the country's human resource development

strategy. This followed compelling evidence of persistently high failure rates in mathematical sciences especially by learners from previously disadvantaged communities. High failure rates have also persisted despite government acknowledging that a critical mass of youths with exceptional results in mathematics is a prerequisite for the innovation needed to sustain niche industries that can improve the global competitiveness of the country. In this regard, the schooling system is therefore described as clearly failing the country, both with respect to the number of mathematics passes and the number of learners who excel. Given the apartheid view to mathematics being a preserve of the master, persistently high failure rates by learners from poor communities are therefore not only viewed as a pernicious legacy of apartheid but also as a perpetuation of poverty and inequality. In the wake of the 21st knowledge-based economy [KBE], and the demands of the new information technologies, the ability of learners to succeed in today's work environment is increasingly dependent on the understanding of mathematical sciences. Therefore, beyond addressing the racial divide caused by the politics of mathematics education in South Africa prior 1994, the more recent concern is that poor performances in these subjects limit participation in the fourth industrial revolution and are detrimental to the development of scientifically literate citizens. This is the view that drives this study.

Subsequent to President Thabo Mbeki's call and in response to these challenges, a need was felt to identify learners with exceptional ability in mathematical sciences and provide such exceptional learners with better access to focus schools. This logic is not only less controversial in research, but it is also appealing to both common sense as well as to other disciplines such as sports where it is considered reasonable when applied in programs for talent development. In sports for example, if the aim is to prepare top athletes for competing at say the Olympics, it is considered logical that potential is identified first through talent searches before such athletes are put in state-of-the-art facilities for the purposes of honing their skills. Similarly, in the case of South African education, especially now where the country needs to respond to the demands of the 4IR, the elitist view to gifted education is worn out and retrogressive. Instead, there is a shared view among many stakeholders including the National Planning Commission, the Centre for Development & Enterprise as well as the MST Task Team that provision for excellence

must be made to the most talented students in mathematical science. In Singapore for example, gifted education was accepted as reasonable and not elitist. Thus, educational investment had to be directed toward providing a suitable educational environment that would prepare talented youths for responsible leadership and service to self, to families, to country and to society. Similarly, Gagné (2015) cited many studies which have shown that in the wake of the 4IR, it might not be possible to optimize educational resources without considering the innate cognitive abilities of students.

Consistent with this current view to education, in South Africa it was hoped focus schools would play a vital role in providing talented learners in poorly performing schools with new opportunities. Focus schools would allow learners with exceptional ability to spend more time on the mathematical sciences and be taught by teachers with additional training and skills in these subjects. Consequently, the Department of Education together with the Council of Education Ministers [CEM] then launched the National Strategy for Mathematics, Science and Technology Education (NSMSTE) with the goal of doubling the number of South African learners passing high grade (HG) mathematics. The NSMSTE is both a permanent and priority goal whose flagship program was the 100 dedicated schools which later became known as the Dinaledi Schools. The strategy was premised on the view that: (a) an adequate supply of Grade 12 graduates with mathematical sciences was needed to enter higher education; (b) this could be better assured by focusing on mathematical science learners with potential in dedicated schools, rather than through a dilution of effort across the whole schooling system; (c) the dedicated schools would allow those with the most ability to study intensively; (d) talented individuals in mathematical sciences would rather be accommodated at successful schools. The dedicated schools would act as centers of excellence within their locality by accepting learners talented in mathematical sciences who would not otherwise be able to go to a Dinaledi school elsewhere. Both the NSMSTE and the Dinaledi schools' motto was: "Creating tomorrow's stars today". Hence, it was hoped these schools would promote innovative learning and teaching strategies for mathematical sciences that were usually not found in mainstream schools.

Although it was hoped that the launching of the NSMSTE and its flagship Dinaledi Schools project in 2001 would harness the vicious cycle of under supply of mathematical science skills, unfortunately performance remained abysmal a decade later - prompting stakeholders to ponder again as to where the system had gone wrong. The fact that on one hand efforts are being made to close the mathematical skills gap while on the other hand the gap remains as a 'mess that won't quit', has been described by Kahn (2019) as a conundrum that demands analysis, explanation and justification. Taylor (2021) described this mathematics education conundrum as a Sisyphean task where from Greek mythology, we learn that Hades punished Sisyphus for cheating death twice by forcing him to roll an immense boulder up a hill and every time he reached the top, the stone would escape his grip only to watch it roll back down hill, again and again, 'forever'. The story of Sisyphus is often told in conjunction with that of Tantalus, who also offended the gods and as punishment was forced to stand in a pool of water which was filled up to his neck, with fruit hanging just over his head. The water would recede every time the king tried to take a sip, and the wind wafted the fruit away every time he reached to take a bite. Hence from the name Tantalus, to tantalise is to tease or torment by offering something desirable but keeping it out of reach. Similarly, a Sisyphean task is both endless and pointless: it demands unending, thankless, and ultimately unsuccessful efforts. Thus, the words Sisyphean and Tantalizing are eponymous English words which make reference to 'eternal' frustration in a similar way that the challenges faced in mathematics education in South Africa seem to be both tantalizing and endless.

Reminiscent of Sisyphus in Greek Mythology where he had to gather more energy each time the boulder rolled agonisingly down the hill, South Africa also had to gather fresh energy to address the persistent poor pass rates in mathematics education. Hence the then South African President Jacob Zuma yet again appointed in 2010 the National Planning Commission (NPC) whose mandate was to take a broad, cross-cutting, independent and critical view of the challenges facing the country. In its first diagnostic overview which is presented in fifteen chapters, chapter 9 focuses on education where the NPC (2011) lamented a "credential inflation" caused by a focus on numeracy at the expense of critical skills. With respect to students, the NPC's view was that a few well-

motivated and talented individuals would be of more importance to national economy than many who were (a) not at the cutting edge and (b) were content with substandard work. The subsequent NPC's 2012 report then made it clear that opportunities for excellence be provided to the most talented students and that consideration should be given to expanding the Dinaledi Schools initiative, with a focus on its shortcomings (NPC, 2012:305). It is important to note that the NPC was not set up with a specific focus on education, but that it made recommendations about education amongst other recommendations related to health, economy and other areas of concern. Following the recommendations made by the NPC with specific reference to education, another Mathematics, Science & Technology Education (MSTE) task team was set up with a specific mandate to investigate the shortcomings of the NSMSTE and its Dinaledi Schools project. From their investigations, the MSTE task team report also lamented that South Africa is devoting significant resources to large numbers of learners who have little chance of passing Senior Certificate mathematical sciences. At the same time, large numbers of gifted learners with the potential to succeed in mathematics and science are not getting the opportunities to study these subjects thoroughly. For whatever reason why this did not happen, this particular task team's finding points to a typical example of the many self-defeating elements of transformation.

In their paper entitled: "The DNA evidence that belies the claim....", Mhlolo & Ntoatsabone (2022) also point to this self-defeating practice where on one hand the NSMSTE claimed that its major goal was of identifying learners with exceptional ability and placing them in dedicated schools yet on the other hand the elitist stigma keeps raising its ugly head. Consistent with the goals, one would have expected some form of screening/identifying of gifted learners in mathematics and science to be the first step in the implementation process. Yet in all the documents that were accessed for this study, it is clear that throughout the two decades that the Dinaledi Schools have been in existence, no screening of learners was done. From as early as 2004 the Centre for Development & Enterprise [CDE] has been consistent in that there was nothing to show that Dinaledi Schools were dedicated schools for exceptional learners but instead they became just a randomly selected group of ordinary schools.

The MST task team's report has a section that seeks to focus on specific areas where particular intervention had been identified as necessary and one of them was that MST talent development programs should be incorporated into the revised NSMSTE strategy (DBE, 2012:48). This current study argues that there is nothing new in the task team's recommendation but instead this is pointing to a serious chasm that must be closed urgently because it draws stakeholders' attention to what was claimed would happen, but which did not happen. Although the CDE 2004 report indicates that the National Department of Education went to some lengths to avoid using the term Dinaledi [which means stars], an observation that is confirmed in that in May 2022 the term has been changed to focus schools, this does not in any way suggest that these were not schools for the gifted. Instead, this denial on the part of government is typical of obfuscation games that get played when an innovation has failed to deliver. Spaul (2013) points to an existing culture of blame-shifting, impunity, patronage and obfuscation in South Africa, with the intention to cover up for ineptitude and incompetence. This is unsustainable and is arguably a binding constraint to systemic progress (Spaul, 2013). On the contrary, the fact that both the NPC and the MST task team specifically mention 'talented learners' and 'gifted learners' respectively confirms that in fact the Dinaledi Schools project was meant to be a 'special schools' programme for gifted learners, similar to gifted education programmes in many other countries. Even the requirement that special schools become centres of excellence as well as a resource to other schools in the area and to the local community is found in other gifted education systems. Assuming consensus on this argument and considering that at the heart of talent development are the capabilities residing in the people, then it goes without saying that identifying and cultivating domain-specific [mathematical] abilities of students who show exceptional potential must have remained at the heart of the strategy.

Yet in the five-year strategic Action Plan to 2014, the Department of Basic Education admits that one area where government needed to do more was to provide "exceptional learners" with greater access to focus schools. In the Department of Basic Education 2018/2019 annual report, the foreword by the Minister of Education reads:

When talented children do not participate in school, or drop out before achieving their potential, this is a grossly inefficient use of a country's human capital (DBE, 2019:16).

Similarly, in an interview with Professor Maree this is what the late Archbishop Desmond Tutu had to say about gifted children in South Africa: ...

We should do all we can to make our children want to aim for the stars. Every child should seek to be the best that he/she can be. We cannot afford to play ducks and drakes. Where you have children who are particularly gifted, it would be criminal not to want to develop their potential to the highest possible extent. We are not looking for uniformity...we want to ensure that every child has a basic education, but we mustn't make a virtue of mediocrity. We must produce the best possible children in every possible sense (Tutu in Maree, 2007:6)

All these recommendations suggest that if South Africa were to move from laggard to world-class and transform student potential into the skills that are needed in the 21st century, there is need to put well-structured talent development programmes in place for the country's gifted students in mathematical sciences. Although the term 'Dinaledi' might have been buried in 2022, a take home message that comes clearly from all these efforts is that the idea has remained the same, and that it must be expanded is unequivocal evidence of the wisdom therein. If this view is shared, then positive changes need to be made that are consistent with the original ethos of the programme - gifted education in mathematical sciences is what is likely to take the country forward in terms of addressing the skills needed in the knowledge-based economy. Against this background and despite other views, this study was premised from that position that NSMSTE has good plans for addressing the correctly identified needs in mathematical sciences (DBE, 2013) hence a revised version of the Dinaledi projects needs to become a permanent feature of the South African education system.

1.2. Problem Statement

At the inception of the dedicated schools project, it was well known that the improvement of learner achievement was largely dependent on a competent teaching corps of mathematics and science educators. Hence the selection criteria for Dinaledi status were clear that under-resourced and well-performing schools would be chosen from those that had competent educators in both mathematics and science. However, as early as the first phase of implementation from 2001-2004, CDE (2004) tables showed that some Dinaledi Schools actually did not offer mathematics and science in Grade 12, nor did they have any mathematics and science educators. The report went on to acknowledge the tensions created between the National Department of Education and the provincial departments by local interest groups that wished to have a prestigious Dinaledi school in their area. Subsequent independent reports of the Dinaledi Schools project bemoan the self-destructive 'politics of knowledge' which came to bear onto the project which had otherwise been very well conceived and was indeed visionary in its focus on the much needed 21st century skills. Due to this 'politics of knowledge' many Dinaledi Schools were delisted year-in-year-out because they failed to meet certain performance targets. Across the general education system as well as the NSMSTE's Dinaledi Schools' project, one common attribution was that mathematics teachers have been identified as the major human factor causing poor performance of students in the country. In the 2013 MSTE task team review report of the project, it was clear that poor performance of learners in mathematics was a result of many teachers who do not have the required content knowledge and teaching skills. In the keynote address by the Minister of Basic Education, at the 2016 Mathematics Indaba held at the Sol Plaatje House in Pretoria, the minister candidly admitted that although, improving teaching quality alone may not be sufficient to redress the country's schooling ills, it is likely a necessary precondition for such improvement. Even the latest revised NSMSTE [2019 – 2030] is clear in that it aims at developing a relevant curriculum taught by competent and professionally qualified teachers with the necessary resources to inspire and equip learners with competencies for the demands of a changing world. The Minister then asked the question: *Where does one start in this regard?*

Informed by various research conducted, Spaul (2013) developed four points that must be borne in mind in addressing South Africa's numeracy and mathematics schooling challenge. This study might not have all the relevant answers to concerns raised by Spaul, but it builds on the third point that if South Africa is to be realistic about having a knowledge economy and creating more and better jobs, it will require a sustained focus on teacher-training and development, particularly in mathematics teaching. This is consistent with a view echoed in a UNESCO maxim - that an education system is only as good as the quality of its teachers because the teacher is viewed as being at the core of quality. With specific reference to mathematics education, Leikin (2011) posits that teachers are the agents of the educational system who should design mathematical challenges appropriate for all the students in general and particularly for the mathematically gifted ones. Hence it can be argued that teachers can either make or break the education system for gifted students. Yet in South Africa, teachers interviewed by Oswald & de Villiers (2013) unanimously concurred that they had never received training on how to identify and support gifted students prompting the authors to recommend that the quality of gifted education is dependent upon the quality of training the teachers receive. Similarly, Kokot (2011) posits that teacher colleges and universities exert direct influence on the education of gifted children by training (or not training) future teachers. Her recommendation was that these institutions should be the major focus of advocates for improving gifted education.

1.3. Purpose of this study

This research project responded to that recommendation in that it aimed at developing a teacher training program that higher education institutions might use for training teachers for the gifted. Given this focus, it can be argued that this study was also conceptualised as a response to the minister's question – where does one start. In the review report by the MSTE task team, addressing the issues linked to teachers and teaching was considered the single most important strategic intervention. This followed from an observation where all provinces highlighted the inadequate quality of MST teachers as one of the main causes for concern (DBE, 2013:42). These findings together with other similar studies (Oswald & de Villiers, 2013; Kokot, 2011; Mhlolo,

2017) all suggest that if South Africa were to transform student potential into the skills that are needed in the 21st century, there is need to put well-structured teacher development programmes in place for its gifted students. In fact, Taylor (2021) emphasizes that point through an analogy wherein mathematical science interventions in the absence of knowledgeable educators are likened to accelerating a car through wheel-spinning mud, lacking the essential element which provides the traction needed to make them effective. According to the Council for Higher Education (CHE) report in 2013, if higher education does not bring about systemic reforms within its teacher training system, the status quo will largely remain, to the detriment of development, equity and individual advancement (CHE, 2013).

Admittedly these recommendations are indeed commendable, however, a concern raised by the MSTE task team was that while all strategies have clear goals, many lack sufficient detail in respect of intended actions, scale, timelines and budgets to facilitate action, management and monitoring (DBE, 2013). The overall perception from provincial education department officials and schools is that higher education institutions [HEIs] are failing the system by delivering new MST teachers who are not adequately trained. Admittedly the approach to teacher training must be reviewed and strengthened as recommended by the MST task team. However, where this current study differs with previous recommendations made about improving teaching [and therefore its contribution to knowledge] is that it is more precise by problematizing specialist teachers for the gifted.

As a researcher I want to keep drawing the reader's attention back to the Sisyphean task which was alluded to earlier. There is a danger that if stakeholders continue to mix teacher shortages in the general education system with teacher shortages in the NSMSTE in particular, then the country runs the risk of targeting interventions at the general and maybe traditional teacher training programmes. For example, in the NSMSTE document it was stated that programmes that can equip educators with competences to teach at all levels of the schooling system will be appreciated (DoE, 2001). Such a recommendation lacks exactness and accuracy in detail of the diagnosis of the disease which will inevitably lead to an inaccurate prescription or inappropriate

use of the prescribed antibiotic and which in turn will make the mathematics conundrum to be a drug-resistant infection thereby again perpetuating the Sisyphean task. According to the MSTE task team report, it is increasingly clear that we cannot continue to do what we have done previously and yet expect a better result. This study argues that stakeholders have continued to 'sit on the fence' regarding gifted education, where on one side we would like to identify learners with exceptional ability and put them in dedicated schools but on the other hand we don't gather the courage to declare that we are introducing gifted education back as a solution to the perennial poor performance in mathematical sciences. For example, in the May 2022 meeting of the deputy minister of education with the portfolio committee, the term Dinaledi Schools is said to have been changed to focus schools, but the concept has remained the same. - a clear indication of the government sitting on the fence. Admittedly there is an elitist stigma attached to gifted education in this country, but unfortunately this continued neutrality due to fear of being labelled elitist is a typical example of what we have continued to do which is proving to be detrimental to all our efforts towards the effective implementation of the Dinaledi Schools project. Decisive and innovative action on some key priorities is clearly needed (DBE, 2013:52) and this study argues that decisive pronouncement of gifted education leading to the justification for specialist training of teachers for the gifted is one such innovative action that should be prioritized.

The NSMSTE was very clear in that in the context of competing priorities and limited resources, it was better to provide sufficient and adequate learning and teaching facilities to fewer schools with the aim of going full scale over a longer period of time (DoE, 2001). This could be better assured by focusing on mathematics and science learners with most ability to study intensively in 'dedicated schools', rather than through a dilution of effort across the whole schooling system. It should be clear from these statements that the dedicated schools project would run parallel to the general schooling system. Surely, if this was a specialist schools' project which would allow those with the most ability in mathematical science to study intensively, then logic would dictate that general education practitioners would not be fit for this purpose. Renzulli (2012) for example admits that teachers in the regular classroom can achieve success in regard to educating gifted learners effectively, but only up to a point and with difficulty. A

number of studies have shown that approximately 65% of teachers stated that training courses or teacher education programs had little or no focus on academically gifted students. Taylor (2021) goes further to describe the kind of differentiation taught in traditional teacher-education programs, as a smokescreen behind which bright kids get a few extra assignments or more work based on the traditional (didactic) models of learning. Academically gifted learners benefit more from teachers who receive special training on the topic, and this is only possible with teachers who know and understand the needs of gifted students in terms of their educational, social and emotional needs (Hudson et al., 2010). In the South African context, this project argues that 'specialist schools' for 'specialist children' should also be taught by 'specialist teachers' who understand gifted children. Assuming concurrence with that logic, stakeholders cannot continue therefore to take a business-as-usual approach by deploying general practitioners to specialist schools project such as the Dinaledi Schools. Given that traditional pre-service teachers are ineffective when teaching gifted children, the CDE (2004) report was clear that systemic change does not work optimally by starting with improvements to the least effective components of the system. On the contrary, and with specific reference to the Dinaledi Schools project, CDE (2004) suggested that it was important to create positive outcomes as rapidly as possible, as these would create a sense of progress, and motivate participants. Discouraging quick-fix approaches which are prevalent in the implementation of the project, CDE cautioned that interventions need to be considered in the framework of long-term goals of systemic reform and should not be counterproductive from this perspective simply because they can be undertaken more quickly. The CDE view shared in this study is that a successful way of achieving focus is to group efforts relating to a particular problem, [such as the NSMSTE] into a 'programme' [such as gifted education programme], with specific participant inputs, [such as specialist teachers for the gifted children] activities [such as a differentiated curriculum], and goals [such as a pass at 80% and above] that can develop quickly and provide results that can be generalised to the whole system. According to the CDE (2013) report, potentially, the Dinaledi Project, if structured properly, could be a case in point leading to the more wide-spread acceptance of specialist schools. For this reason, the main aim of the present study was to develop a specialist teacher training program for teachers for the gifted learners.

1.4. Research objectives

To achieve that central goal of this research, the objectives of this study are:

1. To identify content material from Teacher Professional Learning Programs on gifted and talented education used by some selected established universities around the world.
2. To learn good practices from the trained teachers for gifted learners.
3. To investigate South African teachers needs that should be included in the Teacher Professional Learning Program for teachers for the gifted.

1.5. Research Questions

Admittedly, there are various views regarding what should go into a programme for training the teachers of gifted students. However, studies concerned with the essential competencies of teachers of the gifted are relatively consistent in their assessment of which competencies should be found in educators working with gifted students (Cross & Dobbs, 1987; Hansen & Feldhusen, 1994). For example, Gagné's (2021) Integrated Model of Talent Development [IMTD] which has been adopted as a theoretical underpinning for this study argues that giftedness will not develop into talent if the catalysts are weak. Gagné sees the interplay of the catalysts as a chain that breaks if any link is missing, weak, ineffective or does not meet the learner's needs over a period of time. Gagné (2015) further argued that, within his list of environmental catalysts, teachers (individuals) deserved to be labelled the "weakest link", because all the other catalysts (resources) are manipulated by the teacher. Similarly, Clark (2002) argued that classroom teachers have the most significant influence on the learning, development and achievement of gifted learners. Gagné (2015) then provides seven constitutive characteristics of exemplary talent development programs which highlight the 'best' practices that proper Academic Talent Development [ATD] programs should implement, in what he calls 'a best practice model'. The view in this study is that such a theoretical underpinning "sets the stage" for the presentation of the specific research questions that drive the investigation being reported. In the literature previous studies have used the terms Teacher Training Programs [TTP] and Teacher Professional Learning

Program [TPLP] interchangeably and identified three groups of the sources from which one can gain insights about these competencies. These are (a) established institutional programs (b) experience gained by experts in the field i.e., in developing a successful teacher development programme for teachers for the gifted, stakeholders must identify what teachers know and believe about gifted children and their education and (c) expectations from prospective teachers for the gifted. Having set the stage and consistent with its chosen framework of the IMTD, the study then raised the following three questions each linked to those three sources:

1. Which content is common among some selected Teacher Professional Learning Programs [TPLP] in gifted education globally?
2. What insights can we gain from some trained teachers for gifted learners?
3. What are the needs of South African teachers that should be included in the Teacher Professional Learning Programs [TPLP] for the mathematically gifted?

1.6. Importance of the study

This section discusses the factors that motivate the research undertaken in this PhD study on gifted education. I enter that discussion through a question: What is the principal goal of education and I quote:

The principal goal of education is to create men and women who are capable of doing new things, not simply repeating what other generations have done.
—Jean Piaget—

In his paper entitled Re-examining the Role of Gifted Education and Talent Development for the 21st Century: A Four-Part Theoretical Approach, Renzulli (2012) asked the question: Why should a society devote special resources to the development of giftedness in young people? He answers that question in two parts as follows: The first purpose of gifted education is to provide young people with maximum opportunities for self-fulfillment through the development and expression of one or a combination of performance areas where superior potential may be present. The second purpose is to increase society's reservoir of persons who will help solve the problems of contemporary civilization by becoming producers of knowledge and art rather than mere

consumers of existing information. Although there may be some arguments for and against both of the above purposes, most researchers would agree that goals related to self-fulfillment and/or societal contributions are generally consistent with democratic philosophies of education. What is even more important is that the two goals are highly interactive and mutually supportive of each other. In other words, self-satisfying work of scientists, artists, writers, entrepreneurs, and leaders in all walks of life has the potential to produce results that are valuable contributions to society. If we agree that the goals of gifted education and talent development are to maximise young people's opportunities for self-fulfilment and increase society's reservoir of creative problem solvers and producers of knowledge, then it would seem plausible to put in place some well-structured programming and services that enhance students' capacity for creative productivity, not just content acquisition. From this view the argument for special education programs that focus on gifted learners and creative productivity follows logically – we want to create men and women who are capable of doing new things, not simply repeating what other generations have done.

This would also be consistent with ethos shared in inclusive education. Students with exceptional gifts, talents and learning potential have needs that require specific attention. With careful nurturing and appropriate education, gifted and talented students have the potential to make a unique contribution to their communities and the world. When this does not happen, the price we and they pay is “lost academic growth, lost creative potential and sometimes lost enthusiasm for educational success and eventual professional achievements and substantial contributions to society” (Davis & Rimm, 2004). Hence this study makes the first contribution towards these issues in a South African context.

In terms of contributing to theory, this study argues that when the issue of inclusive education is raised, it is most often with regard to pupils who have one or more educational disadvantages or difficulties (defective). For example, an analysis of the relevant research databases from 2012 concluded that the dominant use of the term inclusion was in relation to the ‘narrow’ approach focusing on special education and disability (Norwich, 2014). This narrow approach states that students with disabilities

shall be entitled to full membership in regular classes together with children from the same neighbourhood in local schools. This is in conflict with the broader ideology of inclusive education contained in the UNESCO's – Salamanca Statement in which the guiding principle that informs inclusivity is that schools should accommodate all children regardless of their physical, intellectual, social, emotional, linguistic, or other conditions (UNESCO 1994). This should include disabled and gifted children, street and working children, children from remote or nomadic populations, children from linguistic, ethnic, or cultural minorities and children from other disadvantaged or marginalised areas or groups (page 6). So, this study was premised on and in line with the Salamanca Statement's broad definition of inclusion which concerns all students and marginalised groups, and not only those with disabilities (Thomas, 2013).

The study argues that in South Africa the NSMSTE is a typical intervention where consideration is not given to corresponding needs of children with different kinds of high ability or gifted students but who had endured severe cultural deprivation and educational neglect. Therefore, gifted students in South Africa fit very well into what Vygotsky described as *child-primitives* because when schools do not actively identify giftedness among young children, then they underserve these students who consequently underachieve in relation to their full potential. So, the argument is that if gifted children are denied educational opportunities due to some perceived advantage, then it is the lack of education, and not their differences that limit their opportunities. Consistent with Vygotsky's notion of child-primitive the study further argues that gifted students' learning disability emanates from endured severe cultural deprivation and educational neglect in the current South African inclusive practices. Vygotsky criticised mainstreaming as a "negative model of special education" because of its combination of lowered expectations, a watered-down curriculum, and social isolation (isolation from students who think alike). Gifted children experience all these negatives in their current inclusive classrooms in this country. Vygotsky worked for several years to develop his vision for the future model of special education that can be called, using his own words, "integration based on positive differentiation" (Vygotsky, 1995, pp. 114, 167). He implored his readers to consider that the education of all children, regardless of the norms they follow, should contribute to the development of a socially accepted adult

capable of “social labour, not in degrading, philanthropic, invalid-oriented forms . . . but in forms which correspond to the true essence of labour” (p. 108-109). He believed that few children, much less those of evolutionary difference, reach their potential as most of them were stuck at the lowest end of their social potential. In contrast, he believed, schools of defectology needed to be spoken about as schools of exceptional learning whose goal it was to promote, with attention to developmental issues, integration of extra-normal children into the current social life, such that upon their graduation they exhibited the higher mental functions that enabled full participation in this full social stream, even if they navigated its waters with unconventional psychological tools. Although the language and ideology of deficit remains at large in spite of efforts to attend more respectfully to the issues of difference that were Vygotsky’s concern; Vik & Somby (2018) posit that the conception and rhetoric Vygotsky questioned in his works on Defectology are still relevant today in the discussions about inclusive education. Nowadays, to rely on Vygotskian foundations means to seek having an inclusive education that confronts every barrier “that limits or prevents the person’s social participation, as well as enjoyment, fruition, and exercise of their rights to accessibility, freedom of movement and expression, communication, access to information, understanding...” (Barroco 2018). This would also be consistent with the ideal values and principles of inclusivity that are contained in the Salamanca Statement. It is against this background that this study makes a contribution to a more comprehensive view to inclusive education.

Another contribution from a theoretical point of view, is that creativity and innovation are becoming increasingly important for the development of the 21st century knowledge society because they contribute to economic prosperity as well as to social and individual well-being. Creativity is seen as the source of innovation, and innovation in turn as the implementation of creativity. Creativity and gifted education are like fish and water because of a common view among researchers which is the recognition that creativity plays a central role in how giftedness is conceptualised. Feldman has even coined the term creative giftedness. From this view it is expected that the gifted will accomplish more in terms of creative outputs than the non-gifted because they are better able to apply sophisticated thought processes to what is essentially the same

substantive material (Tannenbaum, 1983). Leikin (2011) therefore proposed that mathematics education must pay more attention to research of different kinds of mathematical activities, with a clear focus on students' creative thinking and giftedness. Consistent with these views, the justification for this study is that it has potential to add to this research knowledge by investigating the extent to which the Dinaledi Schools enabled gifted learners to develop their creative potential.

From a practical point of view, at the time of initiating the NSMSTE, the department of education was clear [under Section 7 on research] that it would welcome research that tracks the success of interventions implemented as a result of this Strategy (DoE, 2001). This research does exactly that as it has identified teachers as one of the stumbling blocks inhibiting the successful implementation of the strategy. In the literature search there seems to be not a single report in the two decades since 2001 which suggests that the Dinaledi Schools project should be terminated. Instead, there is ample evidence from many reports that if the Dinaledi Project could be restructured it could be a case in point which could lead to the more wide-spread acceptance of specialist schools. But it is over two decades after the introduction of the project now, yet it has not achieved positive gains in the top-end performance for which it was intended. Hence it can also be argued that if the idea of the dedicated schools for STEM needs to be expanded as per the NPC recommendation, with shortcomings in the dedicated schools' strategy being a principal concern (DBE 2018), then surely there is need to identify these shortcomings before further expansion.

Another justification of the study can be couched in the form of a question: Why the specific focus on giftedness in mathematical sciences? In a similar way that society has been trying to figure out which skills matter in the 21st century KBE, researchers have also posed questions for education about which subject(s) matter in the development of skills needed in the fourth industrial revolution (4IR). There is a general consensus in the literature that connects innovations to the cluster of subjects related to science, technology, engineering, and mathematics education (STEM) (Lubinski & Benbow, 2021). Empirical evidence has actually shown that the positive impact on a country's Gross Domestic Product (GDP) can be isolated mainly to STEM-related achievements

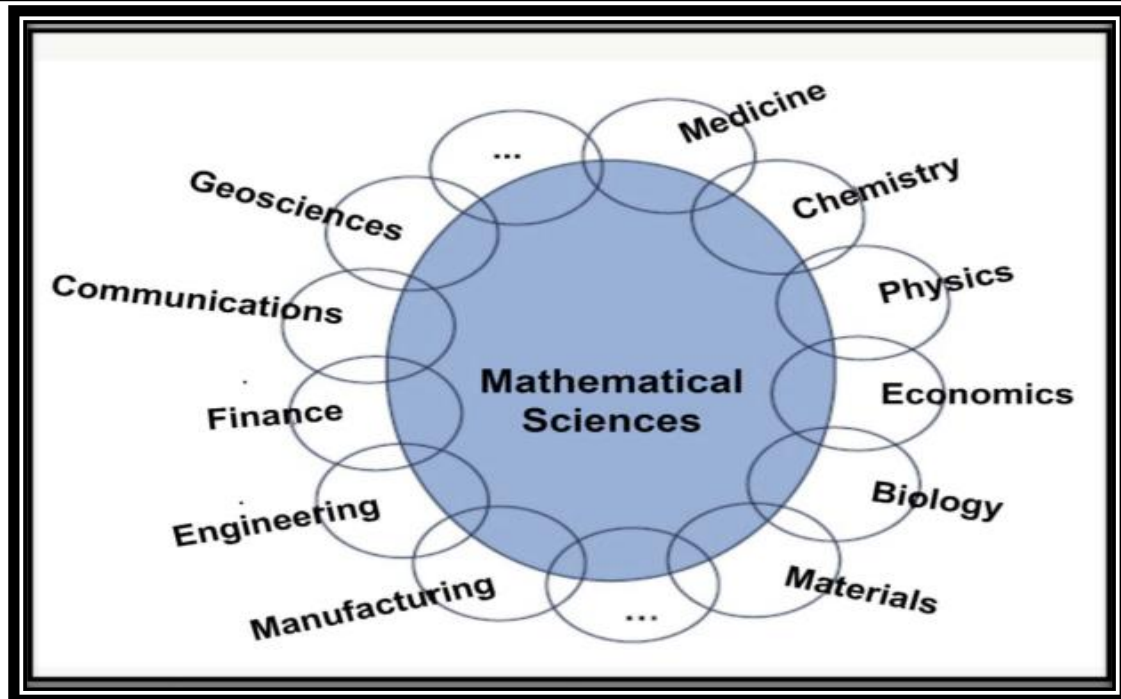
as opposed to achievements outside the STEM fields, suggesting that STEM-related achievements are the main drivers of national affluence in terms of creativity and innovation (Tanenbaum, 2016). Similarly, in their more recent paper entitled “Intellectual Precocity: What Have We Learned Since Terman?” Lubinski & Benbow (2021) have synthesized numerous studies done over the past 50 years, which have reached some consensus that individuals who pursue STEM disciplines possess a different intellectual design space for problem solving and creative thought. Over a host of personal attributes, STEM graduates exhibited psychological profiles typical of outstanding engineers and physical scientists. In South Africa this view is also shared by the Department of Basic Education who state in the Action Plan to 2014, that poor performance in STEM has caused a shortage of people who are able to study for professions such as medicine, financial management and engineering. This also limits South Africa’s capacity to come up with new technological innovations that can improve the global competitiveness of the country (DBE, 2011).

Admittedly STEM graduates matter in terms of the skills needed in the 21st century knowledge-based economy but do all STEM graduates make an equal contribution to economic development, one might ask. Deeper analyses of STEM skills and their relevance in the 21st century knowledge-based economy have shown that the truly extra ordinary advances in STEM have not been the work of typical or average individuals in the STEM workforce. Rather, talented, and committed individuals within STEM (such as Bill Gates, Mark Zuckerberg, Michael Dell just to name a few) have produced such advances (McCabe et al., 2020). Earlier Tanenbaum (2016) had argued that gifted children are the tiny minority we suspect may someday produce important new theories, inventions discoveries, artistic masterpieces and solutions to monumental’ problems in order to enhance the human condition. These findings again have had some influence on STEM reforms with more emphasis being placed on top-end performance rather than general performance in the fields.

Still further refinements in these studies have been made in attempting to identify some important attributes of the STEM experts. For example, Super and Bachrach’s committee report as cited in Lubinski (2016) concluded that, in addition to superior

levels of general intelligence, promising engineers and physical scientists tend to be highly adept in mathematical and spatial reasoning ability. Earlier, Lubinski et al. (2014) had found out that early manifestations of exceptional mathematical talent did lead to outstanding creative accomplishment and professional leadership in science related endeavors. Conclusions have been unanimous that all STEM disciplines require an understanding of mathematics suggesting that “Mathematics is the bedrock of science while science is the necessity for technological and industrial development” (Betiku, 1999:49). Given this bedrock status, mathematics has been described as the subject that drives the KBE hence it should be an important part of any efforts at modern-day technological innovation and development. Even the DBE admits that it is widely recognised that, if schools fail to provide a good education in these two areas [language and mathematics], then the overall education of the child is compromised. As evidence of the important role played by mathematics; six of the 13 output goals set in the action plans of the NSMSTE make specific reference to this subject area, while five are focusing on general access and retention with only one focusing on science. The department of education was not apologetic about this focus as it eloquently argued that mathematics connects all the other science subjects and that improved mathematics results were almost a true reflection of improved language skills, which in turn influence results in all other subjects (DBE, 2015). The focus on mathematics, especially in South Africa, is also important given that a very large majority of the scarce skills in South Africa require mathematics. All these studies confirm an important characteristic of mathematics namely that mathematics operates at the interface of multiple disciplines of Science, Technology, Engineering and Mathematics (STEM) subjects, hence the National Science Foundation suggested the inclusive term of Mathematical Sciences (**see Figure 1.5**).

Figure 1.5. The mathematical sciences and their interfaces. (Source: National Research Council, 2013).



These studies suggest that, while STEM giftedness in general should be valued, the need for talent development of mathematically gifted students is even more pressing in the 21st century economy. In South Africa the National Strategy for Mathematics and Science (DoE, 2001) accentuates the role of mathematics arguing that the ability of all learners to succeed in today's technically orientated work environment is increasingly dependent on their understanding of mathematical and computational sciences and their application in practical situations. In fact, these sciences have become essential for all learners, including those preparing to become technicians, engineers, educators, leaders in business and government, and more generally, for developing scientifically, mathematically and technologically literate citizens. Despite this consensus according to the UNESCO (2012) report, in many countries government and other stakeholders are still some ways from aligning their efforts with such findings, resulting in wastage of resources and a proliferation of initiatives that are too small to have meaningful impact.

This study is also in line with national priorities as stated in the latest version of the five-year strategic plans. The DBE (2014) admits that a shortage of Grade 12 graduates,

with a mathematics pass, is a major obstacle in the way of solving shortfalls in a number of professions in areas such as medicine, financial analysis and engineering. Moreover, a critical mass of youths with exceptional results in mathematics is a prerequisite for the innovation needed to sustain niche industries that can improve the global competitiveness of the country. The schooling system is clearly failing the country, both with respect to the number of mathematics passes and the number of learners who excel. The Action Plan 2019-2024 reflects six priorities identified by the Council of Education Ministers (CEM) early in 2020. One of the priorities is the immediate implementation of a curriculum with skills and competencies for a changing world, with the emphasis being on the Three Stream Model, entrepreneurship education, focus schools, coding and robotics, and the implications of the Fourth Industrial Revolution. In that document DBE (2020) the minister of basic education cautioned that where success has been limited, it is important that we understand why, and take remedial action. This study argues that the national strategy for mathematical sciences has not been successful because there were no competent teachers for those subject areas hence it aims to take remedial action by developing a teacher training program for teachers for the gifted students in mathematical sciences.

This study is also important in terms of poverty alleviation especially in the public schools of South Africa where most gifted learners from poor backgrounds attend school. Section 1 of the Action Plan to 2024 locates South Africa's mathematics educational challenges within a historical context and explains the role of education in overcoming the legacy of colonialism, inequality and poverty. According to the DBE (2020), it is also noteworthy how the provinces with the greatest burdens of poverty, and the worst learning outcomes among learners, are precisely those provinces whose teachers experience the largest subject knowledge gaps (DBE, 2020). This underscores the need for a more equitable distribution of teaching skills. Critics argue that low-quality mathematics education (especially for the poor) becomes a poverty trap from which it is almost impossible to escape. In South Africa, studies have shown that a vast gap persists between the quality of mathematics education provided for and the achievement of White and African students (Maree, 2018). What this means is that schools and the schooling system must continuously make a conscious effort to heal

the divisions of the past, foster a sense of South African nationhood and, above all, provide education opportunities that will break down the deep inequalities that still pervade South African society. Hence in the Action Plan to 2019, the Department of Basic Education (DBE, 2015) says, all efforts to strengthen mathematics must pay special attention to overcoming the devastating legacy of apartheid which, despite improvements over the years, is still evident in facts such as that only 46% of learners with mathematics distinctions in the 2013 Grade 12 examinations were black African, though 83% of all examination candidates were from this population group. Post-colonial reform in education aimed at reversing such evils of Bantu Education - an education 'for ignorance' where blacks would be taught to develop "manipulation skills" and to have an interest in the soil. An inquiry into how far post-colonial education has closed the poverty gap between blacks and whites, of necessity must therefore begin with an examination of mathematics education - given that the philosophy and ideology of apartheid deemed it absurd to teach a 'Bantu' child mathematics. Admittedly such statements evoke strong emotions but the stark realities of mathematics education in South Africa today require our stakeholders to take the bull by its horns. Has the country really reversed that absurdity? Even if government argues that the system has increased accessibility to mathematics education, can the country really be proud that its African graduates will compete favorably in the 4IR? There is need to constantly take stock of the country's political history versus its post-colonial vision lest the system 'covertly perpetuates' the very same philosophy and ideology of 'absurdity' in teaching mathematics to poor black South Africans. Heuser, Wang, & Shahid (2017) for example pointed to the important role that policies can play in the translation of a vision into practice, sometimes with unintended or inverse consequences. They argue that poorly aligned requirements of certain policies, created out of concern for social equity, might actually create practical limitations to the provision of more inclusive programs for gifted learners from poor backgrounds resulting in another unintended 'covert exclusion'. They further argue that an important principle is that whatever government does in education, it should remain pragmatic, not doctrinaire, in its approach. It should, as the Chinese would say, seek truth from facts. Where the evidence shows that government is not achieving what it set out to gain, it changes methods. Where the aims are no longer relevant to circumstances, it revises the aims.

In a 2019 synthesis report on the National Higher Education Conference, the Dean of Students affairs [Wits], Jerome September is quoted as saying "... enhanced access and success for disadvantaged and excluded communities equalize the life chances of talented individuals, irrespective of their social origin or financial capacity". Yet in South Africa reports show that the plight of the gifted learner is seldom mentioned (Kokot, 2011) and that far too many of the gifted from poor backgrounds currently do not stand even the remotest chance of achieving up to near their potential (Maree, 2018). In post-apartheid South Africa education, stakeholders have been hostile to and resentful of gifted education programs which are critical for academic talent development (Kokot, 2011). With a study such as this one, it is possible to reverse such hostility and present gifted education as another form of special education consistent with a broader and not narrow view to inclusive education.

Another justification for this study is that teachers normally have negative attitudes about gifted children before receiving training. A study by Geake and Gross (2008) shows that a teacher's unconscious negative attitude can be reduced through professional development courses in which teachers become more familiar with the characteristics of gifted students and their learning needs. If teachers develop positive attitudes towards giftedness, they are more likely to be supportive of gifted education, and to be effective in identifying and catering for gifted students. Research shows that teachers, trainers, and education specialists execute programs of gifted education in accordance with their own level of training, and their perceptions and dispositions can serve as important catalysts or barriers (Heuser, Wang, & Shahid 2017). In many developing countries, there are hostile and negative stereotypes that shape teachers' attitudes and expectations regarding gifted students – attitudes and expectations that become barriers to the process of learning and belie the egalitarian ideals that form the philosophical foundation of many schools. Therefore, if the negative attitude of teachers about gifted students is not changed through training, they are likely to retain this attitude in their professional practice.

1.7. Research methodology

To answer the research questions and address the objectives of the study, the researcher used a qualitative approach as the main methodology and a quantitative approach to validate the gathered data as well as to improve the quality of the study.

In the initial stage this study commenced by reviewing the literature of gifted education from the best countries in order to answer the first research question: What is common among the established universities in terms of gifted education? This was followed by the interviews of the participants that work with gifted learners to answer the second research question: What can be learned from the trained teachers for gifted learners?

In the second stage a questionnaire was used as the other source to satisfy the requirements for this study. This questionnaire was distributed to the teachers of mathematics in high schools in order to explore their opinions as well as their needs that should be included in the course for teachers for the gifted children.

Many researchers in the area of research methodology believe that the questions raised by the researcher in questionnaires and interviews need to undergo a pilot study to clarify the wording and to develop and these questions (Collis & Hussey, 2013; Sekaran & Bougie, 2016; Yin, 2017). Accordingly, the researcher conducted two pilot studies with teachers. The first pilot study for the face-to-face interviews was conducted with two program developers. The second piloting for the questionnaire was with six high school mathematics teachers. The responses from the two pilot studies were used in reworking the interviews and questionnaire questions. The data collected using both the qualitative and the quantitative approaches were analysed according to the appropriate method which will be discussed in section 3 of this study.

1.8. Limitations of the Study

The main limitation of this study is the methodology that will cover a limited sample of schools and teachers. However, the outcomes will provide insights into general principles

of practicable and relevant practices of TTPs of high school mathematics teachers, given that all mathematics teachers in high schools follow the same national program. Coupled with that problem, there will be time constraints throughout the duration of the study. The researcher as an educator will often have to work under pressure to complete teaching work that fell behind in the period of the National Lockdown due to Covid 19 while also having to work on this major project of developing TTPs.

1.9. Definitions of key terms

1.9.1. Gifted and Talented

Given the focus of this study on gifted education there is need to start off with the definition of the terms gifted and talented given that common usage of the terms, even by professionals, is ambiguous and sometimes the terms are used interchangeably. For example, an individual is referred to as a 'gifted mathematician and talented mathematician. Some authors see giftedness and talent on a continuum where giftedness is at the top end (Davis, Rimm and Siege, 2013). Some avoid using the term gifted and prefer the term 'more able'. Certainly, there is a need to analyse prevailing concepts and definitions in order to clarify these two terms.

Admittedly various terminology has been used in reference to children with high potentials, talents or natural endowments but in this study uses the terms giftedness and talent strictly in accordance with Gagné's (2004:120) definition who says: *Giftedness* designates the possession and use of untrained and spontaneously expressed natural abilities (called outstanding aptitudes or gifts), in at least one ability domain, to a degree that places an individual at least among the top 10 per cent of age peers. Whereas: *Talent* designates the outstanding mastery of systematically developed abilities (or skills) and knowledge in at least one field of human activity to a degree that places an individual at least among the top 10 per cent of age peers who are or have been active in that field or fields. Gagné's delineation between gifts and talents is a particular case of the general distinction between aptitude (or potential) and achievement resulting from a well-structured developmental process. In accordance with

the recommendations from Renzulli (2012) and Gagné (2015), a gifted learner refers to the 1:10 learners who attend everyday regular class and demonstrate relatively high ability in a specific domain such as mathematics.

1.9.2. Teachers

In the South African context, the terms educator and teacher are used interchangeably. According to the Employment of Educators Act no.76 of 1998, a teacher is any person who educates, provides training or renders educational services including professional therapy or educational psychological support at any public institution or academic centre.

1.9.3. Teacher Professional Learning Programs

According to the South African National Department of Education, professional development/learning involves all the activities undertaken individually or collectively by educators during their career to improve their professional understanding, knowledge, capability as well as management. Professional learning is meant to enhance mastery of the subject and educational program, ability in teaching and promoting learning, understanding of learners as well as their educational needs. It is targeted at improving educators' dedication in the best interests of their learners, the teaching profession and the well-being of their communities (DoE, 2006). Professional development/learning is an intensive and comprehensive strategy to enhance educators' performance in raising performance of learners (Hirsh, 2009).

1.10. Structure of the study

This study consists of six chapters organised in the following format:

Chapter 1 – Introduction

Chapter 1 introduced the reader to the background of gifted education in South Africa. The chapter then provided the research problem, objectives of the study, research questions, rationale of conducting the study, methodology and definitions of key terms.

Chapter 2 – Theoretical Underpinnings

In this chapter, the researcher framed the study using Gagné's Differentiated Model for Gifts and Talent – a model related to giftedness and learning in gifted education programs.

Chapter 3 – Literature Review

The literature review paid attention to the identification of gifted learners and at different programs aimed at supporting such learners. The chapter concluded with an overview of teacher training of gifted learners globally, with specific reference to United States of America, Singapore, Australia and South Africa.

Chapter 4 – Methodology

The study aimed at developing a Teacher Training Program for teachers of mathematically gifted learners in South Africa. The study methods used in this study were dealt in this chapter. The researcher justified why the Mixed Methods Research (MMR) was chosen for this study. The chapter also elaborated some important points such as research design, material development in educational research, model development, type of data, data analysis technique, validity and research procedures.

Chapter 5 – Results

The results from quantitative data and qualitative data were analysed in chapter 5.

Chapter 6 – Discussion

Chapter 6 provides a discussion of the findings as analysed in terms of literature review in chapter three.

Chapter 7 – Conclusion

The chapter concludes the study using key findings from chapter 6.

Chapter 8 – Recommendations

Chapter 8 provides recommendations based on the findings from the study.

CHAPTER 2: THEORETICAL UNDERPINNINGS

2.1. Introduction

I enter this chapter with a quote:

He who loves practice without theory is like the sailor who boards a ship without a rudder and compass, and never knows where he may land [Leonardo da Vinci].

Following this advice, there was need to start by providing a rudder and compass i.e., a theoretical underpinning of the study. I start with a brief discussion on forms of theoretical ‘underpinnings’ a collective term used in research to describe the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs one’s research. The decision to begin this chapter with that discussion was not made whimsically but consideration was given to the two most dominant perspectives regarding where a theoretical underpinning should be placed in the doctoral thesis. For example, a study based on grounded theory is likely to begin with a question, or even just with the collection of qualitative data then develop a theory afterwards. While researchers acknowledge that some doctoral candidates are capable of crafting their own blueprint for a new theory to be developed a posteriori as a result of their research endeavors, Kivunja (2018) warned that trying to unpack either a grounded theory or a conceptual framework at the doctoral level could be quite ‘messy’ and therefore should be avoided. On the other hand, the more traditional scientific methods are premised on the view shared by many researchers that the theoretical underpinnings for a study must be identified at the inception of any dissertation work because it has implications for every decision made in the research process. Theory frames what and how one chooses to look at something, and according to Renzulli (2012) if we are not guided by a unified theory when choosing options, we are likely to fall for anything. Theory is therefore the rudder and compass that should guide us toward practices that avoid randomness in the goals we pursue. Absence of theory in educational practice usually results in services comprising piecemeal, fragmented, and loosely related activities rather than integrated theory-driven programs characterised by internal consistency from goal setting to services and evaluation. Similarly, Grant and Osanloo (2014) opine

that the importance of theory-driven thinking and acting is emphasized in relation to the selection of a topic, the development of research questions, the conceptualization of the literature review, the design approach, and the analysis plan for the dissertation study. That the theoretical underpinning is one of the most important aspects in the research process, is confirmed by the United Kingdom (UK) Quality Assurance Agency (2014, p.30) who states that a student for a doctoral degree should demonstrate “the creation and interpretation of new knowledge, through original research or other advanced scholarship... *at the forefront* of an academic discipline or area of professional practice”. Anderson, Day & McLaughlin, (2006) capture the necessity of including a sound theoretical underpinning at the inception of a dissertation study with a quote from a dissertation supervisor who stated, “I don’t see how you can do a good piece of work that’s atheoretical” (p. 154). From a similar view, Sarter (2005) lamented the limited usefulness of findings and conclusions when a study is not justified by some a-priori theoretical underpinning. Given this background, evidence across disciplines is clear that the explicit identification and inclusion of such a theoretical underpinning at the inception of the study, is a necessity of sound research.

So, what are these theoretical underpinnings one might ask? Underpinnings indicate how research ideas can be formulated through conceptions that may be subjective or believed or even imaged or imaginary (Passey, 2020). Although these imaged ideas can take a number of different forms, Passey (2020) suggests that the term underpinnings collectively include models, conceptual/theoretical frameworks and theories for research. The distinction between different forms of underpinnings is fundamentally important, as Grant & Osanloo (2014) opine that if differences between models, conceptual frameworks, theoretical frameworks or theories are considered (a) it can determine the applicability of any choice of underpinning to a specific study and (b) such distinctions might provide quite a different conceptual or theoretical basis for a study. Given that the term underpinnings collectively include models, conceptual frameworks, theoretical frameworks and theories for research, many researchers advise that we would not use these terms interchangeably and the majority also advise against the use of multiple underpinnings (Fried, 2020; Passey, 2020). With this in mind, researchers are usually advised to adopt one of the terms and then stick to that term

throughout their work. Despite this expectation being foundational in the research process, Passey (2020) cites various studies which show how the definition, selection and formulation of a theoretical underpinning, that is appropriate and that can inform a study throughout its various phases and stages is often considered a ‘doctoral or research challenge’ in itself. Similarly, one of the things that Kivunja (2018) found problematic for many postgraduate students is the inability to articulate differences between a theory, a model, a theoretical framework and a conceptual framework for a proposed research project. Given this background, I now discuss each of these terms and my aim here is specific, I need to take a clearly justifiable position regarding the choice of an appropriate underpinning for this study. Although each of these underpinnings can be viewed as a stand-alone idea, there is a thread that runs through all of them. In an attempt to show how they are linked; my approach follows the pairing method used by Passey (2020) as well as Kivunja (2018) which I found more appealing. These authors show the connections not only by comparing but also by contrasting pairs of underpinnings which are often confusing to postgraduate students as well as novice researchers.

2.2. Theoretical/Conceptual Framework

Although theoretical and conceptual frameworks are alluded to by many methodologists, they are either ignored or misunderstood by postgraduate students and novice researchers because they are usually described without a full explanation or clarity of the two constructs as well as their role in research. Numerous studies have shown how (a) many postgraduate students as well as novice researchers are confused by the two terms conceptual framework and theoretical framework (b) this confusion consequently results in the terms being applied wrongly in the research papers (Grant & Osanloo, 2014; Passey, 2020; Fried, 2020). Though these frameworks work hand in hand, they have characteristics that make them different from each other and

Figure 2.1 might help us see the similarities and differences.

Figure 2.1: Theoretical Framework vs Conceptual Framework

[Source: Kivunja, 2018]

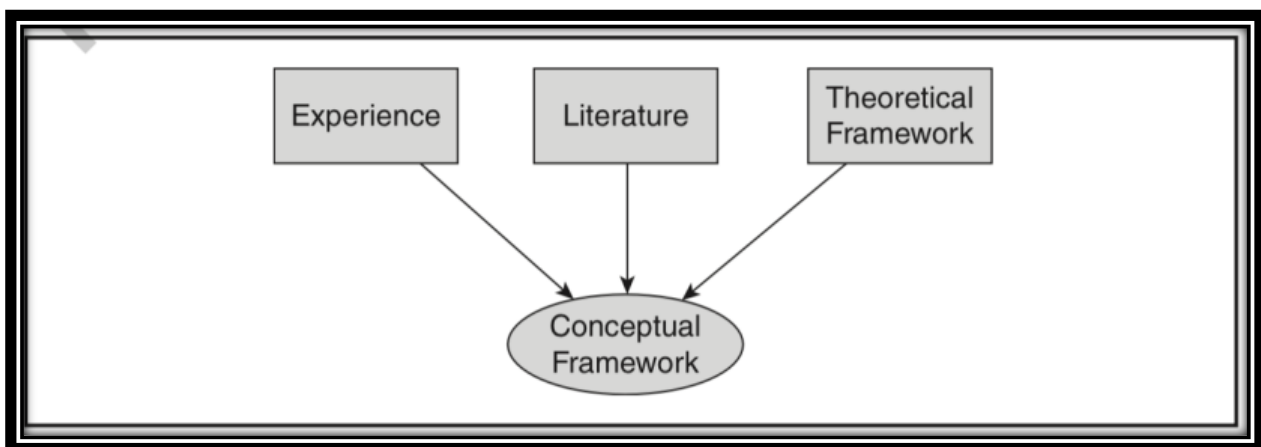
Theoretical Framework	Conceptual Framework
It provides a general or broader set of ideas within which a study belongs.	It refers to specific or narrower ideas a researcher utilizes in his/her study.
It is based on existing theory/theories in the literature which has been tested and validated by other scholars.	It is based on the concepts which are the main variables in a study.
It is in the form of a model that pivots a study, with its exponents and the results of their studies.	It is a researcher's own constructed model that s/he uses to explain the relationship that exists between the main variables in his/her study. It can also be an adaptation of a model in an existing theory which a researcher adapts to suit his/her research purpose.
It is well developed, designed and accepted.	Its design is not accepted, but it's a proposal of the researcher's answer to the research problem s/he has defined.
It offers a focal point for approaching the unknown research in a specific field of inquiry.	It is the framework that shows logically how the research inquiry is to be undertaken.
It consists of theories that seem interrelated with their propositions deduced.	It consists of concepts interconnected to explain the relationships between them and how the researcher asserts to answer the research problem defined
It is used to test theories, to predict and control the situations within the context of a research inquiry.	It is aimed at encouraging the development of a theory that would be useful to practitioners in the field.

It should be clear from **Figure 2.1** that the theoretical framework for a research proposal or thesis is not a summary of one's own thoughts about their research. Rather, it is a synthesis of the thoughts of giants in one's field of research, as they relate to one's proposed research or thesis, as one understands those theories, and how one will use those theories to understand their data. In essence, the theoretical framework comprises what leaders in the field of research say about one's research question,

about the problem one plans to investigate, and might even include suggestions of how to solve that problem, including how to interpret the findings in one's data. What those leaders say, helps the researcher to develop an informed, and specialised lens, through which they can examine their data, conduct the data analysis, interpret the findings, discuss them, and even make recommendations, and conclusions.

On the other hand, Akintoye (2015) opines that the conceptual framework is mostly used by researchers when existing theoretical frameworks are not applicable or are not sufficient in creating a firm structure for the study. A conceptual framework is therefore a structure which the researcher believes can best explain the natural progression of the phenomenon to be studied (Camp, 2001). It is the researcher's explanation of how the research problem would be explored. The framework makes it easier for the researcher to specify and define the concepts within the problem of the study (Luse, Mennecke & Townsend, 2012). In **Figure 2.2** we can see how Crawford (2020) summarized the sources of a conceptual framework

Figure 2.2 Sources of a Conceptual Framework [Source: Crawford, 2020]



From these two figures we can conclude that; whereas the theoretical framework comprises other people's theoretical perspectives that one interprets as relevant to their research, and in particular, helpful in one's data analysis and interpretation; the conceptual framework could be the product of the researcher's own thinking about their research study. Due to the fact that it builds on experience as well as literature and other theories, a conceptual framework is thus the umbrella term relating to all the concepts

and ideas that occupy the researcher's mind as they contemplate, plan, implement and conclude their research project. For that reason, the term conceptual framework is so all-inclusive, that trying to unpack it in a doctoral research proposal could be messy (Kivunja, 2018). It is too diverse, too big a task for a doctoral candidate to explain in a research proposal or a thesis hence at postgraduate level the advice by Kivunja (2018) is that there is no need to explain a conceptual framework. He opines that postgraduate students should avoid using this conceptual framework suggesting instead, that they need to select and explain a theoretical framework for their thesis.

While Kivunja (2018) makes that recommendation, I was mindful of the fact that my research on gifted education borrows concepts such as intelligence, gifts and talents from the field of psychology. Fried (2020) would argue that the imprecise nature of such constructs especially in psychology act as obstacles to theory formation – suggesting that the solution to the issue of deciding on an existing theoretical framework might not be that straightforward in certain fields. So, what does Fried (2020) suggest we do when dealing with such imprecise constructs?

2.3. A theory vs a model

Authors who show the complete genealogy of the different theoretical underpinnings, enter their discussions by showing how theory is foundational to the building of theoretical frameworks. Eisenhart, for example, defined a theoretical framework as “a structure that guides research by relying on a formal theory...constructed by using an established, coherent explanation of certain phenomena and relationships” (1991, p. 205). Thus, the theoretical framework consists of the selected theory (or theories) that undergirds one's thinking with regards to how one understands and plans to research one's topic, as well as the concepts and definitions from that theory that are relevant to the topic. The general picture from these definitions is that theoretical frameworks are built on existing theories which are established, and which aim to explain robust phenomenon. One might then ask if there is a relationship between theory and model to complete the lineage connecting these four underpinnings.

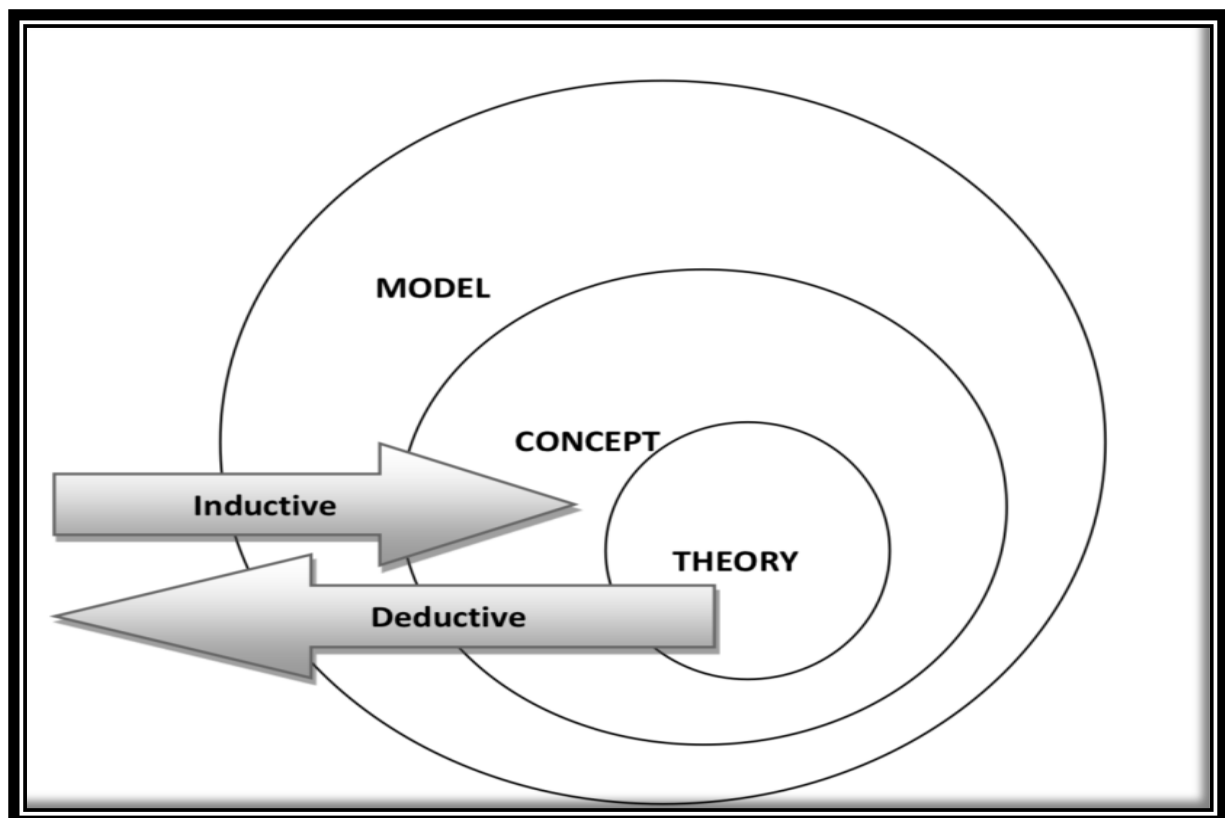
In the paper entitled: Theories and Models: What they are, what they are for, and what they are about, Fried (2020) eloquently articulates the relationships between theories and models with the main aim of exposing specific obstacles to theory formation which psychological scientists face and how models serve as intermediaries between theories and the real world. He guides his discussion through a number of questions the first of which is: What are theories? In response, a systematic review of pertinent literature provides an understanding that a theory is a generalised statement of abstractions or ideas that asserts, explains or predicts relationships or connections between or among phenomena, within the limits of critical bounding assumptions that the theory explicitly makes (Gabriel, 2008). The generalised statement brings together ideas, interrelated concepts, definitions, and propositions that explain or predict events or situations by specifying relations among variables (Glanz, 2008). The ideas, concepts and themes, constitute a deep and broad base of knowledge in the discipline – which constitutes the theory. These ideas, concepts, and themes together comprise the theory, which enables us to explain the meaning, nature, relationships, and challenges asserted, or predicted to be associated with a phenomenon in an educational or social sciences context, so that an application of those attributes of the theory, enables us to understand the phenomenon and to act more appropriately (Asher, 1984), including ability to predict. In line with this understanding, Kerlinger and Lee (2000, p. 11) define and explain the meaning of a theory very well, as follows:

A theory is a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena. This definition says three things: (1) a theory is a set of propositions consisting of defined and interrelated constructs, (2) a theory sets out the interrelations among a set of variables (constructs), and in so doing, presents a systematic view of the phenomena described by the variables, and (3) a theory explains phenomena; it does so by specifying which variables are related to which variables and how they.

Models on the other hand are instantiations of theories, narrower in scope and often more concrete in nature, which is commonly applied to a particular aspect of a given

theory thereby providing a more local description or understanding of a phenomenon (Fried, 2020). From this statement it can be argued that models play a role in making theory more visible and concrete. From another perspective, models can be a valuable starting point for theory formation hence some researchers describe models as intermediate between theory and data (Fried, 2020). Ngulube et al., (2015) capture both the inductive as well as deductive relationship between models and theory in a continuum as shown in **Figure 2.3**

Figure 2.3 Model-theory continuum [Source: Ngulube et al., 2015]



The arrows in **Figure 2.3** pointing in opposite directions show that a model does both i.e. (a) it describes a phenomenon and (b) it embodies a theory. Hence the relationship between these notions is iterative and cyclical, rather than linear (Ngulube, et al., 2015). From an inductive perspective, models derive from experiencing the world, a concept derives from a given model and a theory is “a set of concepts used to define and/or explain some phenomenon” (Silverman, 2000:77). From deductive perspective theories are tested through propositions or hypotheses using a methodology that fits with the

model or theory. Celine (2011) captures the inductive/deductive relationship by arguing that the building blocks of theory are models, concepts, constructs and propositions, suggesting that models may lead to the formulation of theories, which in turn lead to the construction of another model for the verification of a theory. Puttergill (2000:19) posits that theories are constituted through concepts, and certain aspects of a theory may therefore be used as a conceptual framework. Consequently, researchers will be operating in the second circle when they use aspects of a theory, rather than the whole theory but when you use the whole theory, one is more on the level of a theoretical framework than a conceptual framework (Ngulube et al., 2015). Therefore, models can be viewed as the main route for researchers to conceptual frameworks, while theories lead to theoretical frameworks. It is noteworthy that the system is flexible, hence researchers can still operate at a lower level using models. Figure 4 then summarises the four underpinnings.

Figure 2.4 Examples of theoretical underpinnings summarized [Source: Passey, 2020]

Form of underpinning	Description	Examples
Model	holds for a given case or stated population, identifies major features of influence, arising from context-specific research	Technology Acceptance Model (TAM) (Davis, 1989) Diffusion of Innovation (Rogers, 2003) Pathways to Implementing Change (Corbett & Rossman, 1989)
Conceptual framework	tends to be more flexible and descriptive, as it usually identifies factors or criteria that relate to each of the features of influence in a particular field	Technological, Pedagogical and Content knowledge (TPACK) (Mishra & Koehler, 2006) Discovery Learning (Bruner, 1961) Experiential Learning (Kolb, 1984)
Theoretical framework	arises from outcomes beyond a single study, based on one or more theories	Social Creative Constructivism (Passey, Dagien, Atieno & Baumann, 2019) Human Motivation (Maslow, 1943)
Theory	considers a broader and deeper concern or context, suggesting the detail of what might be more general, beyond one or a number of contexts	Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003) Social Constructivism (Vygotsky, 1978) Constructionism (Papert, 1986) Behaviourism (Skinner, 1953)

2.4. Special consideration for a model

While Fried (2020) captured this basic inductive/deductive relationship between models and theory, the aim of his comprehensive article was not so much about showing the genealogy of these underpinnings; rather it was to argue that the discipline of psychology faces particular challenges with the question of what theories are about and how at times they fail to bring concrete meaning in psychological research. He supports this argument with the well-known quote that - “theories look great on paper until reality scribbles all over the page.” While a number of these weaknesses are exemplified, the two core challenges cited by Fried (2020) are construct definition and measurement. His concern was that many psychological constructs we study are subjective to some degree, complicating their measurement.

For example, this current study was all about gifted education where in general usage, no definite distinction is made between the ideas of giftedness and talent. Even the scientific literature on giftedness, supports this ambiguity by randomly using one or the other term in the same paragraph, thus suggesting that they are synonyms. Yet after more than a half-century of research on giftedness, the concept remains subject to various and sometimes divergent definitions. This is a disturbing situation in that the accepted definition determines both the procedures used to identify the gifted and the content of enrichment programs offered to those identified (Passow, 1981). Fried’s (2020) concern follows from such ambiguity in terminology and warns us that when the majority of studies in a field define, operationalize, and measure a construct differently, but it is assumed everyone is talking about the same thing, this poses a serious threat to scientific progress. Formal models for such psychological constructs may help with this measurement problem because they clearly describe both the theory’s structures and the target system it represents (Robinaugh et al., 2019). This suggests we can learn most about our target systems when either our theories or models represent them well with some level of abstraction. Another weakness of theory that was cited alludes to the chicken and egg dichotomy between theory and testing it as evidence of its plausibility. Fried (2020) opines that many theories in psychology are explananda and not explanantia and that themselves require explaining. Hempel & Oppenheim (1948) in their deductive-nomological model of scientific explanation, motivated for the

distinction between explanandum and explanans in order to answer why-questions, rather than simply what-questions. An *explanandum* (a Latin term) is a sentence describing a phenomenon that is to be explained, and the *explanans* are the sentences adduced as explanations of that phenomenon. For example, one person may pose an *explanandum* by asking "Why do people look intoxicated?", and another may provide an *explanans* by responding "Because they were drinking alcohol". In this example, "intoxicated" is the *explanandum*, and "alcohol" is the *explanans*. In terms of theory, the argument Fried (2020) is raising is that theories are supposed to provide us with an explanation of a phenomenon. Hence the reason to think that theories are plausible or true is that assuming them gives us explanations that we would not otherwise have and does not deprive us of explanations that we already have or raise explanatory puzzles that would not otherwise arise (Morris, 2011). In other words, theories more generally should be endorsed, at least in part, on the grounds that they provided better explanations than would otherwise be available. In contrast to theories, models illustrate with precision the processes that lead to a phenomenon by decomposing those processes into relevant parts, relations between the parts, together with some temporary dynamics of their change. Hence Fried (2020) argued vehemently that different models may be more useful in certain contexts. He reminds us that the idea that we can build a theory on theory-neutral facts has been philosophically discredited long ago hence we first need good candidate theories to guide us and to determine which testing tools would be relevant at all for assessing, updating, revising and refining theory. Another way to link the two theory and model, is that a model is often used to describe an application of a theory for a particular case. So, when we understand models as intermediaries between theories and the real world, the idea that all models are wrong because they are incomplete is a feature, not a bug. Hence a model's inability to perfectly reflect reality does not stand in the way of providing actionable insights as shown by for example, Newton's theory of gravitation. The decision to settle for a model as the theoretical underpinning in this study is justifiable against the articulated advantages. So, what model did the study adopt and why?

2.5. The Integrated Model of Talent Development [IMTD]

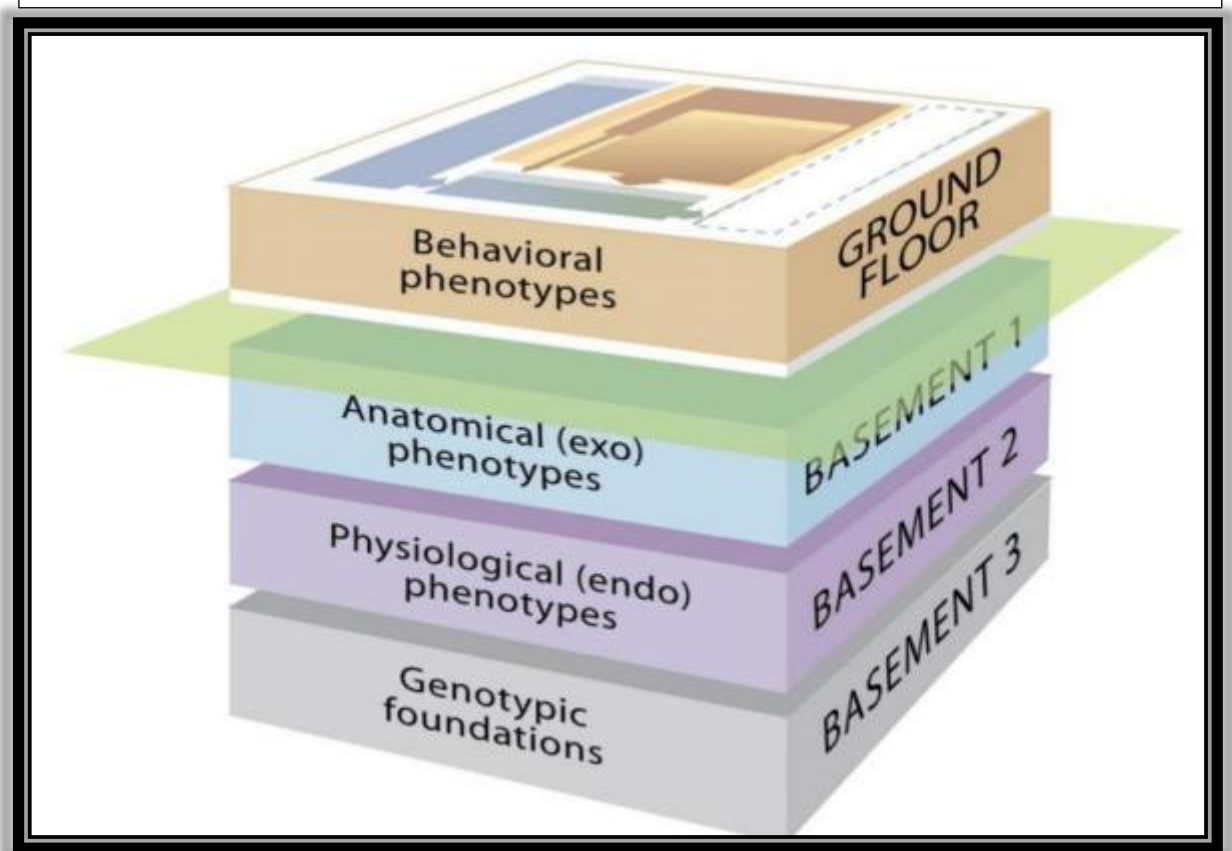
While there are several influential models in the field of gifted education, Gagné's (1985) 'Lucy the Ancestral' model on talent development, has progressively developed into what is currently ranked among the top six that have been considered dominant in the field. Although in 1985 Gagné had absolutely no inkling of what the newborn model would be almost four decades later, he recounts how his initial thoughts drew mixed feelings from peer reviewers of the journal *Gifted Child Quarterly* [GCQ] and how he thought his work was never going to be published therein. Convinced that the manuscript with the model would never be accepted, he put it aside but later received encouragement from the editor who, when the manuscript got published, had this introduction in the journal:

The lead piece by François Gagné offers the best discussion of giftedness and talent presented in the last decade. It is critical of some current conceptions offered by other theoreticians but offers an excellent model to guide our thinking about the distinction between these two constructs (Gagné, 2021:8).

Later on the model progressively acquired international recognition, evidenced by (a) a growing number of citations across different disciplines (b) a growing role as the conceptual framework of choice by many researchers and PhD students (c) a growing number of international invitations to be guest speaker (d) invitation to contribute chapters in most handbooks in the field (e) the National Association for Gifted Children [NAGC] recognizes Gagné's Differentiated Model of Giftedness and Talent as one of the most prominent theoretical conceptions of giftedness (f) two awards from the Mensa Society (g) the author being the 2021 recipient of the World Council for Gifted & Talented International award for research. Admittedly there is no theory without blemish hence there are pockets of disagreement here and there about Gagné's framework, but generally his model has received worldwide recognition because it is generally viewed as resolving the controversies that the gifted field has struggled with for years (Pfeiffer 2013). It is the framework that was considered suitable for this study and **Figure 2.5** illustrates the most recent version of the model in 3D configuration. For almost four decades now, Gagné has been preoccupied with the explanation of how gifts develop into talents which in turn has resulted in him being best known internationally for his

Differentiated *Model of Giftedness and Talent (DMGT)* shown above the basement of **Figure 2.5**. However, the DMGT is a behaviourally oriented model which focuses strictly on phenotypes or the set of observable characteristics of an individual, yet talent development has its distal origins in the progressive buildup of natural abilities, as early as through the chance meeting of a sperm cell and an ovum. This produces a unique genotype in the fertilized egg hence as Angoff (1988) perceptively highlighted, the most significant distinction between gifts and talents remains the amount of direct genetic contribution. It is for this reason that the DMGT has been criticised for representing a theory of talent development limited to the 'ground level' of directly observable behavior. Hence during the past two decades people have been asking about the proper way to integrate into the DMGT the biological substrates of aptitudes and competencies.

Figure 2.5 The Differentiated Model of Gifts & Talent's [DMGT] biological underpins

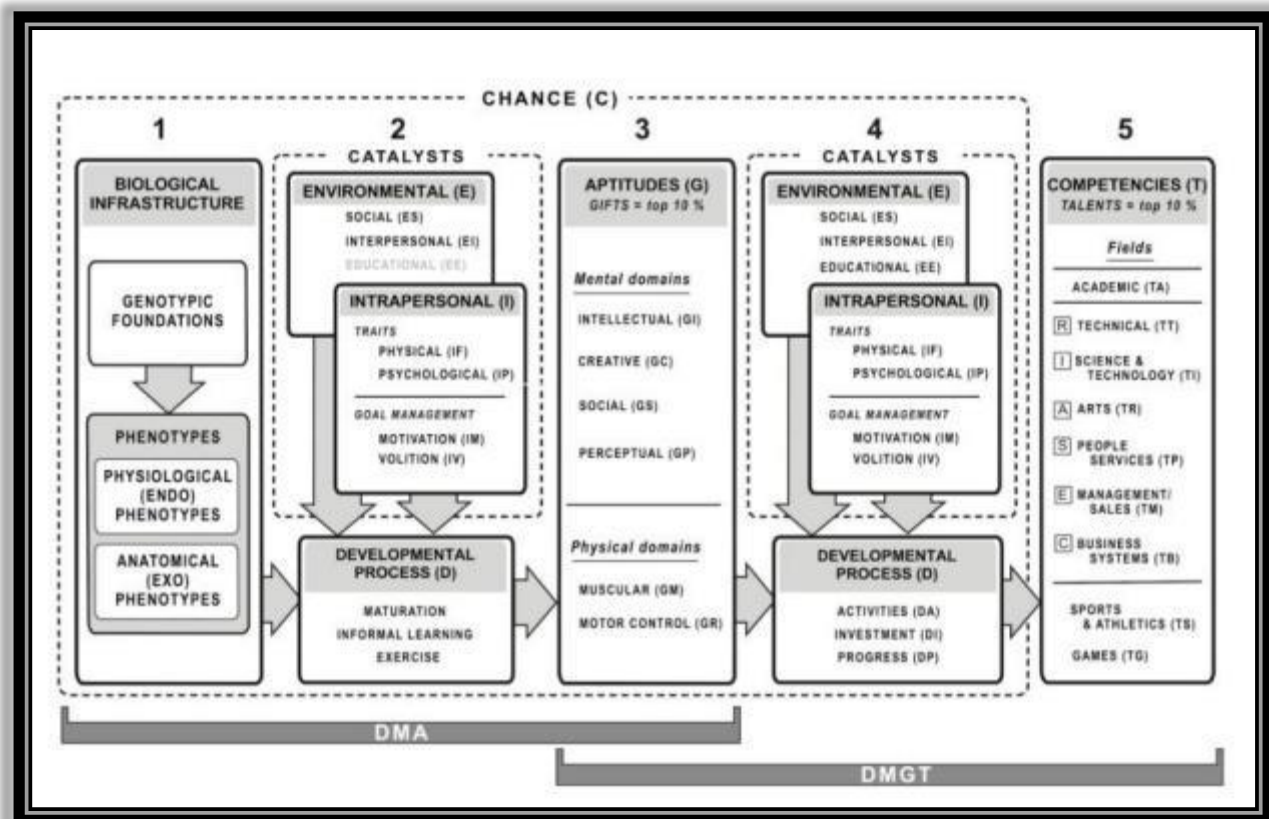


In response, Gagné, (2015, 2021) used a 'house' metaphor, where he has the DMGT occupying the ground floor (**see Figure 2.5**), with three distinct basements underneath

depicting a Developmental Model of Aptitudes (DMA) that describes the growth of abilities and gifts from their biological underpinnings. These maturational processes have no direct relationship with the talent development process itself; hence the supporting biological structures are situated underneath the observable behaviours of the DMGT. As for the learning subcomponent, it is called 'informal' because it lacks the structured organization (e.g., curriculum, systematic schedule, formal assessment) typical of talent development activities. It takes the form of spontaneous learning acquired mostly subconsciously, with little daily or weekly attention to its growth. These DMGT's basements can be metaphorically subdivided into three levels. At the bottom, we find genotypic structures and processes. The second level contains a large diversity of physiological and neurological processes (called endophenotypes) that ensure the proper functioning of body and brain. The highest level includes anatomical structures, called exophenotypes (e.g., brain size, tallness, joint flexibility), which have been associated with abilities and other personal characteristics. These three underground structures interact dynamically to ensure the proper development of aptitudes and many intrapersonal catalysts. Since each basement exerts its influence upwards, genes will first affect the physiological processes, then more indirectly the anatomical structures, these processes will finally generate individuals of aptitudes and intrapersonal traits. The publication of these basements offered satisfactory answers to most questions about the biological foundations of gifts and talents.

Gagné, (2021) finally merged the DMA and DMGT into the Integrative Model of Talent Development (IMTD) **Figure 2.6** that proposes a full analysis of aptitude and talent growth, all the way from conception to adulthood. Hence Gagné opines that the IMTD represents the crowning point of his conceptual efforts to represent all the causal factors, immediate and distant, involved in the development of gifts and talent. He then talks about the Siamese status of the DMA and the DMGT models since both share a common component i.e., aptitudes.

Figure 2.6 The Integrated Model of Talent Development [IMTD]

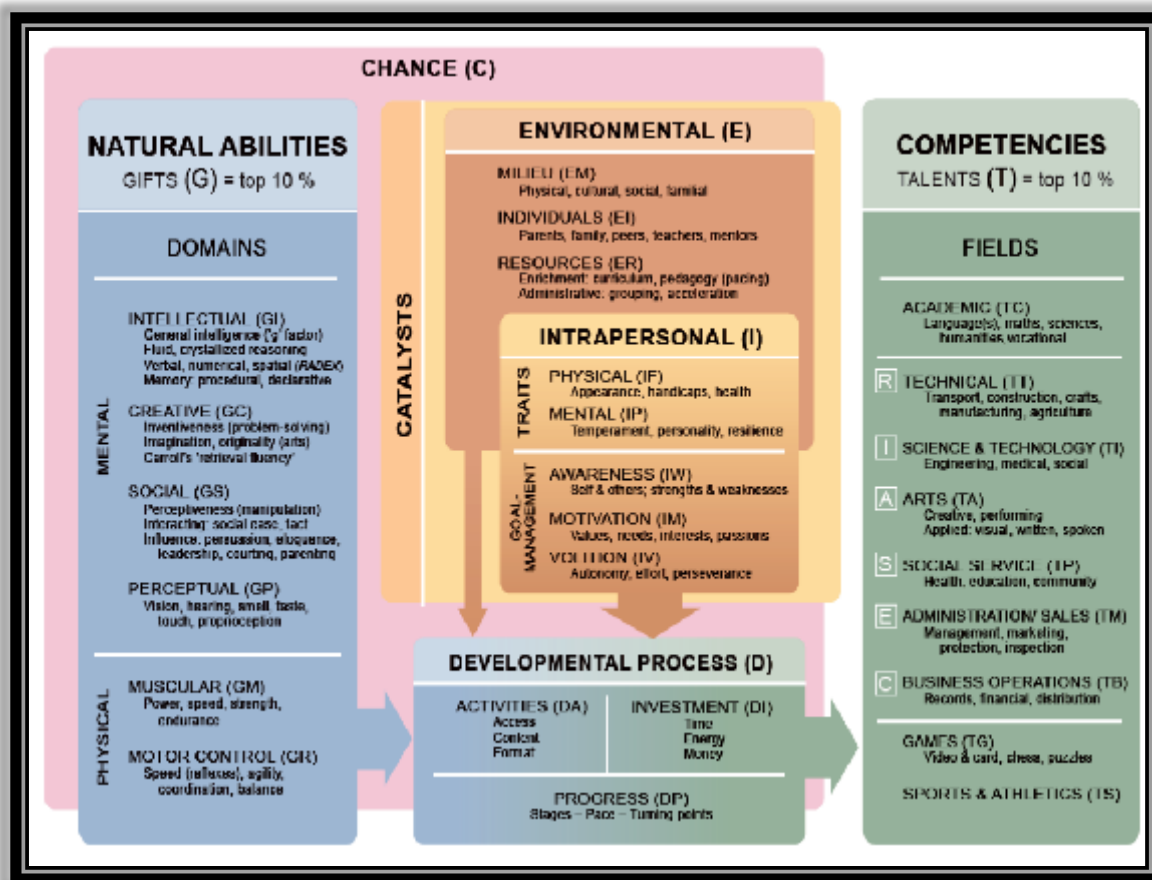


2.6. The Differentiated Model of Gifts and Talent [DMGT]

Admittedly, the IMTD represents Gagné's latest and comprehensive image in the form of DMA and DMGT (Figure 2.7) as Siamese 1 and 2 respectively who share aptitudes as their common organ. While Siamese 1 depicts the maturational development of different abilities Gagné opines that such processes have no direct relationship with the talent development process itself. Their role is only to mould the natural abilities that will become aptitudes which in turn, the building blocks of talents. With reference to Siamese 2, Gagné's view is that while high ability has some genetic basis, learning, practice, and environmental factors are necessary for the emergence and development of such talent. An important implication for the field of gifted education is that although the path to outstanding performance may begin with demonstrated potential, the talent associated with giftedness must be developed and sustained by way of training and

interventions in domain-specific skills (Lubinski, 2010). In fact, there is some consensus in the view that academic talent development is the main business of education and assuming there is less controversy on this view then it follows logically that the DMGT is more relevant for studying that process of talent development. Hence Gagné spend a great deal of his time musing around the developmental process of gifts into talent and less time on explaining their biological foundations.

Figure 2.7 Differentiated Model of Giftedness & Talent [DMGT]



In the field of gifted education, the terms giftedness and talent represent two crucial constructs which are often used interchangeably. However, among current conceptions of giftedness, the DMGT stands alone in its clear, distinct, and well-operationalized definitions of those two key concepts giftedness and talent. Here are the formal definitions for the two target concepts:

Giftedness designates the possession and use of untrained and spontaneously expressed outstanding natural abilities or aptitudes (called gifts), in at least one ability domain, to a degree that places an individual at least among the top 10% of age peers.

Talent designates the outstanding mastery of systematically developed competencies (knowledge and skills) in at least one field of human activity to a degree that places an individual at least among the top 10% of 'learning peers' (those who have accumulated a similar amount of learning time from either current or past training). (Gagné, 2010:82)

That is exactly one of the DMGT's unique qualities: differentiating clearly between outstanding natural abilities, the gifts, and systematically developed high-level competencies, the talents. Talent becomes the outcome, the result of a long talent development process that has its origin in outstanding natural abilities. Gagné advises us to think of giftedness versus talent as approximate synonyms for high aptitude versus high achievement, high potential versus high accomplishment, or his own use of high 'natural abilities' versus outstanding 'systematically developed competencies.' Borland (1989) was one of the few scholars in the field to recognize the value of that distinction. He stated: '*Gagné's use of the terms giftedness and talent appears to be the least arbitrary and the most useful of those proposed thus far. The distinction between competence and performance is a real and meaningful one, and it allows for the building of a model that permits the operationalization of the concepts*' (1989:23).

The DMGT was created to take advantage of that distinction. As shown in **Figure 2.7**, the model brings together five components: gifts (G), talents (T), a talent development process (D), intrapersonal catalysts (I) and environmental catalysts (E). The six components can be grouped in two trios (Gagné, 2004): the first trio expresses the talent development and consists in gifts (G), talents (T) and talent development processes (D); the second trio expresses the supportive trio and describes interpersonal catalysts (I), environmental catalysts (E) and chance (C).

Even though the DMGT embraces all forms of gifts and talents, the fact remains that professionals in gifted education have traditionally focused their attention on one type of gift, intelligence, and one type of talent, academic. Hence Gagné described the target population of most school enrichment programs as the intellectually gifted (IG) and academically talented (AT) students, or simply those we could also call “the bright achievers”. Consistent with that view, Gagné proposed the acronym IGAT to designate that target population.

2.6.1. Gifts (G)

According to Gagné (2019) the G component of the DMGT clusters natural abilities into six sub-components. Four of them are mental: intellectual (GI), creative (GC), social (GS), and perceptual (GP). The last two are physical abilities: muscular (GM) abilities devoted to large physical movements, and abilities associated with fine motor control and reflexes (GR); both usually contribute to complex physical activities (e.g., tennis, baseball, gymnastics). Gagné posits that we can observe natural abilities in most tasks children confront in their daily activities and their schooling. He gives examples such as the intellectual abilities needed to learn to read, speak a foreign language, or understand new mathematical concepts. Gagné goes further to emphasise that natural abilities are NOT innate; instead they do develop over the whole course of a person's life, but probably more during a person's early years. Gifts manifest themselves more easily and directly in young children because only limited systematic learning activities have begun transforming them into specific talents. However, we can still observe them in older children and adults through the facility and speed with which individuals acquire new knowledge and skills. The easier or faster the learning process, the more we will assume the presence of underlying high natural abilities. Said differently, ease and speed in learning is the trademark of any type of giftedness. Gifts are divided into two groups: mental (intellectual, creative, social and perceptual) and physical (muscular and motor control). Gagné lists four domains of natural abilities, which according to him are mostly genetically determined:

- intellectual abilities: reasoning, memory, sense of observation, judgement, and metacognition.
- creative abilities: inventiveness, imagination, originality, and fluency.
- socio-affective abilities: perceptiveness, communication (empathy and tact), and influence.
- sensorimotor abilities: sensitivity (the senses), strength, endurance, coordination and others.

Each domain constitutes a sub-component with multiple facets. Natural abilities are not innate; they do develop, especially during childhood, through maturational processes and informal exercise. Yet, that development and level of expression are partially controlled by the individual's genetic endowment. Silverman (1993) provided a useful generalisation of the intellectual and associated personality characteristics of the gifted group as shown in **Figure 2.8**. Not all of these features are exclusive to gifted and talented students, but such students possess them to a greater degree than their peers.

Figure 2.8 Characteristics of Gifted Children [Source: Silverman 1993:53]

Intellectual traits	Personality traits
Exceptional reasoning ability	Insightful
Intellectual curiosity	Need to understand
Rapid learning rate	Need for mental stimulation
Facility for abstraction	Perfectionism
Complex thought processes	Need for precision/logic
Vivid imagination	Excellent sense of humour
Early moral concern	Sensitivity/empathy
Passion for learning	Intensity
Powers of concentration	Perseverance
Analytical thinking	Acute self-awareness
Divergent thinking/creativity	Nonconformity
Keen sense of justice	Questioning rules/authority
Capacity for reflection	Tendency to introversion

Varying patterns of characteristics are found in individual students because they differ in intellectual level, specific abilities and degree of mental activity (Silverman, 1993). The more highly gifted students have a tendency to show more intensity and energy (Clark, 2002). Not all students will display all of these characteristics, all of the time. Many criteria are required to identify gifted and talented students because of their diversity and **Figure 2.9** lists some of the visible behaviors that are associated with some of these characteristics.

Figure 2.9 Characteristics of Gifted Children [Source: Department of Education, 2007]

Characteristic	Possible Associated Behaviours
learns quickly and easily	becomes bored and frustrated, dislikes repetition and shallow curriculum, hides abilities to gain acceptance, receives negative adult responses to smartness
exhibits verbal proficiency	dominates discussions, has difficulty with listening skills, may exhibit manipulative behaviour
has a high energy level	needs less sleep, becomes frustrated with inactivity, lack of challenge or active inquiry
exhibits heightened curiosity	takes on too many activities
extremely persistent, concentrates on tasks of high interest for extended periods	disrupts class routine, feels stifled by restrictions, resists interruption or schedules, may be perceived as stubborn or uncooperative
concerned with adult/moral issues, idealistic	attempts unrealistic reforms, feels frustrated, angry, depressed, develops a cynical attitude, receives intolerance from age peers
aims at perfection	sets unrealistically high goals, feels inadequate, feels frustrated with others, fears failure which inhibits attempts in new areas
heightened self-awareness, feelings of being different	experiences social isolation, regards differences as bad, worthless, resulting in low self esteem
highly sensitive or acutely perceptive	perceived as immature, tries to mask feelings to conform, vulnerable to criticism
responds and relates to older children and adults	experiences social isolation, seen as show off, odd, superior, critical, rejected by older children

Not all the characteristics of gifted and talented students are seen as positive. Davis and Rimm (1998) listed the following negative characteristics that gifted students may

display. These are often exhibited by gifted underachievers and students with a learning disability:

- stubbornness
- non-participation in class activities
- uncooperativeness
- cynicism
- sloppiness and disorganisation
- tendency to question authority
- emotional frustration
- absent mindedness
- low interest in detail.

2.6.2. *Talents (T)*

As defined in the DMGT, talents progressively emerge from the transformation of these outstanding natural abilities or gifts into the well-trained and systematically developed competencies characteristic of a particular field of human activity. On the potential–performance continuum, talents represent the performance pole, thus the outcome of the talent development process. Talent fields can be extremely diverse. **Figure 2.6** shows nine talent sub-components. Six of them have their origin in John Holland’s work-related classification of personality types: realistic, investigative, artistic, social, enterprising, and conventional (RIASEC). These six basic types lead to 26 specific occupational groups summarised within each of the RIASEC categories. The three others ensure an almost complete coverage of existing human occupations, as exemplified in the International Standard Classification of Occupations (ISCO) (see International Labour Organization, 2008).

According to Gagné (2019) most talents are easy to assess: we need only performance measures, nothing else. Exams and standardized achievement tests cover all K-12 subject matters. Similar assessments exist for most occupational fields, especially during the training period. It is no doubt in sports that outstanding achievements are easiest to measure; every day, newspapers offer pages of such measurements! Note

the lack of elitism in the DMGT's concept of talent. Contrary to most scholars' examples, usually borrowed from eminent individuals in elite professions, the DMGT stresses the presence of talented individuals in most human occupations.

2.6.3. Developmental process (D)

In this model, natural abilities or aptitudes act as the 'raw materials' or constituent elements of talents; they act through the talent development process. Gagné draws the reader's attention to the fact that the concept of 'program' he uses here differs significantly from most services or 'provisions' covered under the 'gifted program' umbrella. His definition endorses a seminal distinction initially proposed by Tannenbaum (1983) and later adopted by Borland (1989). Here is how Tannenbaum differentiates programs and provisions:

A program is a comprehensive offering, sequenced over a long period of time, usually designed as a requirement, and very much a major part of the total school curriculum. Thus, the school offers programs in mathematics, literature, art, social studies, and the like. A provision, on the other hand, is more fragmentary, an ad hoc offering, relatively brief in duration, often designed by an individual teacher with special abilities rather than by a curriculum committee, and supplemental to the major offerings, not integral with them. (2009, p. 515)

Borland (1989) then built on Tannenbaum's distinction and summarised the main differences as follows:

In many respects, programs are everything provisions are not. Whereas provisions are often temporary expedients, programs are designed to be permanent features of school districts' educational offerings. Whereas provisions are fragmentary, programs have well-articulated sequences of goals, skills, and content. Whereas provisions are extracurricular, programs consist of activities that constitute a prescribed part of the course of study of identified gifted

students. Whereas provisions are optional, programs are required for all gifted students who move through the system. (1989, p. 44)

While adopting the basic ideas put forth by Tannenbaum and Borland, Gagné (2010) proposed additional characteristics. His argument was that we can define the concept of talent development (TD) at two levels: global or specific. Globally, we should consider that talent development happens in hundreds of different fields of human activity, hence TD refers to a (more or less) structured theoretical model that brings together a certain number of causal influences, personal and environmental, that affect the emergence of outstanding achievements through a long developmental process. The DMGT fits perfectly well within that global meaning and Tannenbaum and Borland definitions were basic and general enough to cover any field where talents can emerge. However, Gagné was more concerned about talent development as it should be implemented in educational systems (Gagné, 2009) hence his proposal for Academic Talent Development [ATD] programs. Following these newly revised contributions, Gagné (2019) proposed that the expression academic talent development (ATD) designates either (a) a structured long-term program of learning activities anchored in a constantly challenging academic curriculum directed toward the attainment of high-level excellence goals, or (b) the systematic pursuit by academic talentees of personal long-term excellence goals within such a structured program. He coined the neologism 'talentee' to describe anyone participating in a systematic talent development program, whatever the field. Gagné suggests that we can break down any academic talent development program into three main components in accordance with Moon & Rosselli, (2000): (a) the identification of the target population, (b) the definition of the program's developmental goals, and (c) the content of the proposed developmental intervention, both in terms of its curriculum and its administrative parameters. Consistent with these three components, Gagné (2019) proposed that the D component should have three sub-components: activities (DA), investment (DI), and progress (DP), each of them with multiple facets. From this perspective, talent development begins when a child or adult gains access (DAA), through identification or selection, to a systematic program of activities. These activities include a specific content (DAC), the curriculum, offered within a specific learning environment or format (DAF). The investment (DI) sub-

component quantifies the intensity of the talent development process in terms of time (DIT), money (DIM), or psychological energy (DIE). Finally, the progress (DP) of talentees from initial access to peak performance can be broken down into a series of stages (DPS, e.g., novice, advanced, proficient, expert). Its main quantitative representation is pace (DPP), or how fast – compared to their initially planned progress rate (ipsative view) or to learning peers (normative view) – talentees are progressing toward their predefined excellence goal. The long-term developmental course of a talentee will be marked by a series of more or less crucial turning points (DPT) such as (a) being spotted by a teacher or coach, (b) receiving an important scholarship, (c) accidents, (d) death of a close one.

2.6.4. *The ‘supporting cast’.*

The talent development process is facilitated (or hindered) by the action of two types of catalysts: intrapersonal and environmental. In the DMGT Gagné, (2019) starts by explaining the similarities and differences between catalysts as understood in chemistry against how they are interpreted in his model. In chemistry, catalysts facilitate and accelerate a chemical process; they also remain unmodified after their contribution. Their DMGT metaphorical counterparts differ in two ways: (a) they may exert—by their presence or absence—both positive and negative influences, and (b) they may be permanently transformed through their involvement in the developmental process.

2.6.5. *Intrapersonal catalysts (I)*

The DMGT distinguishes two basic intrapersonal dimensions: (a) relatively stable physical and mental traits, and (b) goal-oriented processes. Physical traits (IF) include appearance, gender, racial or ethnic traits, handicaps (think of the Paralympic Games), chronic illnesses, and so forth. Within the mental or personality (IP) category, we find an almost infinite list of descriptive qualities. The concept of temperament refers to behavioral predispositions with a strong hereditary component, whereas the term personality encompasses a large diversity of positive or negative acquired styles of behavior. The goal-management dimension includes three sub-components:

awareness (IW), motivation (IM), and volition (IV). Being aware of one's strengths and weaknesses plays a crucial role in the planning of talentees' developmental activities. Strengths and weaknesses concern both the G, I, and E components. Goal-oriented processes may be differentiated according to goal-identification activities (IM), as opposed to goal-attainment activities (IV). The term 'motivation' usually brings to mind both the idea of what motivates us (IM) and how motivated (IV) we are, how much effort we are ready to invest in order to reach our goal. Within the DMGT framework, 'motivation' refers specifically to the identification—and occasional reassessment—of an appropriate excellence goal. Talentees will examine their values and their needs, as well as determine their interests or be swept by a potential—but rare—passion. The loftier the goal, the more efforts talentees will need to reach it. Long-term goals placed at a very high level require intense dedication, as well as daily acts of will power to maintain practice through obstacles, boredom, and occasional failure.

2.6.6. *Environmental catalysts (E)*

The E component comprises three distinct sub-components: Milieu (EM), Individuals (EI), and Provisions (EP). The first one, called milieu (EM), includes a diversity of environmental influences, from physical ones (e.g., climate, rural vs. urban living) to social or cultural ones. Economic issues (e.g., family wealth) also belong to this sub-component. The second sub-component, individuals (EI), focuses on the influence of significant persons in talentees' immediate environment. It includes of course parents and siblings, but also the larger family, teachers and trainers, peers, mentors, and even public figures adopted as role models by the talentee. In a talent development analysis based on the DMGT, we include only personal influences that impact the talent development process. The third sub-component, resources (ER), covers all forms of talent development services and programs. The two traditional sub-categories of enrichment and administrative provisions directly parallel the 'content' and 'format' sub-categories of the DA sub-component earlier described. Here Gagné, adopts a broader outlook rather than examine provisions from the strict perspective of a given talentee's talent development course. Enrichment refers to specific talent development curricula or pedagogical strategies; its best-known example is called enrichment in density or

curriculum compacting. Administrative provisions are traditionally subdivided into two main practices: (a) part-time (e.g., clusters, pull-out classes) or full-time ability grouping, and (b) accelerative enrichment (e.g., early entrance to school, grade skipping, Advanced Placement Program)

2.6.7. *The Chance factor (C)*

According to Gagné, (2010) the DMGT gives significant importance to the role of chance, a concept borrowed from Tannenbaum (1983) that groups all non-controllable (positive and negative, distal and proximal) causal influences of talent emergence. Chance manifests itself mainly through the genetic background we receive at birth, as well as the family environment in which we are raised. Chance's placement within the DMGT has evolved considerably over the years. It used to be introduced as a fifth causal factor associated with the environment, for instance the chance of being born in a particular family, or the chance of the school in which the child is enrolled developing (or not) a program for talented students. However, more recently Gagné, (2019) is of the view that strictly speaking, chance is not a causal factor. Just like the type of influence (positive vs. negative), chance qualifies the various causal influences in terms of the degree of control a person possesses with regard to any one of these causal influences. Chance's crucial involvement is well summarized in a statement made by the late John W. Atkinson, a pioneer researcher in the field of achievement motivation. He believed that all human accomplishments could be ascribed to 'two crucial rolls of the dice over which no individual exerts any personal control. These are the accidents of birth and background. One roll of the dice determines an individual's heredity; the other, his formative environment' (1978, p. 221). These two impacts alone give a powerful role to chance in sowing the bases of a person's talent development possibilities. Because of its redefined role, the 'chance' factor should no longer appear in a visual representation of the DMGT. Yet, its popularity among DMGT 'fans' – as well as my personal attachment to it – brought me to create some room for it in the background of the components it influences.

2.6.8. Developmental dynamics

In explaining the developmental dynamics Gagné, (2019) draws the reader's attention to what he calls the basic dynamic rules. The basic dynamic process at the core of the DMGT implies all five components: outstanding natural abilities (G), usually from a specific domain, progressively give rise (D) to the high-level competencies (T) typical of a particular field of talent; and both groups of catalysts (I and E) constantly intervene to 'catalyze' that long-term process. We also observe all kinds of interactions between components (e.g., the efforts by teachers and parents (EI) to influence the motivations (IM) and personality characteristics (IP) of children), as well as within components (e.g., how personal qualities (IP) affect a person's choice of goals (IM), or how cognitive abilities (GI) contribute to the growth of creative (GC) or social (GS) natural abilities).

Gagné, (2010) further opines that within the DMGT, because natural abilities or aptitudes act as the "raw material" or the constituent elements of talents; it follows that the presence of talents necessarily implies the presence of well above average natural abilities. Consequently, in most situations, one cannot become talented without first being gifted, or close to the minimum giftedness threshold. The reverse is not true: high natural abilities may remain just gifts, and not be translated into talents, as shown by the phenomenon of academic underachievement among intellectually gifted children.

There is also a dynamic association between specific gifts and talents. Given their status as 'raw materials,' gifts represent generic abilities that can be molded into somewhat divergent skills, depending on the field of activity adopted by a talentee. For example, manual dexterity, one of many natural physical abilities, can be molded into the particular skills of a pianist, a dentist, a typist, or a video-game player. Similarly, analytical reasoning, one of many cognitive natural abilities, can be molded into the scientific reasoning of a chemist, the game analysis of a chess player, or the strategic planning of an athlete.

In most talent development situations, the four causal components (G, I, D, E) contribute positively to the emergence of talents. And it is assumed that this positive contribution

will become more intense as talentees attempt to reach higher talent goals. These contributions can vary a lot in intensity and continuity from one talentee's story to another. No two developmental paths look alike. This is why talent development is a very complex process, a process where the four causal components modify their interactions over the course of a talentee's developmental path. Think for instance of the close supervision many parents give to their children's homework in elementary school, and its virtual disappearance by the time these youth reach high school. Any significant coverage of the dynamics of talent development within the DMGT framework well exceeds the scope of this brief overview. Here are a few highlights. In the DMGT, outstanding natural abilities are treated as the raw materials or the constituent elements of talents. Because of this basic relationship, the presence of talent necessarily implies the possession of well above average natural abilities; one cannot become talented without first being gifted, or almost so. The reverse is not true however. It is possible for outstanding natural abilities to remain potentialities, as witnessed by the well-known phenomenon of academic underachievement. The arrows in Figure 5 indicate that intrapersonal and environmental catalysts typically act through the talent development process. That moderator role of the learning/practice process is quite normal: it confirms that talent does not manifest itself overnight. The skills have to be built over time even when, thanks to very high natural abilities, the first achievements appear almost immediately and without apparent effort. Interactions can be very complex. Indeed, it is my conviction that empirical evidence exists to support causal interactions between any pairing of the five components, and in both directions in each case. For instance, the impact – positive or negative – on one's self-concept of being labeled 'gifted' or 'talented' is a typical case of $G \rightarrow I$ interaction. Conversely, I factors may exert an impact on the development of natural abilities. Moreover, interactions can manifest themselves within a given component. The relationships between parents and teachers regarding a child's special educational needs, whether they are collaborative or tainted with conflict, represent one of the most common instances of direct interactions within the E component. Similarly, within the I component, personality disorders may affect the goal setting process. Finally, talented outcomes may themselves enter into a feedback loop and influence the talentees and/or influential persons in their environment. No doubt

that the early successes of young students, young artists, or young athletes serve to heighten their motivation to pursue their training and even increase its intensity.

In summary, no causal component stands alone. They all interact with one another and with the developmental processes in very complex ways; and these interaction patterns will differ significantly from one person to the next, as well as at different stages of that process.

2.7 What makes a difference?

Even though all four causal components are always active in any talent development process, it does not mean that they are equally powerful as agents of talent emergence. Gagné then posed the question: Could it be that some of the components and/or sub-components of the DMGT play a more important causal role than others? Of course, this 'what makes a difference' (WMD) question makes little sense at the individual level, and so for many reasons, the most significant being that any answer given in the case of Subject X has little chance of applying to Subject Y's talent development trajectory. Extreme individual differences abound, and I have accumulated over the years dozens of such examples. One of the more recent of such counter-intuitive examples targets the famous tennis player Andre Agassi. In his recent autobiography he states on the very first page: 'I play tennis for a living, even though I hate tennis, hate it with a dark and secret passion, and always have' (Agassi, 2009, p. 3) What does this say about the importance of intrinsic motivation as a driver of exceptional achievements!

But what about averages? Are some factors generally recognised as more powerful predictors of outstanding performances? For all those involved in identifying youth with high potential and planning the development of their talents, this is the ultimate question. Unfortunately, that question has yet to receive a clear answer in the empirical literature. In a target article published in this journal a few years ago (Gagné, 2004), I devoted over 20% of my text to that specific question. I summarised my tentative answer with the acronym GIPE. The GIPE part meant that I gave first rank to outstanding natural abilities (G), with successively lower ranks given in turn to intrapersonal catalysts (I),

the developmental process (then labeled P), and finally to environmental catalysts (E). The chance factor (C) received a special priority (with a 'dot' separating it from the rest) to acknowledge its prominent role in creating individual differences in natural abilities and intrapersonal catalysts – Atkinson's two crucial rolls of the dice. Space does not allow a discussion as extended as the one in the target article cited above. I will only briefly comment on the G vs. I ranking.

To explain the superiority given to G over I, I pointed out that virtually every comparative study of the unique explanatory power of motivational constructs over and beyond IQ measures had shown a clear superiority of the latter. I then quoted Gagné and St Père's (2002) exhaustive literature review as follows. Motivation's independent contribution to the prediction of scholastic or occupational achievement appears limited. It is frequently non-existent... or much less powerful than the independent contribution of cognitive abilities... The 4:1 and 6:1 ratios respectively extracted from Walberg's (1984) and Schmidt and Hunter's (1998) syntheses, probably upper-limit estimates, are more or less equidistant from the two extremes. (Gagné & St Père, 2002, p. 10)

This quote means that IQ scores 'explain' on average about five times more achievement variance. As for other constructs included in the I component, there is little scientific literature on their unique contribution to talent development. Of course, that analysis applies strictly to academic talent development within the general K-12 schooling process. If we consider that the school system is the only field in which unmotivated talentees do not have the option to drop out – at least not until late high school – this might modify any comparison of various predictors of outstanding achievement. That special constraint does not exist in other fields, like arts or sports. After re-reading that long analysis in the 2004 HAS target article, I felt comfortable in maintaining the same GIDE hierarchy. The only small modification that came to my mind was to suggest that if I had to rank order the IM and IV sub-components, I would not hesitate to give priority to IV, especially in two situations: (a) K-12 academic talent development, and (b) the pursuit of exceptional or extreme levels of talent in any field.

In conclusion, allow me to 'loop the loop' by bringing back the very first quote I introduced in this article: '[famous athletes] tell us all something about ourselves and what we may be capable of achieving, if we dream and make the commitment to work hard towards that vision' (Hemery, 1986, p. 204). It clearly differentiates the IM component – if we dream – from its volitional counterpart. And I believe that these two distinct sets of goal-management processes offer a very useful analytical framework to dissect the goal-oriented behavior of talentees in all fields of talent development.

So, let us briefly explain how the components are related. Many documents, use the terms 'gifted' and 'talented' interchangeably, implying a single-concept approach. Essentially, Gagné has been dissatisfied with this frequent, all-encompassing and interchangeable use of these terms. He argued that the 'one term fits all' was inaccurate, misleading, and detrimental to all efforts to identify and nurture talent, because it suggests that talents are inborn hence there is no place for systematic training, learning or practicing. Yet there is ample evidence from elite sport and performing arts programs that have combined identification of ability with honing or sharpening of this potential into talents. Gagné therefore argued that there is, and should be, a clear distinction between these two most basic concepts - gifts and talents. We see this in the model which has three columns, with gifts on the left-hand side, talents on the right-hand side and catalysts that impact the developmental process in the centre.

The labels 'natural' vs. 'systematically developed' used in the two definitions point to Gagné's choice of the overarching differentiator, namely the strength of genetic input in the case of aptitudes as opposed to the capital role of practice in the case of competencies/talents. The DMGT model then depicts the progressive development of gifts into talents in a potential-performance continuum where on one end 'gifts/natural abilities' represent the raw material and on the other end 'talents/competencies' represent the outcome of the talent development process. This developmental process is continually modulated by two large sets of catalysts which are critical in activating the translation of giftedness into talent. Central to this translation are the very important mediating effects of systematic training and practice through a structured program of activities. The concept of talent development is formally defined as the systematic

pursuit by talentees, over a significant and continuous period, of a structured program of activities leading to a specific excellence goal (Gagné 2010). So according to Gagné (2015), if this formal developmental process is poor gifted students may never develop to their full potential. Therefore, the education system needs to provide effective support for the gifted because their gifts may otherwise never be translated into talents.

2.8 Relevance of the DMGT model in this study

It is one thing to identify an appropriate theoretical underpinning for a study, but it is another thing to show the connections between the model and the study. Given that a theoretical underpinning is the researcher's lens with which to view the world the researcher has the responsibility to show the criteria for selecting and applying the theory to a study and that criteria must be appropriate, logically interpreted, well understood, and align with the question at hand. According to Grant & Osanloo (2014) the theoretical underpinning should resonate with every aspect of the research process from the definition of the problem, literature survey, methodology, presentation and discussion of the findings as well as the conclusions that are drawn.

The DMGT model adds coherence to this study in many ways. Firstly, Gagné's model suggests that giftedness is merely potential and must undergo transformation to become a talent, with teaching and learning opportunities being one of the most significant influences (catalysts) in this process. Hence it is vital that students receive support from their school and teachers if they are to develop their gifts into talents. If the development process is poor, a gifted student may not become talented. Students performing at very high levels exhibit inherent gifts that if nurtured and developed often lead to the display of talent. The DMGT shows where the student – and the student's family – can be influential. In the centre of the model, between gifts and talents, are the catalysts.

Catalysts are the important aspects of the student's environment, both external and internal, that impact their development. The developmental process can be influenced through the way catalysts are managed either directly or indirectly by the student's

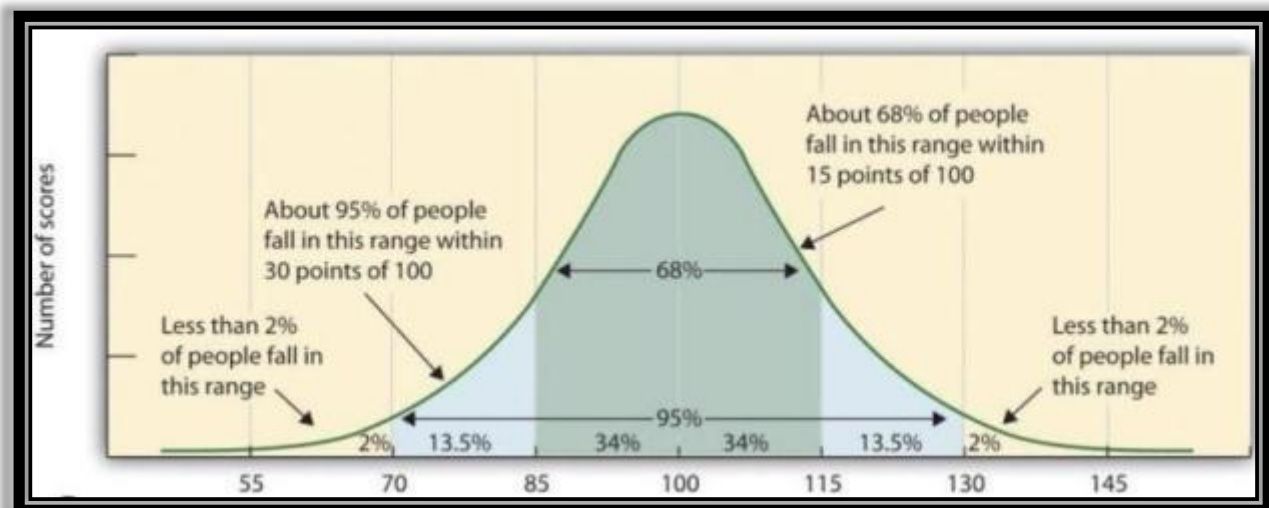
family; for example, a student's potential can either be developed or hindered by environmental and intrapersonal catalysts. Nurturing and developing gifts into talents involves a complex, structured program of activities over a period of time and depends on the individual student's level of giftedness and need.

An underlying principle of Gagné's view is that while high ability (talent) has some genetic basis (giftedness), learning, practice, and environmental factors are necessary for the emergence and development of such talent. The developmental process can be influenced through the way catalysts are managed either directly or indirectly implying that a student's potential can either be developed or hindered by environmental and intrapersonal catalysts. This conceptualisation of the gifts-talent continuum through the catalysts enables any interested research to investigate (1) the physical, cultural or social environment, (2) the teachers, parents, peers as individuals who manage the other non-human catalysts and then (3) the gifted students themselves in terms of their temperament, personality and motivation. With reference to role played by teachers who are the focus of this study, I borrow from the former USA President Obama who once said that all the wireless devices and fancy software in the world won't make a difference unless we have great teachers in the classroom (Dyslexia International Annual Report 2015). This view is also echoed in a UNESCO (2014) maxim that an education system is only as good as the quality of its teachers because the teacher is viewed as being at the core of quality. When considering the unique characteristics and needs of gifted and talented students, it is clear that teachers play a central role in the academic success (or failure) of these students. In fact, a central tenet in Gagné's (2003, 2010) DMGT is that teachers are positioned as a vital facilitator for ensuring that gifted and talented students' educational needs are met. Yet the pervading belief of many educators is that gifted and talented students are already academically advantaged and will achieve even without any teacher intervention (Colangelo, Assouline & Gross, 2004; Gallagher, 2003; Lassig, 2009; Megay-Nespoli, 2001; Taylor & Milton, 2006; VanTassel-Baska, 1997). Research shows this to be a myth (albeit a widely accepted one), instead showing that gifted and talented students are unlikely to achieve on their own (DeBuhr, 2011; Parliament of the Commonwealth of Australia, 2001; Plunkett, 2002). As an example, the 2001 Senate Inquiry on the Education of

Gifted and Talented Children (Parliament of the Commonwealth of Australia, 2001) estimated that up to 75 percent of gifted students underachieve in school and 40 percent leave school before completing year 12. Research further supports the significant impact of educators on the development, learning, engagement and achievement of these students (Lassig, 2002; McCoach, 2007; Plunkett, 2002; Rogers, 2007). It is therefore crucial for educators to be mindful of their pedagogy and practices and the way in which they may contribute to the benefit or neglect of gifted and talented students' educational, social and emotional needs (Hudson, et al., 2010; Vialle & Quigley, 2002)

Besides the distinction between giftedness and talent another important question that has caused controversy in the field of gifted education has been: 'How can we identify a gifted student from his/her peers?' Identification of gifted and talented children was initially based on the use of intelligence tests. However, the use of intelligence tests (IQ tests), as the sole criteria for identification has been out of favour with some professionals. For example, Card & Giuliano (2014) warn that low-income students, black students, and second language English learners have barriers that make it harder for them to get into gifted classes especially when the IQ test is used as the single determinant. In addition, gifted students with limited English proficiency are often overlooked because most tests require oral or written language skills (Cohen, 1990). Renzulli (1998) was among the first to say that the gifted field's exclusive emphasis on high I.Q. was misguided because intelligence tests and standardized tests may lack in ecological validity due to cultural or linguistic diversity. The view today is that children with outstanding talent perform or show the potential for performing at remarkably high levels of accomplishment when compared with others of their age, experience or environment (Mhlolo, 2018). The "cultural specificity" of intelligence makes IQ tests biased towards the environments in which they were developed – namely white, Western society. Several alternative tools have been proposed including the prevalence ratio and in response to this concern, Gagné developed, as an intrinsic part of his DMGT, a clear and defensible metric-based system (MBS) based on this prevalence ratio.

Figure 2.10 Distribution of IQ Scores in the General Population



Gagné starts by citing results of studies assessing the measurement of intelligence which show that IQ is distributed in the population in the form of a **Normal Distribution (or bell curve)**. The normal distribution curve shows that people whose mental age is equal to their chronological age will always have an IQ of 100. If the chronological age exceeds mental age, then such people will have a below-average intelligence as follows:

- Low Average Intelligence - 80 to 89
- Borderline Intellectual Functioning - 71 to 79
- Mild Mental Retardation - 55 to 70
- Moderate Retardation - 40 to 54
- Severe Mental Retardation - 25 to 39
- Profound Mental Retardation - Below 25

If the mental age exceeds the chronological age, then such people will have an above-average intelligence as follows:

- Very Superior Intelligence (gifted) - Above 130
- Superior Intelligence - 120 to 129
- High Average Intelligence - 110 to 119
- Average Intelligence - 90 to 109

Gifted Education borrows from such normal distribution curve of intelligence but is more concerned about those children whose mental age exceeds their chronological age. From this category, Gagné's MBS conceptualisation posits a five-level system of cut-offs for giftedness as follows:

Figure 2.11 The DMGT's Metric Based System of Levels within the Gifted/Talented Population (Gagné 2009)

Level	Label	Ratio in general population	IQ equivalents	Standard deviation
5	Extremely	1:100,000	165	+ 4.3
4	Exceptionally	1:10,000	155	+ 3.7
3	Highly	1:1,000	145	+ 3.0
2	Moderately	1:100	135	+ 2.3
1	Mildly	1:10	120	+ 1.3

These levels are shared by other researchers such as Gross (1998), who argued that there are five levels of ability within giftedness, including mildly, moderately, highly, exceptionally and profoundly gifted. Gross goes on to suggest that these levels require different types and levels of response. Similarly, Feldhusen (1993) outlines the IQ ranges associated with each level as well as the prevalence of each level within the population and the most appropriate programming options when catering for each level's educational requirements. An important addition that I found from Feldhusen's (1993) work is the inclusion of a column for programming options (see **Figure 2.12**). This is important to the field of gifted education because it suggests what needs to be done with gifted students at different levels. In his model Gagné also highlights the 'best' practices that proper talent development programs should implement suggesting that this study could have an ideal template against which to compare its findings. This ideal template also helped the study to be more specific in the development of its data collection tools.

Using this MBS, Gagné argued that the mildly gifted (1:10) or the top 3 achievers in a regular class of 30 already distance themselves very significantly in terms of ease and

speed of learning. He referred to such mildly gifted learners as the ‘garden variety’— a common English expression in the USA that means the ‘most common group’. Similarly, Renzulli (2012) used the terms ‘high achieving’ or ‘schoolhouse giftedness’ to refer to students who are good lesson learners in the traditional school environment.

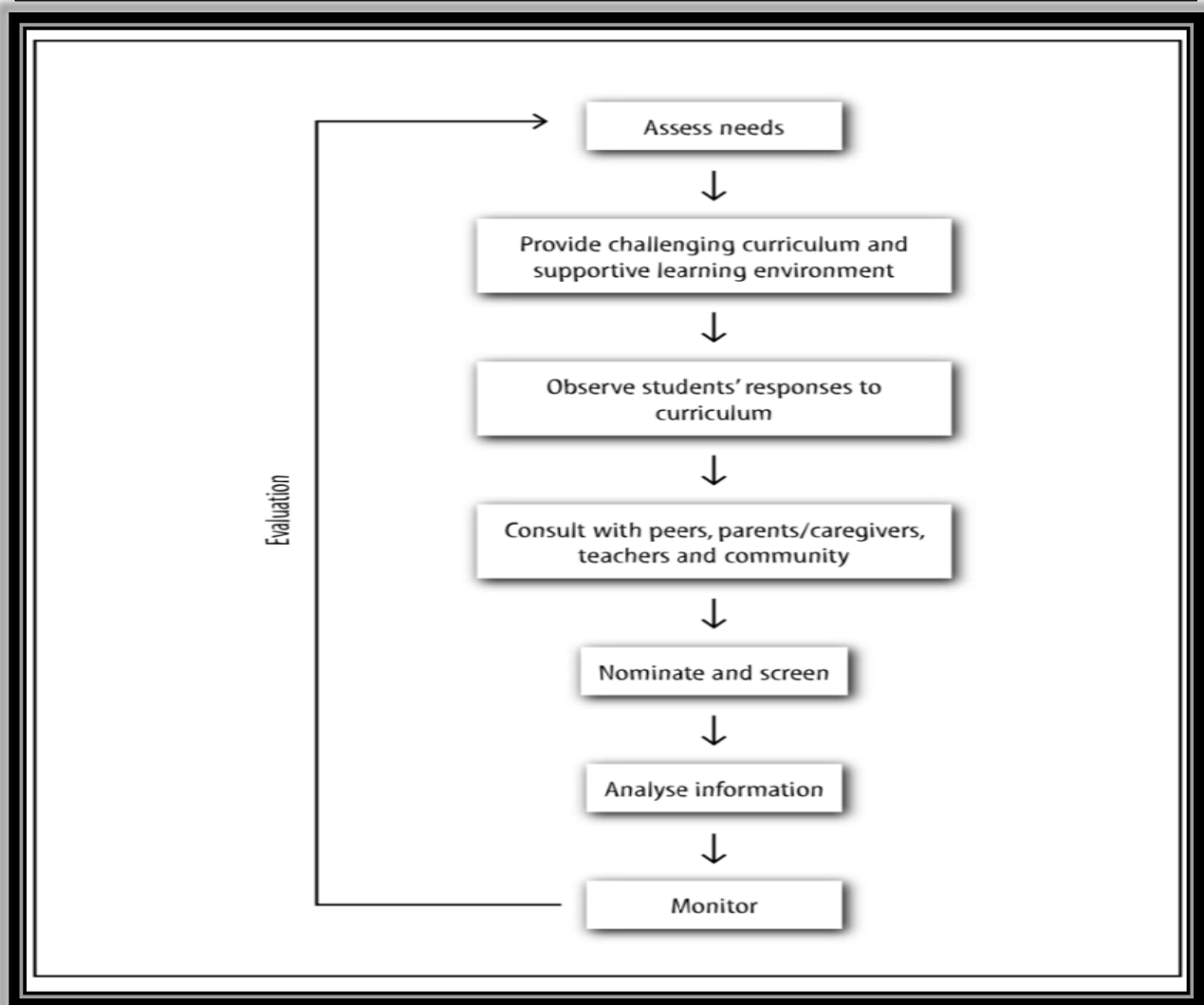
Figure 2.12 Levels of Giftedness prevalence & Programming Options Feldhusen (1993)

Levels of Giftedness	Prevalence	Programming Options
Mildly (115-129)	1:6 → 1:40	Enrichment in regular classroom Modified curriculum Curriculum compacting
Moderately (130-144)	1:40 → 1:1000	Advanced work Challenges within context Some forms of ability grouping Mentorships Single subject acceleration/single grade skip or early entry
Highly (145-159)	1:1000 → 1:10000	Fast paced content work in talent area Ability grouping at least in talent area Acceleration options Challenging academic enrichment Mentorships
Exceptionally (160-179)	1:10000 → 1:1million	Highly individualised programs High school university level prog. Advanced placement Radical acceleration (3+ carefully spaced grade skips) Ability grouping in specific talent areas Specific counselling services
Profoundly (180+)	Fewer than 1.1 million	Radical acceleration Early admission to university Highly individualised programs Specific program searches Special counselling services Ability grouping in specific talent areas

So, in this study the term ‘gifted learner’ is used to refer to the ‘mildly gifted’ in accordance with the recommendations from Gagné (2015) and Renzulli (2012). It refers to the 1:10 learners who attend everyday regular class and who demonstrate relatively high academic ability. The focus on the ‘mildly gifted learners’ follows Gagné’s recommendation that the clear majority (90%) of the gifted/talented individuals belong to this lowest level while the highly gifted/talented (1:100,000) individuals are a rarity. His concern was that when we present extreme examples of behaviour to parents or

teachers, we risk conveying a distorted image of the ‘garden variety’ of gifted individuals because stakeholders would be tempted to judge that such a rare population does not justify large investments of time and money to meet their educational needs. Gagné (2010) therefore recommended that gifted and talented program coordinators should think first and foremost about services for their mildly gifted learners. Similarly the New South Wales department of Education provided a sequence in this identification depicted in a three-stage process of nomination, screening and monitoring.

Figure 2.13 The identification process [Source: State of NSW, Department of Education and Training, 2004]



2.9 Stages of identification

2.9.1. Nomination

This is the identification of gifted and talented students by parents/caregivers, teachers, peers, school counsellors, community members and the students themselves. It involves the collection of subjective information, usually via checklists. Checklists may need to be translated into the language of the target population to collect valid information.

2.9.2. Screening

Screening involves the use of a combination of measures of potential and performance. It is more objective than nomination. Ability tests are useful for assessing potential, whereas achievement tests assess student performance in syllabus outcomes, and generally classify students into bands. Underachieving students with high intellectual potential may score poorly on achievement tests. Diagnostic tests are designed to identify specific areas of difficulty and do not identify students with higher abilities.

2.9.3. Monitoring

Teachers should ask the questions, “What is being observed?” and “How should the observations be noted?” before beginning to formally observe students. Teachers can develop proformas to aid in recording observations of students. This information can give a picture of students’ performances, interests, strengths, weaknesses and skills. Specific data can be collected to reveal the effectiveness of the identification strategy.

2.10 Summary

The main issues coming from this discussion of the IMTD are that (a) gifts and talents should not be used interchangeably (b) gifts will not develop to their full potential if there are no properly structured developmental programs (c) talent development programs

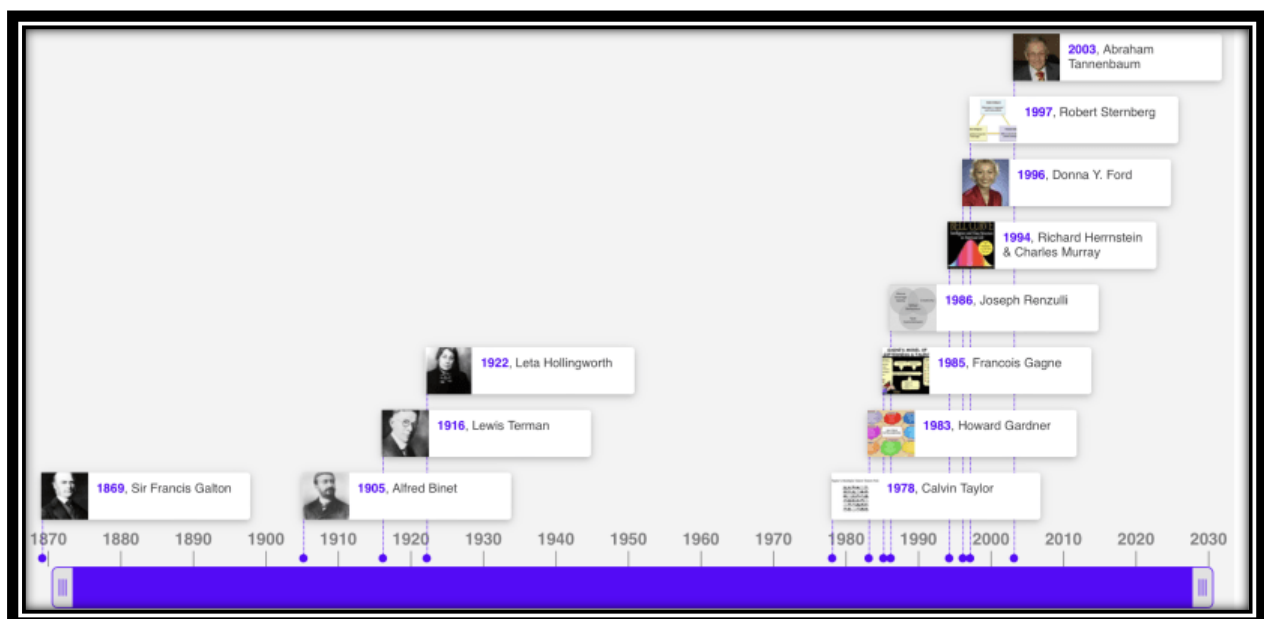
should focus on the mildly gifted children i.e. 1:10 in every regular class of 30 and (d) that teachers matter most in the development of gifts into talent because they manipulate all the other non-human catalysts. Yet teacher training institutions usually don't provide teachers with skills to meet the needs of gifted learners hence this study was conceptualised with that focus.

CHAPTER 3: REVIEW OF THE RELATED LITERATURE

3.1 The history of Gifted Education

Although many researchers have contributed to the field of gifted education, the life and work of Sir Francis Galton (1822-1911) is considered by many researchers as the most important in any history of the field of gifted education (VanTassel-Baska, 2014). Results from a google search of major contributors to gifted education provide various timelines up to and including the year 2020 but they are consistent [as shown in **Figure 3.1.**] on the view that any historical aetiology of gifted education would be incomplete without tracing it back to Sir Francis Galton. It is also important to note that François Gagné, whose model anchors this study, is also featured in this historical aetiology of gifted education.

Figure 3.1 Sir Francis Galton the father of gifted education



Why would Sir Francis Galton be considered the father of gifted education and his book *Hereditary Genius* mark the beginning of our continued interests in the field? That explanation starts in a paper entitled “The Intelligence Quotient of Francis Galton in Childhood” written by Terman (1917). The paper articulates with ample evidence to

show that Galton was a boy of unusual attainments and that he was ordinarily precocious. Besides his role as a colleague as well as a researcher in Galton's laboratory, Karl Pearson also became Galton's biographer after the latter's death in 1911 (Pearson, 1922). In his four-volume biography of Galton, Pearson further informs us that Galton knew his capital letters by twelve months and both his alphabets by eighteen months; that he could read a little book, *Cobwebs to Catch Flies*, when he was two and a half years old, and could sign his name before three years. Pearson quotes the following letter written by a visitor at the Galton home on December 28, 1828:

" The youngest child, Francis, is a prodigy. He is seven next February and reads 'Marmion', 'The Lady of the Lake', 'Cowper's', 'Pope's' and 'Shakespeare's works' for pleasure and by reading a page twice over, repeats it by heart. He writes beautiful hand, is in long division, and has been twice through the Latin Grammar all taught by Adele (the sister)."

We also learn that Francis Galton was admitted as a medical student at the general hospital in Birmingham at the age of fifteen years. This and much more attest to the view that he was a genius of the first order. Though perhaps best known as the "father of eugenics," Galton contributed to a wide range of scientific fields and today's society can attribute many unrelated items and works to Francis Galton. In the field of meteorology, he was the first person to create a weather map and helped develop the initial understanding of anticyclones (a weather concept where there is high pressure near the ground which pulls air down and circulates it). He contributed to forensic science by creating a way to identify fingerprints. Galton made numerous contributions to biometrics and statistics, including introducing the concepts of correlation and of regression towards the mean (taking data multiple times of an event will cause results to become more average the more tests are taken), both of which are used in psychology research to this day. He was also the first person to use a survey to collect data for his research in the fields of anthropology and anthropometry. As one might imagine, since Galton was so intelligent himself, it would not be much of a surprise that he became curious about a way to measure people's intelligence.

For example, *A Century of Contributions to Gifted Education* (edited by Robinson & Jolly, 2014), explores the lives of individuals who made fundamental contributions in the areas of eminence, intelligence, creativity, advocacy, policy, and curriculum. Drawing heavily on archival research and primary source documentation, expert contributors highlight the major philosophical, theoretical, and pedagogical developments in gifted education over the course of a century, providing both lively biography and scholarly analysis. Bookended by Sir Francis Galton's *Hereditary Genius* published in 1869, each chapter represents the life and work of a key figure in the development of the field. Literature abounds that highlight how Sir Francis Galton's compulsive curiosity, mechanical ingenuity, mathematical bent, and theoretical inventiveness resulted in original contributions to meteorology, composite photography, graphology, fingerprint classification, anthropometry, sociology, education, genetics, psychometrics, and statistics. Whole chapters in other books on the history of some of these fields have been devoted to his contributions (e.g., Stigler, 1986).

With specific reference to gifted education, his book *Hereditary Genius* (1869) is considered the first social scientific attempt to study '*genius* 'and '*greatness* '. According to Goldstein (2012), one of the motivations driving the work of Galton, was the perceived need to identify and nurture those individuals, who by virtue of their potential as scientists, were viewed as essential to the advancement of society. The belief that more and better scientists held the key to prosperity and progress was shared by many intellectuals at the end of the nineteenth century, and not just by scientists themselves. Yet gifted education is characterised by a persistent dichotomy where on one hand society values contributions made by its most talented 'men' yet on the other hand their ability/potential is rarely recognised, identified or nurtured. This is captured in one of Galton's quotes:

Men who leave their mark on the world are very often those who, being gifted and full of nervous power, are at the same time haunted and driven by a dominant idea and are therefore within a measurable distance from insanity.

The introduction section of his famous book *Hereditary Genius* Galton (1869) concludes that each generation has enormous power over the natural gifts of those that follow and

maintain that it is a duty we owe to humanity to investigate the range of that power, and to exercise it in a way that, without being unwise towards ourselves, shall be most advantageous to future inhabitants of the earth. So here we see Galton emphasising why research in gifted education should be a human endeavour worth pursuing.

Galton was not only the first to study giftedness in a serious way, but he also invented statistical techniques such as correlation and regression in order to use statistics to handle the data sets, he constructed. Thus, his work impacted many aspects of what we still do today in education in general as well as in gifted education. Due to his significant contributions to the field, Sir Francis Galton (1822-1911) often carries the moniker "father of gifted education" hence this chapter starts by highlighting some of Galton's contributions to the field.

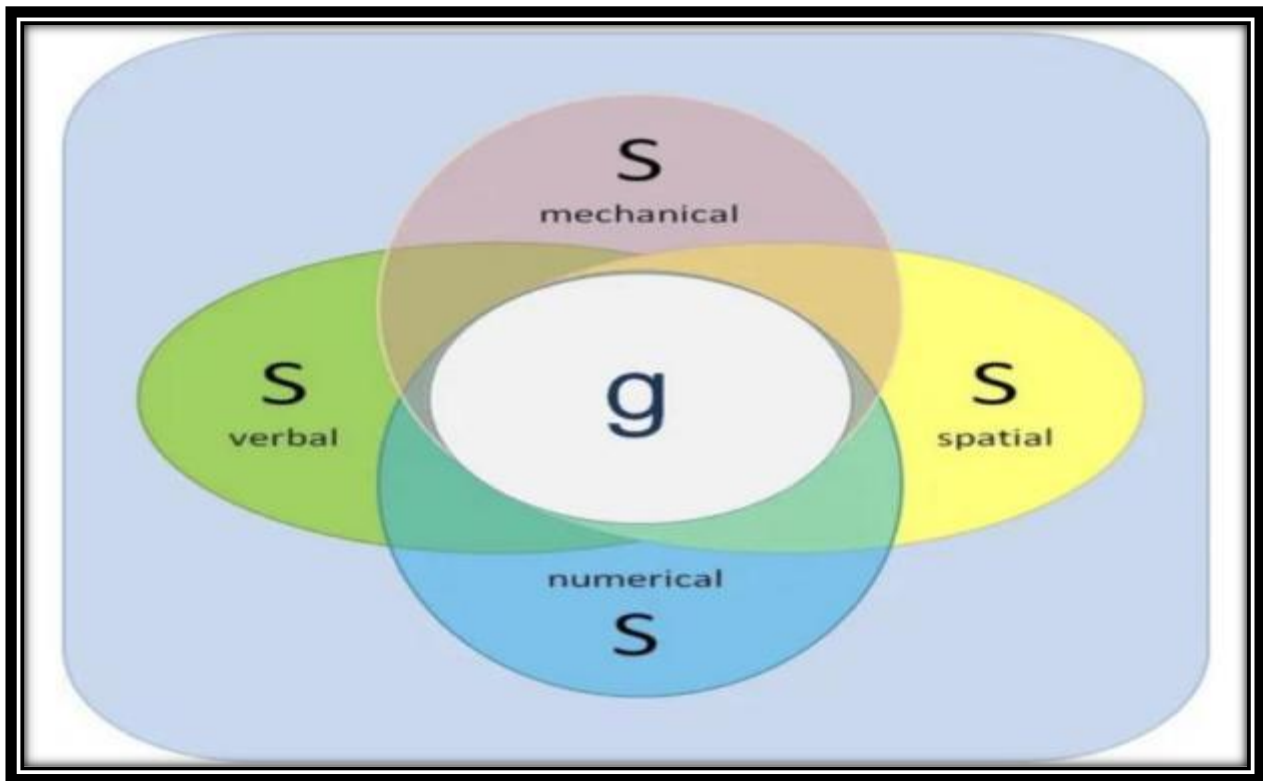
Although according to Jensen (2002) the conclusions Galton drew from his empirical studies were seldom compelling for lack of the needed technology and methods of statistical inference in his day, contemporary research was generally borne out of most of Galton's original and largely intuitive ideas, which still inspire mainstream scientific research on intelligence today. Although various frames have been used to analyse the good, the bad and the ugly of Galton's contributions, Jensen (2002) suggests that the Galton paradigm with respect to mental ability can be analysed from four research perspectives to each of which he turned his attention and proposed at least tentative answers. They are: (1) the idea of 'general mental ability'; (2) the 'inheritance' of individual differences in this general ability; (3) the 'measurement' of general ability; and (4) 'racial differences' in general ability. Let us now look at each of those perspectives in more detail.

3.1.1. General mental ability

Among his many diverse scientific accomplishments, Sir Francis Galton is also recognised as the founder of 'differential psychology' [DP] which is the study of individual and group differences in psychological traits (Eyre, 2011). In DP, the main idea of 'individual differences' goes with its amorous concept of 'uniqueness' and refers

to any psychological characteristics that identifies a person as a distinct human being. While this uniqueness manifests itself in various ways, Galton's focus was on general mental ability and not genius as suggested in the title of his most famous book. Although the word genius appears in the title of his book *Hereditary Genius*, in the "preface" to its edition of (1892) Galton expressed regret at the choice of this title. He himself substituted the term genius with "natural ability" by which he meant what now figures in many discussions as general intelligence. The subsequent literature is clear that Galton's focus was on general mental ability and for most of the history of eugenics, "intelligence" was used synonymously with "general mental ability". For example, Galton theorised that because quickness and other physical attributes were evolutionarily advantageous, they would also provide a good indication of general mental ability (Jensen, 1982). The well-known hypothesis of Sir Francis Galton (1883) posed that individual differences in performance on diverse sensorimotor tasks are rooted in a single general sensory discrimination ability. Spearman (1904) took Galton's proposed mechanism of sensory discrimination so seriously that he virtually equated intelligence with sensory discrimination. In this regard he hypothesised that this discrimination ability and intelligence share the same neural basis and thus should be statistically equivalent (Stanton, 2020). Spearman reached "the profoundly important conclusion that there really exists something that we may provisionally term 'General Sensory Discrimination Ability' and similarly a 'General Intelligence,' and further that the functional correspondence between these two is not appreciably less than absolute" (Spearman, 1904, p. 272). Spearman then proposed that there is a single g factor which represents an individual's general intelligence across multiple abilities, and that a second factor, s refers to an individual's specific ability in one particular area such as verbal, spatial, numerical and mechanical abilities (see **Figure 3.2**).

Figure 3.2 Spearman's general intelligence



This general intelligence **g** factor exhibits an extensive range of external correlates, implicating it as arguably the most scientifically significant dimension of human psychological diversity uncovered by differential psychology to date.

In his studies of this general mental ability, influenced by Locke's theory that the senses are the building blocks of knowledge, Galton put forth the notion that fine differences in sensory discrimination should be related to individual differences in cognitive ability (Acton & Schroeder, 2001). Today, there is probably a considerably greater consensus that individual differences in performance on tests of reasoning, problem solving, and many other kinds of mental ability are to a large part attributable to differences in general cognitive ability. The belief that everyone is created equal and that we all have the same chance to succeed in life would be fundamentally flawed in Galton's view. According to Galton (1869), it is in the most unqualified manner that I object to pretensions of natural equality; the experiences of the nursery, the school, the university, and of professional careers, are a chain of proofs to the contrary. Following this line of thought, the view is that we are not all created equal in our ability to achieve success. Every person has a

unique set of strengths, which can aid in achieving the success they desire. Conversely, each person also has their own unique set of challenges that inhibit them in achieving such success. Hence the view that variation in a natural, general cognitive ability constitutes the main source of individual and group differences in intellectual achievement, both in school and in occupations, therefore, is clear in Galton's writings. Since then, there is ample consensus on the view that individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by engaging mental faculties (OECD, 2020). Results from a number of longitudinal studies attest to the long-term stability of individual differences in intellectual functioning. Hence, according to OECD (2020) to address gifted students' 'uniqueness' is therefore essential in supporting them reaching their full potential and in achieving one of the main requirements of inclusive education: the self-fulfilment and self-respect of individuals.

Not only were people different in their cognitive abilities but Galton also believed that 'the sensory discriminative capacity would be highest among the intellectually ablest' (1884, p.29). His study of the genealogies of eminent persons in many fields led him to a belief in the adaptive value of natural ability which became translated into widespread conviction that general intelligence provides the single most critical psychological factor underlying success in life" (Simonton, 2003). Galton also believed that general ability was more heritable than are special abilities, which are more influenced by environmental opportunity and education and are developed to a distinguished level only through assiduous practice. Although Galton's view is more than a century old, it is still revered in the more recent Eyre Equation (Eyre, 2011). He also held that a sufficiently high level of general ability was required for the distinguished expression of any special talent. Galton thought that intelligence was one of the great traits that superior man possessed and contributed most to their success. More recent research also suggests that these intellectually ablest (gifted/talented) contribute disproportionately to countries' economic growth. For example, Hanushek & Wößmann (2008) provide strong evidence that ignoring differences in cognitive skills significantly distorts the picture about the relationship between education and economic outcomes.

Galton, in his *Inquiries in Human Faculty* (1883), recognised this variation in mental ability (p. 57), that could be manifested in many different kinds of intellectual achievement hence he was convinced that success was due to superior mental ability. Intelligence was therefore regarded as one of the good qualities superior men possessed, which in turn was beneficial for society as a whole. Hence, it seemed obvious and even unarguable to Galton that, from a eugenic viewpoint, superior mental and behavioural capacities, as well as physical health, are advantageous, not only to an individual but for the well-being of society as a whole (Jensen, 2002). Hence according to OECD (2020) to address gifted students' uniqueness is therefore essential not only in supporting them reaching their full potential and in achieving one of the main requirements of inclusive education: the self-fulfilment and self-respect of individuals but also for the benefit of society. Consistent with this view, Galton's seductive promise was of a bold new world filled only with beautiful, intelligent, productive people. In *Hereditary Genius*, Galton envisaged a situation conducive to resilient and enduring civilisation as follows:

The best form of civilisation in respect to the improvement of the race, would be one in which society was not costly; where incomes were chiefly derived from professional sources, and not much through inheritance; where every lad had a chance of showing his abilities, and, if highly gifted, was enabled to achieve a first-class education and entrance into professional life..... (Galton, 1869 p. 362).

More recent views to gifted education therefore assume that the societal reward for finding out how to stimulate gifted children to reach their full potential could be particularly significant (Sahlgren, 2018; Boer, Minnaert & Kamphof, 2013). Moreover, gifted students are regarded as innovators and creators of knowledge who, through the appropriate environment and development, will be able to develop solutions to challenges anticipated in the future (Watters & Diezmann, 2003). A comprehensive and well-implemented gifted education could therefore “offer the possibility of cultivating a society’s most promising talents into a source of exceptional human capital and creative capacity” (Heuser, Wang & Shahid, 2017). These recent considerations mean that the

inclusion of gifted students in order to improve their academic and well-being outcomes is increasingly regarded as a necessity (OECD, 2020).

3.1.2. The 'inheritance' of individual differences in this general ability

Although Galton regretted the term genius and replaced it with natural ability, one might be forgiven for getting the impression that Galton was interested in studying the 'average man'. Contrary to that deluding impression, *nay*, the average person played no part in his studies, other than to be a "sensitive instrument, the benchmark that defined who was exceptional" (Pearson, 1924) – hence the genius. Galton's contempt for the "average man" may well have grown out of his frustration with the "stupidity and wrong headedness" of the crowds that had visited his lab, who wandered in a drunken state, wasted his time puzzling over simple tests or were incapable of completing them without breaking his equipment. Hence, more than a decade before the Anthropometric Laboratory opened, Galton wrote that he looked forward to the day when "the non-gifted would begin to decay out of the land" just as "inferior races always disappear before superior ones." That Galton despised the average man is also evident in that in 1890 he published a little pamphlet extolling the benefits of anthropometrics and its first chapter asked: "Why do we measure humans?" to which Gallon, and consistent with his persuasion techniques which he always had in hand, offered various answers, such as the identification of aptitudes and talents, and perhaps spotting potential health issues that could be corrected early. He stressed that the benefits were to pure science. However, later in the pamphlet he admitted that he was really only interested in exceptional individuals, commenting that "an average man is morally and intellectually an uninteresting being" and therefore "of no direct help towards evolution, which appears to our dim vision to be the goal of all living existence" (Pearson, 1924: 381-85).

With respect to these exceptional individuals and inspired by the power and influence that his cousin Charles Darwin attributed to heredity in the book "*On the Origin of Species*" (1859), Francis Galton became interested in answering the question: What is the source of variation in human abilities? To this end Galton conducted extensive research on the subject and in 1869, he released a compilation of the data he had

collected and published it under the title “Hereditary Genius” (Galton, 1869). In this book, Galton showed that success seemed to run in families, and that the more closely related a person was to a high achiever, the more likely they were to become one themselves (Galton, 1869; Mackenzie, 1976). In short Galton concluded that intelligence, accomplishment, and various other traits were inherited and that a person’s environment had very little to do with the development of such characteristics.

One might then pose the question: *Now that we know that human mental abilities and personality traits are inherited so what?* In other words what was Galton’s aim in trying to prove that intelligence is inherited? In *Inquiries into Human Faculty and its Development*, Galton (1883) summarises his aim as:

...to learn how far history may have shown the practicability of supplanting inefficient human stock by better strains, and to consider whether it might not be our duty to do so by such efforts **as may be reasonable**, thus exerting ourselves to further the ends of evolution more rapidly and with less distress than if events were left to their own course (1-2).

The emphasis on ‘*as may be reasonable*’ is my own and the intention is to point the reader to an important cause for concern in some of Galton’s legacy where he faced a hostile audience. For example, a number of critics have found Galton’s idea of supplanting inefficient human stock to be ‘cruel’, ‘racist’ and ‘disgusting’- just to use a few of their adjectives. Without going much into those debates and subsequently losing focus, it is important just to note that a number of Galton’s biographies attest to his non-cruel nature. For example, according to Terman (1917), it is well known that, in general, a high correlation obtains between favorable mental traits of all kinds. As an example, Terman posits that children superior in intelligence also tend to be superior in moral qualities and Francis Galton was no exception to this rule, as indicated by the following letter written by his mother when the boy was only eight years old:

Francis from his earliest age showed highly honourable feelings. His temper, although hasty, brought no resentment, and his little irritations were soon

calmed. His open-minded disposition, with great good nature and kindness to those boys younger than himself, made him beloved by all his school fellows. He was very affectionate and even sentimental in his manners. His activity of body could only be equalled by the activity of his mind. He was a boy never known to be idle. His habit was always to be doing something. He showed no vanity at his superiority over other boys, but said it was a shame that their education should have been so neglected."

So, it can be argued that Galton was interested in the nature/nurture question not in a cruel sense, but because he thought an answer to it could be used to guide interventions in the world. For Galton, the interventions came in the form of eugenics—a term derived from the Greek word *eugenes*, meaning “good in birth” or “good in stock”. Galton first used the term in 1883 book, “Inquiries into Human Faculty and its Development”.

We greatly want a brief word to express the science of improving stock, which is by no means confined to questions of judicious mating, but which, especially in the case of man, takes cognisance of all influences that tend in however remote a degree to give to more suitable races or strains of blood a better chance of prevailing speedily over less suitable than they otherwise would have had. The word eugenics would sufficiently express the idea.

Eugenics, meaning “good birth,” was Galton’s vision for a science that increased the prevalence of traits deemed desirable (the positive form of eugenics), and decreased the prevalence of traits deemed undesirable (the negative form of eugenics). Galton believed that his family and twin studies pointed to nature trumping nurture when it came to traits such as criminality and intelligence, and so he envisioned eugenics as a scientifically guided social program which would encourage more intelligent and less criminal people to marry and breed more, while less intelligent and more criminal people would be encouraged to marry and breed less.

Following some earlier studies on the breeding of cattle and horses, Galton pondered:

“If a twentieth (fraction) part of the cost and pains were spent on measures for the improvement of the human race that is spent on the improvements of the breed of horses and cattle, what a galaxy of genius might we not create!”

He became convinced that many of society's problems were the result of the irresponsible activities of the least intelligent, and that it might be possible to improve the human species through selection, in much the same way that a horse breeder produces winners by only allowing the swiftest and strongest to interbreed. Galton argued that if the most fit, that is, intelligent members of the species reproduce together, the general level of human intelligence will be raised, eliminating the many social problems brought about by those of low intelligence. Consistent with this view about a galaxy of genius, Galton coined the word *eugenics* to describe the process of human improvement he had in mind, an improvement which encompassed not just mental ability but also physical traits such as health, strength, height and what he called “energy”. Galton argued that “there is no escape from the conclusion that ‘*nature*’ prevails enormously over *nurture*” (1883, p. 241). Joining these two words created a fission that exploded into the longest-lived controversy in the behavioural sciences to date.

While it might be easy to dismiss eugenics as a pseudoscience, the fact is that it appealed to a wide variety of fields. Hence it was supported by many of the leading academics of the day who employed the latest of modern techniques in investigating it. It appeared self-evident to these groups that qualities such as intelligence, mental illness, work ethic, criminality and poverty were inherited. Some experts raised the spectre of social degeneration, insisting that “feeble-minded” people were responsible for a wide range of social problems and were proliferating at a rate that threatened social resources and stability. Therefore, it seemed logical that if undesirable groups were prevented from reproducing, their numbers would decrease to the overall benefit of society. Let us note that the Victorian Literature and Culture (2015), endorse the view that Galton's vision of eugenics was primarily hopeful and forward-looking and as a result many eugenics movements emerged from those who shared this view. After the turn of the century, eugenics movements—including demands for sterilisation of people

considered unfit—had, in fact, blossomed in the United States, Canada, Britain, and Scandinavia, not to mention elsewhere in Europe and in parts of Latin America and Asia. Consequently, in countries such as Sweden and the USA, tens of thousands of people were compulsorily sterilised in the name of eugenics. However, the worst honour to Galton came in Nazi Germany, where eugenics became malodorous precisely because of its connection with Hitler's regime, especially after the second world war, when its complicity in the Nazi death camps was revealed. Hence literature suggests that when Galton popularised the term "Nature versus Nurture" in the late 1800s, his studies resulted in two-pronged eugenics. One prong was positive eugenics, which meant manipulating human heredity or breeding, or both, to produce superior people; the other was negative eugenics, which meant improving the quality of the human race by eliminating or excluding biologically inferior people from the population. The positive variety seeks to promote improvement through rewards, by encouraging those with higher abilities to have more children. Tax breaks and other schemes are what Galton himself had in mind, together with the creation of a *moral* atmosphere which encouraged better breeding, as he would have it out. On the other hand, the negative variety is where critics moan about Galton's ideas as having inspired the policy of forced sterilising, and eventually of exterminating the unfit and those from "inferior races. This was achieved through punishment and compulsion, usually of the legal kind, sometimes involving measures like forced sterilisation of the feeble-minded. Indeed, Eugenics came to be Galton's religion later in his life, and he directed all his efforts in the decade before his death to its promotion. Galton died in 1911, too early to observe the horrors his theory would inspire, so we will never know how he would have responded to them. What is certain though is that his faith in his ideas remained undiminished at his death: he left the equivalent of over £3 million today to found a national eugenics laboratory and endow a professorship of eugenics. He could afford to leave such a large sum because, ironically given his lifelong preoccupation with inheritance, Francis Galton died childless. His ideas were to be his only children.

So, when the phrase "Nature Versus Nurture" was coined by the English polymath, Francis Galton in 1869, a controversial debate has existed since then. For example, the behaviourist John Broadus Watson (1878–1958) in the 1920s and 1930s established

the school of *purist behaviorism* that would become dominant over the following decades. Watson is often said to have been convinced of the complete dominance of cultural influence over anything than heredity might contribute. This is based on the following quote, which is frequently repeated without context, as the last sentence is frequently omitted, leading to confusion about Watson's position:

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief and, yes, even beggarman and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. I am going beyond my facts, and I admit it, but so have the advocates of the contrary and they have been doing it for many thousands of years.

During the 1940s to 1960s, Ashley Montague was a notable proponent of this purist form of behaviorism which allowed no contribution from heredity whatsoever:

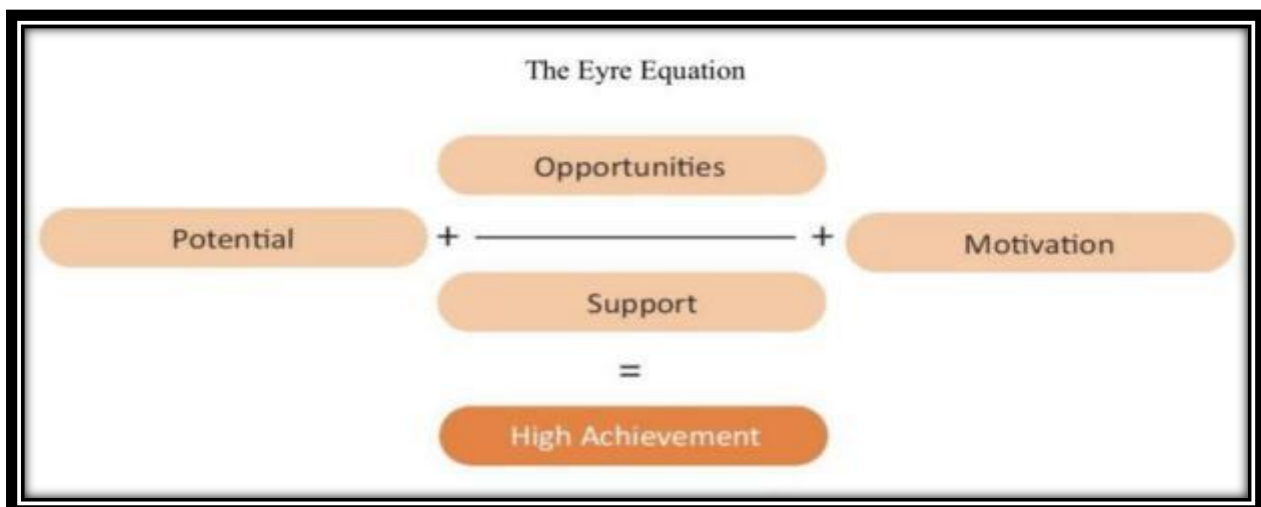
Man is man because he has no instincts, because everything he is and has become, he has learned, acquired, from his culture ... with the exception of the instinctoid reactions in infants to sudden withdrawals of support and to sudden loud noises, the human being is entirely instinctless.

However, even though Galton favoured heredity, he was careful to add that “Neither of the terms implies any theory: natural gifts may or may not be hereditary; nurture does not especially consist of food, clothing, education or tradition, but it includes all these and similar influences whether known or unknown” (Galton, 1874: p. 12). He went on: “It is needless to insist that neither is self-sufficient; the highest natural endowments may be starved by defective nurture, while carefulness of nurture can overcome the evil tendencies of an intrinsically bad physique, weak brain, or brutal disposition” (Galton, 1874: pp. 12–13). This would be consistent with Gagné argument that giftedness or potential [nature] would not translate into talent if the developmental catalysts [nurture] were weak. However, Galton concludes that: “In the competition between nature and

nurture, when the differences in either case do not exceed those which distinguish individuals of the same race living in the same country under no very exceptional conditions, nature certainly proves the stronger of the two” (Galton, 1874: p. 16). It can be argued therefore that while Galton may have led claim to this still widely studied dichotomy, his beliefs weighed heavily on the genetic predisposition to abilities in general.

To date those who agree with the nature side argue that the DNA and genotype that we are born with determine who we are and what personality and traits we will have. On the other hand, those who agree with the nurture side of the debate argue that we are born with our minds as a 'blank state'. Through learning experiences and interactions with the world around us, we begin to gain an understanding of life and acquire different attributes. One of the major reasons we are unable to resolve the nature-nurture debate is that all these different questions are tangled together into an indissoluble knot, making it all but impossible for us to stay clearly focused on a single, well-defined and meaningful question [Fox, 2010]. Hence, some people believe in both sides of the argument, saying that although we can learn and acquire traits from our surroundings, we are also born with unique abilities. When psychologist Donal Hebb was asked which contributes more to personality, nature or nurture, he answered: Which contributes more to the area of the rectangle, its length or its width? In Gifted Education, the Eyre Equation captures this view well.

Figure 3.3 The Eyre Equation of gifted education [Source: Eyre, 2011].



Basically, it has been widely agreed that both genetics and environment play a role in determining giftedness, but their relative importance is still being debated. In short, to be considered gifted, a child needs to have the right biological make up (genes, brain structure) and environment (education, exposure, diet, emotional security) to enhance and bring out the gifts (Aziz et al. 2021). It is this same view that is shared in Gagné's Differentiated Model of Giftedness and Talent (DMGT). Today, scientists have also come to realize that the question of “nature versus nurture” is a false dichotomy. In reality, very few human traits are the result of only genes or only the environment. Rather, there are two factors that distinguish a person's level of intelligence, namely (1), the heredity factor (hereditary), which comes from genes that are brought from parents and (2) environmental factors, both in the home environment and in the school environment.

Similarly, OECD (2020) point to more recent developmental models, such as Gagné's, that have been central in shifting the conceptualisation of giftedness towards the idea of “potential”. The tendency to conflate giftedness with talent is challenged by Gagné (2004), who makes a distinction between the two in his Differentiated Model, a model used in various countries such as in Australia (Merrotsy, 2017). Gagné clarifies that while giftedness is a prerequisite for talent, gifts do not necessarily become talents because for this to occur, a child or adolescent must engage in systematic learning and practice within a supportive environment (Gagné, 1985). That the two terms are used interchangeably point to the fact that giftedness is increasingly viewed as a process subject to the environment within which it is nurtured and encouraged to thrive (Subotnik, Olszewski-Kubilius and Worrell, 2011). Consequently, the transformation that occurs from the potentiality of a gift to the realisation or performance of a talent exists on a continuous spectrum, and the two concepts cannot be thought of as strict binaries. The distinction made by Gagné is nevertheless emphasised to underscore that under particular systems and teaching, potential, and the close relationship it shares with latent talent, may be undeveloped. Furthermore, it acknowledges the counter-intuitive, and thus overlooked, reality that educational underachievement can become a predictable outcome for many gifted students when they are left behind (Subotnik, Olszewski-Kubilius and Worrell, 2011[23]; Mendaglio, 2013[24]). Importantly, Gagné's

model is based on the differentiation of “gift” and talent” which is today considered as fundamental to current debates in the field.

3.1.3. The measurement of general ability

Galton had *quantofrenia*, a term coined by Sorokin (1956) to designate the attitude of those researchers who want to quantify all and everything. He was so obsessed with measurement that his intellectual career seems to have been dominated by a belief that virtually anything was measurable. This true passion for measurement was evidenced by his motto: “Whenever you can, count”. He promoted the idea of objective measurement and quantitative analysis of data, whether by counting, ranking, or by true measurement. He held that objective measurement and the mathematical treatment of quantitative data were essential for a science of human variation; he applied this philosophy to most physical and mental characteristics that were within his power to count, rank, or measure.

Statistics are the only tools by which an opening may be cut through the formidable thicket of difficulties that bars the path of those who pursue the Science of Man. [a quote from Sir Francis Galton].

Although this passion for measurement led to the origination of a number of statistical and psychometric concepts familiar to present-day researchers, this study will only focus on those that gifted education has benefitted from.

The first one of these contributions is the use of intelligence tests. Despite the debates for and against testing, intelligence tests still provide an objective and systematic way for identifying gifted children. Most historical texts on intelligence testing use Francis Galton as a starting point. Since Galton was so intelligent himself, it is not surprising that he became curious about a way to measure people’s intelligence. He believed that many aspects of human nature, including intelligence, could be measured scientifically. Galton believed that intelligence was a function of sensory acuity. Thus, individuals who exhibited high degrees of sensory discrimination were assumed to be highly intelligent.

With specific reference to intelligence, Galton believed that it could be assessed through measuring reaction times, highest audible tone, head size, visual acuity, and colour sense. After devising a wide range of measurements, and instruments to match, and persuading the general public, to pay three pence [3d] each for the privilege of being measured “scientifically”; some 17,000 individuals were measured for various characteristics: strength, weight, height, length and breadth of the head, arm span and lung capacity, visual and auditory reaction time, and perceptions of length between the 1880s and 1890s. About 7,500 of the individual data records have survived to the present day (Johnson et al., 1985).

Galton theorised that because quickness and other physical attributes were evolutionarily advantageous, they would also provide a good indication of general mental ability (Jensen, 1982). He founded his entire theory of intelligence on the premise that if one was smart, one would have a faster reaction time than someone less intelligent. Hence he developed his intelligence test based on testing reaction times. One way that Galton tested reaction time was through sounds. He would have the participants listen to a sound and identify it as fast as possible. The faster the person identified the sound, the more intelligent he declared them to be. However, Galton’s test did not stick as the principal way to measure intelligence mainly because he used a characteristic, such as physical ability, to determine an abstract characteristic i.e., intelligence. Even though Galton’s instruments and techniques lacked the precision and reliability needed to evaluate his hypothesis properly, and the methods of statistical inference required for interpreting his data, when the analysis of variance was later applied to Galton’s data, in 1985, it proved unequivocally that Galton was on the right track (Johnson et al., 1985). Groups that he had classified by educational and occupational level, which were Galton’s only criteria for differences in mental ability, showed statistically significant differences in Galton’s simple sensory and reaction time tests. Hence, even though Galton’s intelligence test did not stand the test of time in the same way others of his accomplishments did, it still was a breakthrough contribution to the fields of psychology and education. In fact within the last few decades, Galton’s hypothesis has been revived and the correlation between sensory acuity and higher cognitive abilities is indeed positive as Galton predicted (Jensen, 2006). The value of

IQ testing is most evident in educational settings especially gifted education. Without IQ testing—or another measure of intelligence—children and adults needing extra support might not be identified effectively.

Galton's second contribution comes in the form of the normal distribution or bell curve. Sir Francis Galton was fascinated with the order of the bell curve that emerged from the apparent chaos of beads bouncing off pegs in the Galton Board [see **Figure 3.4**]. The Galton board, also known as the Galton box or quincunx or bean machine, is a device invented by Sir Francis Galton to demonstrate the central limit theorem, in particular that with sufficient sample size the binomial distribution approximates a normal distribution. Among its applications, it afforded insight into regression to the mean or "reversion to mediocrity". This played a pivotal role in his development of statistical theory, concepts that remain fundamental today. He eloquently described this relationship in his book *Natural Inheritance* (1889):

Order in Apparent Chaos: I know of scarcely anything so apt to impress the imagination as the wonderful form of cosmic order expressed by the "Law of Frequency of Error". The law would have been personified by the Greeks and deified, if they had known of it. It reigns with serenity and in complete self-effacement amidst the wildest confusion. The larger the mob, the greater the apparent anarchy, the more perfect is its sway. It is the supreme law of unreason."

Galton saw "bell curves" wherever he went and was principally responsible for the transformation of the normal distribution (he coined the word normal") from being a "law of error" used mainly in astronomy to a "law of nature" applicable to almost every facet of commerce, industry and everyday life.

Figure 3.4 The Galton Board



With this gadget, the quincunx, he demonstrated and to some extent proved the tendency towards “normality” in nature. By so doing he brought mathematical statistics into the realm of the social sciences and invented the concept of statistical correlation. He insisted that variety is ever present, but that there is often order in what may seem chaos and sometimes there is at least some structure in the seemingly unpredictability of random events. In the late 1860s, Galton conceived of a measure to quantify variation: the standard deviation. It is easy to understand why the mathematical characteristics and the statistical property of the normal curve makes it attractive to all the sciences. In fact, it makes it possible to apply statistical models even to social and

behavioural sciences. Without the normal curve, it would be difficult for psychology to define itself as “a science” in a quantitative sense hence normal distribution of scores, values and data is still seen as the proof of a valid measurement (Sartori, 2006).

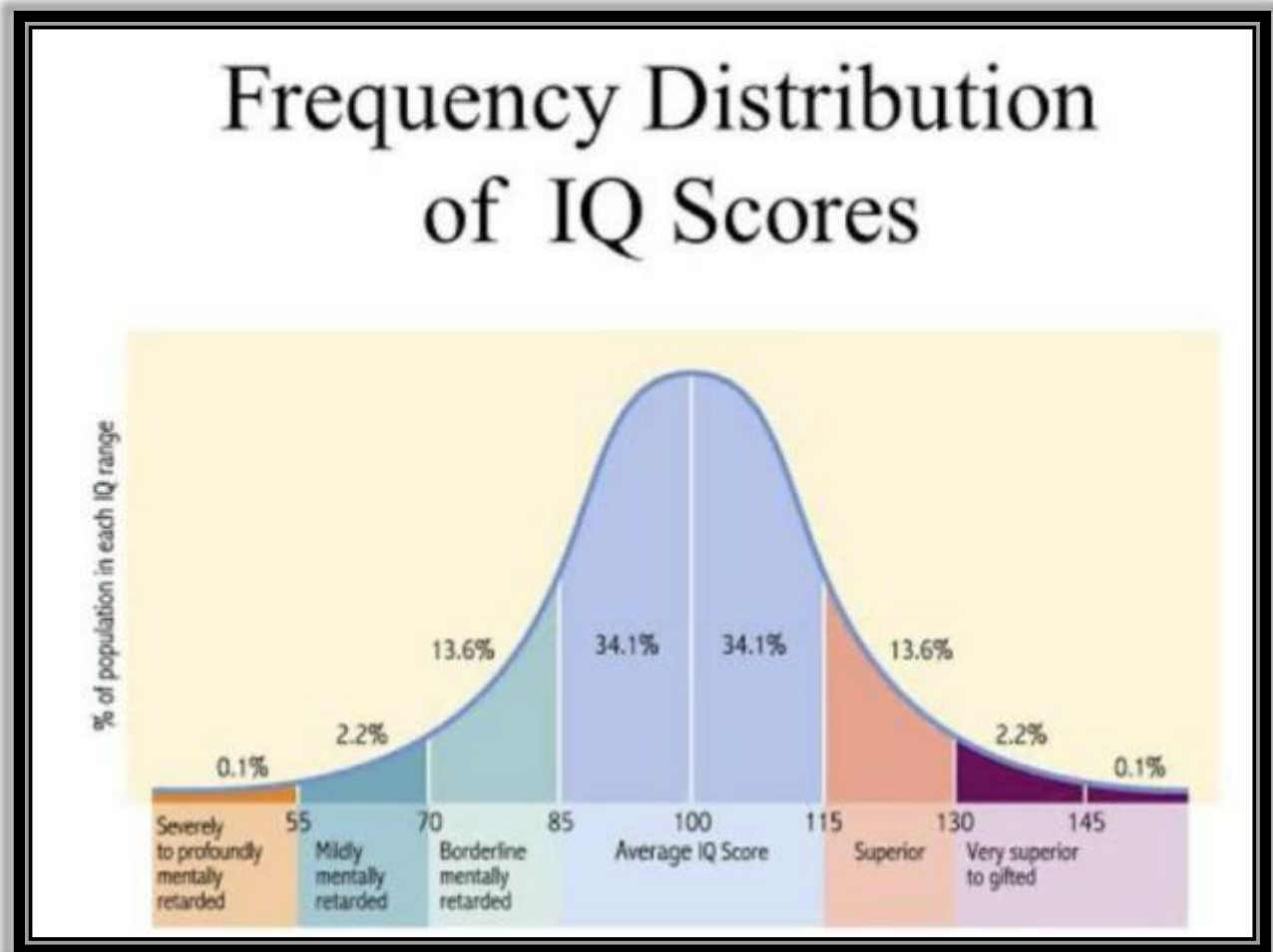
Following this logic, he also popularised the concept that the spread of human abilities like intelligence tends to follow a normal distribution, or bell curve (an idea featured most prominently in the 1994 book *The Bell Curve*). Galton’s delight with the normal distribution, and its success in describing many physical phenomena in fields such as astronomy (Porter 1986), persuaded him that it would permeate all manner of other measurements and in particular mental measurements. He was so impressed with the way it described stature distributions (in France, Scotland and England) that he insisted it had to describe mental measurements also (Galton 1869, 32–3):

Now, if this be the case with stature, then it will be true as regards every other physical feature —as circumference of head, size of brain, weight of grey matter, number of brain fibres, etc.; and thence, by a step on which no physiologist will hesitate, as regards mental capacity.

Hence Galton was the first to demonstrate that the Laplace-Gauss distribution or the “normal distribution” could be applied to human psychological attributes, including intelligence (Simonton, 2003). He held that the distribution of intelligence in the population, like that of many hereditary physical traits, conforms to the normal, bell-shaped curve. His conception of ability as a normally distributed continuous trait represented a break with the typological thinking of his contemporaries; they viewed both genius and mental deficiency as distinct types of intelligence, separate from the general run, not the upper and lower extremes of a continuous distribution.

Galton concluded that general ability, or intelligence, is normally distributed in the population, so measures of rank order could be converted to percentile ranks, which in turn could be transformed to normal deviates. Since Galton scaled intelligence in units of the semi-interquartile range of the normal frequency distribution, his scale can be transformed exactly to the scale of IQ used in all present-day IQ tests.

Figure 3.5 Distribution of IQ scores in the General Population



This curve tells us that the average IQ score is 100, and about 95% of the population have an IQ score (measured by a valid IQ test) somewhere between 70 and 130. The curve shows that 68% have an IQ level between 85 and 115. Each 15 IQ point interval is called one standard deviation – so we can say that 95% of the population have an IQ between -2 and +2 standard deviations from 100. Only 2.2% of the population has an IQ score below 70 (American Psychological Association [APA], 2013). A score of 70 or below indicates significant cognitive delays, major deficits in adaptive functioning, and difficulty meeting “community standards of personal independence and social responsibility” when compared to same-aged peers (APA, 2013, p. 37). An individual in this IQ range would be considered to have an intellectual disability and exhibit deficits in intellectual functioning and adaptive behavior (American Association on Intellectual and Developmental Disabilities, 2013). Formerly known as mental retardation, the

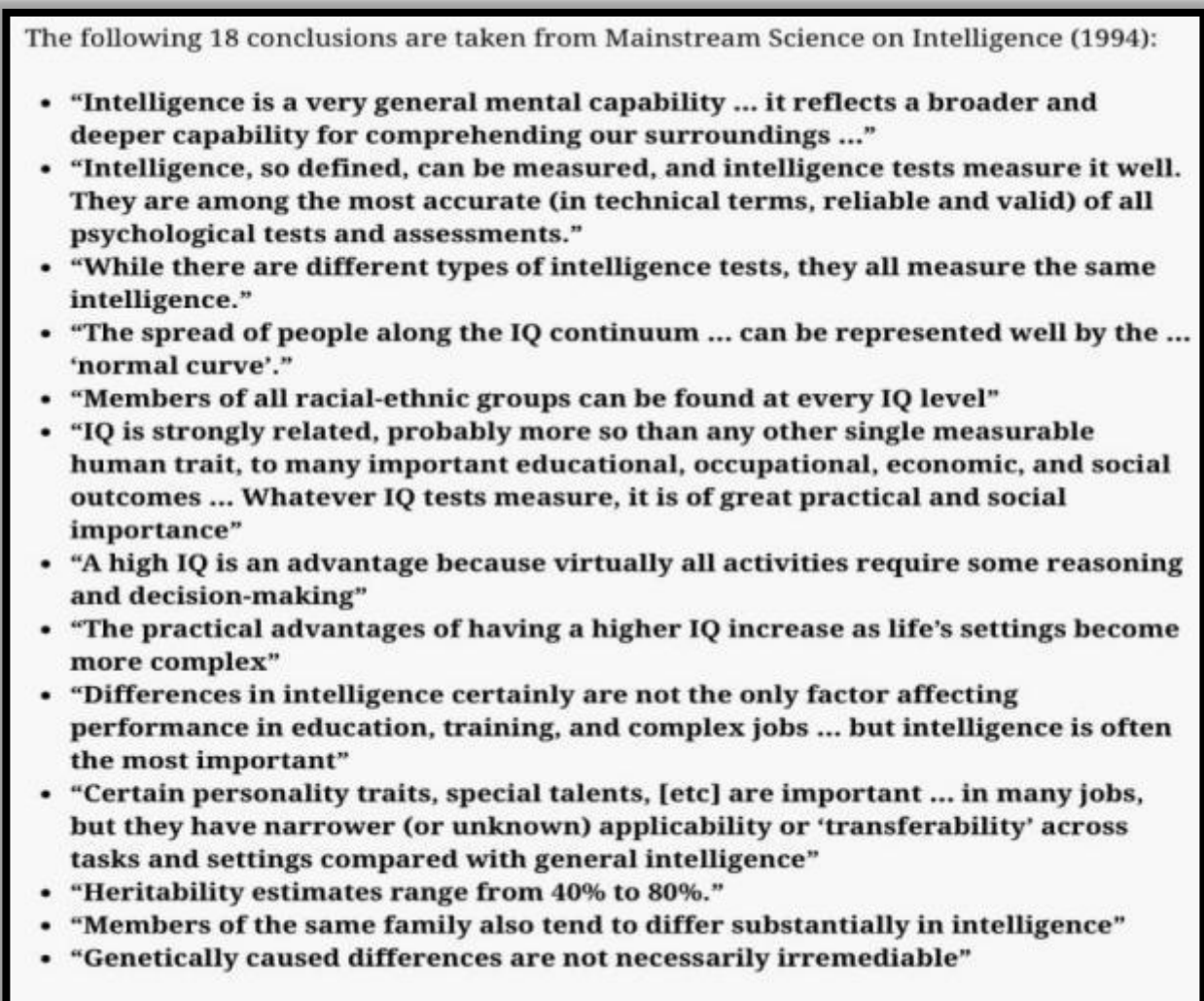
accepted term now is intellectual disability, and it has four subtypes: mild, moderate, severe, and profound.

On the other end of the intelligence spectrum are those individuals whose IQs fall into the highest ranges. Consistent with the bell curve, about 2% of the population falls into this category. People are considered gifted if they have an IQ score of 130 or higher, or superior intelligence in a particular area. Long ago, popular belief suggested that people of high intelligence were maladjusted. This idea was disproven through a groundbreaking study of gifted children. In 1921, Lewis Terman began a longitudinal study of over 1500 children with IQs over 135 (Terman, 1925). His findings showed that these children became well-educated, successful adults who were, in fact, well-adjusted (Terman & Oden, 1947). Additionally, Terman's study showed that the subjects were above average in physical build and attractiveness, dispelling an earlier popular notion that highly intelligent people were "weaklings."

The Bell Curve was controversial and a lot of similarly controversial reports and discussions about IQ were also generated. As a consequence, the validity of psychological instruments, such as IQ and mental abilities tests, is now and again under similar scrutiny. The controversy over the Bell Curve was at its height in the fall of 1994 after the publication of the book by the same title. To counter these reports an IQ manifesto was issued in the Wall Street Journal in December 1994, signed by 52 professors specializing in intelligence and related fields, including around one third of the editorial board of the journal *Intelligence* [Gottfredson, 1997]. The experts represented a variety of disciplines, including anthropology, behavior genetics, mental retardation, neuropsychology, sociology, and various specialties in psychology such as psychometrics, child development, educational psychology, and personnel selection. The IQ manifesto – called 'Mainstream Science on Intelligence' represents the findings widely accepted in the expert community in 1994. This statement outlines conclusions regarded as mainstream among researchers on intelligence, in particular, on the nature, origins, and practical consequences of individual and group differences in intelligence. Its aim is to promote more reasoned discussion of the vexing phenomenon that the research has revealed in recent decades. The following

conclusions are fully described in the major textbooks, professional journals and encyclopaedias in intelligence.

Figure 3.6 Conclusions about Bell Curve and intelligence [Source: Gottfredson, 1997]



Because so many people believe that the bell curve represents the way things are in nature, the ideal of a normal distribution has been naturalized in education and, to some extent, in society at large. Sorting students by ability is one among several competing purposes of education and educators who promote sorting often justify those practices on the basis that a bell curve represents the normal distribution of things in the natural world. Normal distribution patterns have provided justification for norm-referenced standardized tests, grading on a curve, detection of "at risk" students, and the whole

concept of an intelligence quotient. Insofar as the normal curve is held to be a model of natural distribution, the normal curve is regarded as an objective basis for sorting people. The bell-curve model of distribution has been taken for granted in education because it is generally accepted to be a fact of life.

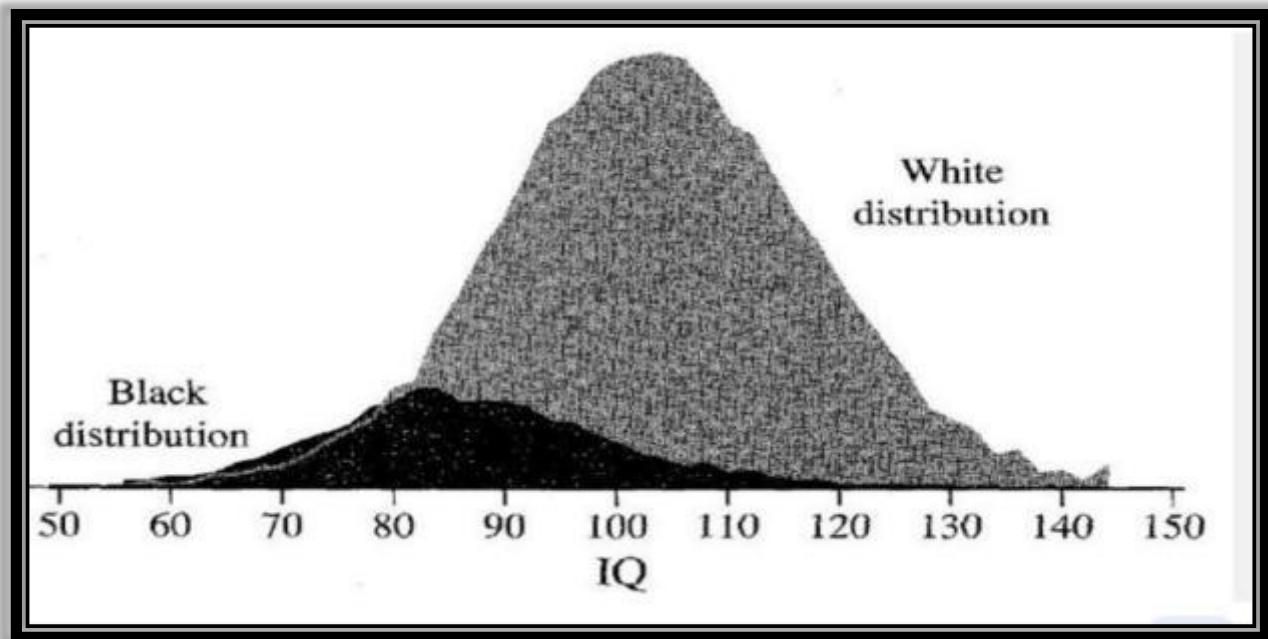
Similarly it is doubtful whether gifted education would survive without the normal curve given that giftedness refers to children who have an IQ of 130 or higher (Lally & Valentine-French, 2015). Fendler & Muzaffar (2008) argued that the bell curve has also shaped the idea of normal in education by functioning as a technology of risk management. The successful management of educational endeavours (including setting policies, building schools, setting standards, and the like) rests on the ability to predict what is going to happen in the future in order to anticipate problems and take proper precautions. This sort of thinking constitutes rational planning for purposes of managing schools at all levels. The bell curve contributes to rational planning by creating the Average Student. If schooling practices can be seen to serve the needs of the Average Student, then those practices can be regarded as reasonable by the general public. Hence the normal curve is a ubiquitous model in the subject of intelligence and achievement measurement, and is, therefore, a fixture, too, in any introductory course in educational psychology or teacher education.

3.1.4 Racial differences in general ability

While many of Galton's scientific contributions are revered to date, his work is also considered distasteful due to the strong connotations of racism. With specific reference to intelligence and gifted studies, South Africa presents an ideal context where the racist view to intelligence was hatched and has remained entrenched in the education system. Galton's African experience was, indeed, important in the development of the biometric statistics, but in South Africa it was also much more significant in the development of racism than scholars have yet recognized. In all of his important works, with the exception of *Natural Inheritance*, Galton relied heavily on the evidence of his travels in South Africa to build his case for eugenic reform. The operations of the normal curve, decades before he had worked out the mathematics, were established using claims

based on his African travels. The connections between Galton's travels in South Africa and his interest in eugenics have been noticed by several historians, but most have moved quickly on, embarrassed, perhaps, by the extremity of his views on Africans. In this regard, Galton conjectured that the difference in general ability between African Blacks and European Whites is twice the semi-interquartile range (equivalent to 1.33 standard deviations or 20 IQ points on present-day IQ tests) between the means of the normalized frequency distributions of the two populations. Galton had no means for directly or rigorously testing this hypothesis, but from his extensive field observations during his explorations in Africa, he made an admittedly rough estimate of the average individual's position in the normal frequency distribution of what he conceived as general mental ability, theoretically scaled on 'Anglo-Saxons', and suggested that Africans were 'two grades' below Anglo-Saxons on his scale [See **Figure 3.7**]. Although Galton's book, *Narrative of an explorer in tropical South Africa* – was published in 1853, a century later in 1953 the view that Black Africans were inferior than their White counterparts formed the basis of creating the Bantu Education Act of 1954. Subsequently during apartheid South Africa, repressive Bantu education, which was the law of the land, did not allow for the identification of non-white learners who might qualify, if tested, for participation in existing gifted and talented programs (Christie, 1991; Nkabinde, 1997). Hence, learners who presented certain exceptional intellectual characteristics under the repressive Bantu education went unrecognised.

Figure 3.7 Differences in Black and White levels of intelligence [Herrnstein & Murray, 1994:279].



According to Moore (2002), one of the lessons of the tragedies of the early twentieth century is that our beliefs about these issues have important influences on our behaviours in both the public and private domains. For example, in South Africa the racist view to intelligence has been the populist view and this in turn has contributed to the demise of gifted education both locally and globally. However, this study's point of departure was in its recantation from the populist view to gifted education in South Africa and was therefore anchored in the 'change of subject' view. Modern scientific consensus rejects the racial view as being irreconcilable with modern genetic research. More recent recommendations are that programs for exceptional students must be inclusive rather than exclusive" because recognising the potentials and talents of all children requires a broadened vision of giftedness that reflects the understanding that talent and creativity vary markedly among individuals of varying cultural, ethnic, socioeconomic, and linguistic backgrounds (Ford, 1995a, p. 60; Richert, 2003, pp. 149-150). In the introductory chapter I have shown how inclusive education has covertly excluded STEM gifted learners especially those from previously disadvantaged backgrounds. Hence, as the old saying goes, "If we continue to do what we've always done, we'll continue to get what we've always gotten." For example, the Jacob Javits Gifted and Talented

Students Education Act of 1988 established that “outstanding talents are present in children and youth from all cultural groups, across all economic strata, and in all areas of human endeavour” (U.S. Department of Education, 1993, p. 26). Therefore, the premise that groups differ on the average in general mental ability (intelligence) is not only deficit thinking but it “is harmful as well as unsound and has no place in educational settings” (Ford, 2003 p. 511). Hence any suggestion to the contrary that giftedness may not exist in equal measure in all race-gender-economic groups is labelled “deficit thinking” and rejected as destructive or racist. For example, in his paper entitled: *Two Other Wrongs Don’t Make a Right: Sacrificing the Needs of Diverse Students Does Not Solve Gifted Education’s Unresolved Problems*, Ford (2003) argued that society is punishing minority students who are gifted and have the potential to achieve at higher levels. These students are being denied opportunities to participate in gifted education for numerous emotional rather than rational reasons hence they are innocent victims for the sins of a society and an educational system that have not adequately addressed historical and contemporary social injustices [such as apartheid].

More recent views in South Africa share similar concerns. For example, in their paper entitled: *Exorcising the ghost of the past: The abandonment of obsession with apartheid*, Rafapa & Mahori (2011) bemoan the practice of bending towards ‘populism’ while failing to handle a topical issue [such as apartheid and racism] in a manner that differs from popular ways in which such an issue is conceived of. They point to the need for Black South Africans to stop apportioning blame for South Africa’s ills on the legacy of apartheid and begin to reflect on their own thoughts and attitudes with regard to issues that are posing challenges in the new South Africa. In fact de Groot cautioned us that those who judge Galton harshly may be judged just as harshly in future. All these recommendations suggest that trying to pretend that the past didn’t exist is less productive than acknowledging it and coming to terms with it. In South Africa, Phaswane Mpe considers the process of exploring the politics of apartheid and racism not as a burden, “but as an opportunity to explore stories that have not been told on the one hand and on the other, to revisit old stories, retell them in a new context and see what you can learn”, because in the process, “you’ll also be seeing what you can retain and what you can do without in the present” (Attree 2005: 146). Similarly in Galton’s legacy

there are many ideas which we can do without in the present yet there are also many others which we should have retained. Galton's most impressive legacy, arguably, is his continued influence on these very fields nearly a century after his death. In fact, Galton's publications can be found cited in numerous scientific articles today (Simonton, 2003).

3.2 Global interest in gifted education

Although many of the problems related to gifted education, such as difficulties with identification, and lack of money and qualified teachers, seem ubiquitous, what also seems to universal is the interest all nations display in providing special programs of some sort for their gifted/talented young people (Alfaiz et al., 2022). Perhaps what is most heartening is that many nations not only see their own survival tied to gifted/talented education but also the survival of the planet. Such enlightened thinking is to be applauded for indeed the welfare of all humanity may in large measure be dependent on the careful nurturing of its best young minds. So, what really drives this global interest in gifted education one might ask. Given that gifted/talented programs exist world-wide and that they continue to develop; Alfaiz, et al., (2022) then asked “Why” and proposed major reasons why this has occurred. These reasons are now going to be discussed in more detail.

3.2.1. Socially desirable behaviours and traits

Since I have earlier argued that Galton is still considered the father of gifted education it would also be logical that we understand what really drove his interest and whether to date we still share those thoughts. Galton's thesis was that people with acceptable hereditary qualities should marry with care and have large numbers of children [this was positive eugenics], while those who possessed hereditary disabilities should be discouraged from having children [this was negative eugenics] (MacKenzie, 1975). Admittedly there is and shall always be the dark side of eugenics, but researchers caution us to check for Galton's position in that mess. Sir Francis Galton coined the term eugenics in his 1883 book *Inquiries in Human Faculty and its development*, he defined it as the use of positive practices to promote healthy and intelligent people to

have more children, thereby improving the human race. Although in Galton's work, he approached the subject of negative eugenics with caution and avoided topics such as sterilization and contraception (Mackenzie, 1975) Galton's eugenics theory has been severely misinterpreted and misused to the detriment of Galton's otherwise immaculate reputation. Eugenics fell into disfavour after the perversion of its principles by Nazi ideologists, and indeed, because of the racist direction the eugenics movement took in the United States as well, many academics after World War II began to deny that races exist, that genes matter, and that intelligence or impulse control are heritable traits that help predict the relative success of different people or groups (Pinker 2002; Cofnas, 2016). In the process, maybe unfairly, these extreme negative eugenics brought Galton's work into disrepute. Today we should continue to learn from this episode in history, but we should stop allowing it to silence any discussion of the merits of eugenic thinking. According to Plomin et al. (2016) in order to learn from the history of eugenics, there is a need for clarity about exactly what was wrong about past eugenic programmes:

For the history of eugenics to be instructive in ensuring social justice with greater knowledge about genes, and perhaps some ability to alter them, the key question is whether ... eugenics was wrong in its very inception. If so, any eugenics programme will be wrong. On the other hand, if the abuses done in the name of eugenics do not necessarily reflect badly on eugenic ideas themselves, then our task will be to ensure that any eugenic interventions of the future avoid these abuses.

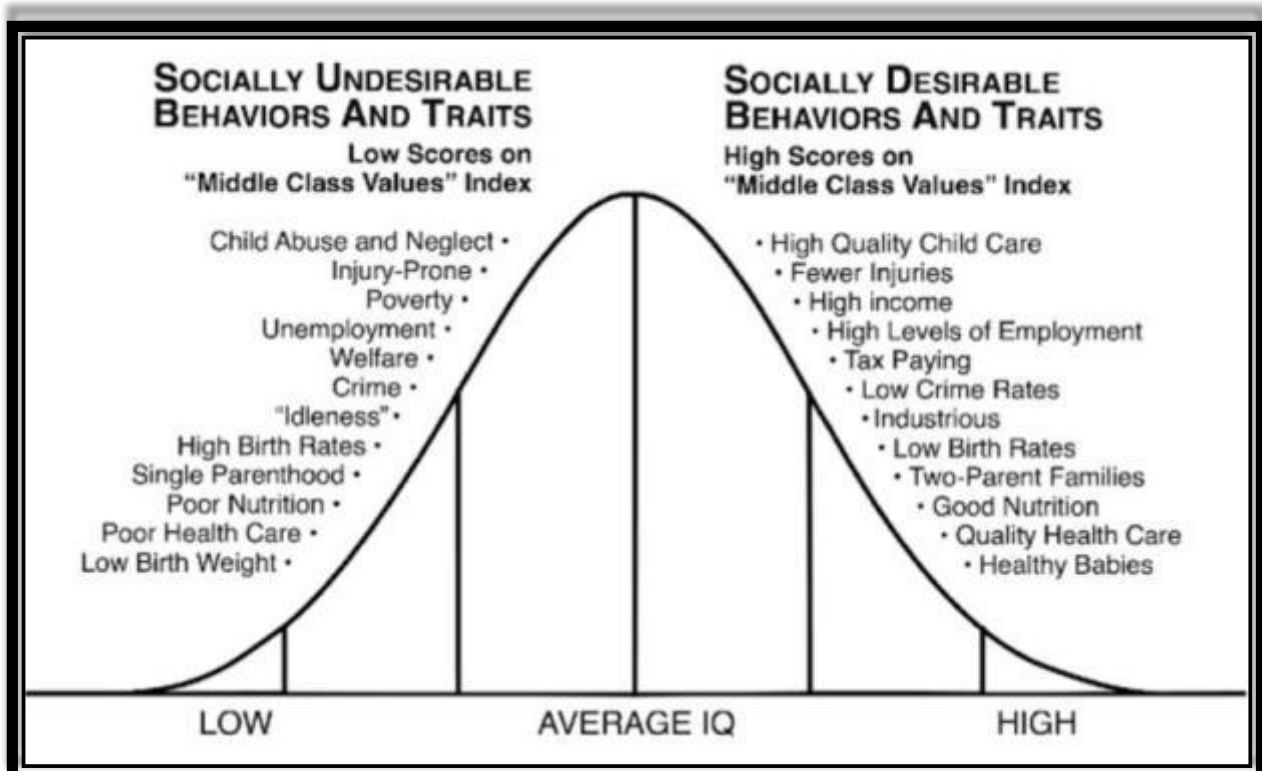
In fact, much of Galton's views on genetics were underpinned with a concern for social justice and this is evident in a number of reports showing that Galton was also frustrated by fellow eugenicists who lacked the patience or rigour to follow the evidence. In *Essays in Eugenics* (1909), Galton urged eugenics advocates not to overstate its benefits or move too fast in its application. "A great deal of investigation is still needed to show the limit of practical eugenics," he wrote.

There are two intertwined drivers for gifted education which can be linked directly to Galton's work (1) the promotion of socially desirable behaviours and (2) the nurturing of potential in scientific skills. Galton was fascinated by his cousin Charles Darwin's ideas about natural selection and survival of the fittest. Galton argued that if the most fit, that is, intelligent members of the species reproduce together, the general level of human intelligence will be raised, eliminating the many social problems brought about by those of low intelligence. It turns out, however, that Galton's original hypothesis was essentially correct; this fact remained unrealised in his time because of the generally low reliability of much of his data—especially that on reaction time, and because appropriate statistical techniques had not yet been invented for determining the significance of his findings. When modern statistical techniques, such as the analysis of variance and multiple regression, were applied to Galton's original massive data, they confirmed his observations—that great overlap exists for the score distributions of the various occupational and educational categories and that the average differences (in the predicted direction) between these various categories appear almost negligibly small. It was also found that most of the average differences are statistically highly significant ($p < .001$), which in Galton's time could not be ascertained (Johnson et al., 1985). Today many of Galton's intuitive hypotheses have proved amazingly fruitful, although in his time the technical means for properly testing them was lacking.

Hence for progressives who agreed with Galton's intuitive hypotheses, eugenics was a branch of the drive for social improvement or perfection that many reformers of the day thought might be achieved through the deployment of science to good social ends. Though no agreement could be reached as to absolute morality, the essentials of eugenics may be easily defined. All creatures would agree that it was better to be healthy than sick, vigorous than weak, well-fitted than ill-fitted for their part in life; in short, that it was better to be good rather than bad specimens of their kind, whatever that kind might be. Eugenics, of course, also drew appreciable support from social conservatives, concerned to prevent the proliferation of lower income groups and save on the cost of caring for them. The progressives and the conservatives found common ground in attributing phenomena such as crime, slums, prostitution, and alcoholism primarily to biology and in believing that biology might be used to eliminate these

discordances of modern, urban, industrial society. The core principles of eugenics as they came to be understood by the mid-1930s were summarised in a report, *Eugenical Sterilization: A Reorientation of the Problem*, published in 1936 by the Committee for the Investigation of Eugenical Sterilization of the American Neurological Association. The report articulates four major principles: first, that a number of social and behavioural problems, such as "insanity, feeble-mindedness, epilepsy, pauperism, alcoholism and certain forms of criminality are on the increase"; second, that people bearing these various defective traits "propagate at a greater rate than the normal population"; third, that such defects in mental function and behavior are "fundamentally and mainly hereditary"; and fourth, that the environment in which a person was raised was of much less importance than the germ plasm inherited from his or her parents as the cause of "adverse social status," criminality, or general "social maladjustment." **Figure 3.8** captures both the socially undesirable as well as the desirable behaviours.

Figure 3.8 Socially desirable and undesirable behaviours and traits [Source: Eyre, 2011].



In more recent studies the relationship between levels of IQ and socially desirable behaviours continues to be researched. For example, Kaufman (2018) argues that yes, IQ tests measure an important set of cognitive abilities for dealing with on-the-spot novel and complex problem solving. However, IQ is also a societal outcome, deeply intertwined with a larger nexus of other positive societal outcomes. When it comes to relationships between this societal outcome and other important societal outcomes, the data don't simply speak for themselves. It is empirically true that the cognitive abilities that are measured on IQ tests are positively correlated with each other, giving rise to a "general intelligence factor". It is also true that the cognitive skills that are most strongly related to IQ (e.g., abstract reasoning, working memory, vocabulary, visual-spatial mental rotation) are highly general in the sense that they facilitate the speed and efficiency of learning novel and complex information across a wide range of contexts. Similarly, Jensen (2018) also conclude that IQ also correlates positively with family income, socioeconomic status, school and occupational performance, military training assignments, law-abidingness, healthy habits, illness, and morality. In contrast, IQ is negatively correlated with welfare, psychopathology, crime, inattentiveness, boredom, delinquency, and poverty. The overall finding was that people who show *fewer* negative externalising behaviours such as cheating, stealing, breaking rules, or harassing somebody else on purpose--have higher IQs. More intelligent people tend to follow rules and be less aggressive and better behaved, research finds. On the other hand, young people with lower IQs, though, are more likely to take part in antisocial behaviour, such as harassing or alarming others. Boys who are antisocial have an average IQ 10 points lower than their more social counterparts. These socially desirable behaviours continue to be revered to date given that education is described as the process of bringing desirable changes into the behaviour of human beings. The behavioural changes must be directed towards a desirable end. They should be acceptable socially culturally and economically and result in a change in knowledge, skill, attitude and understanding.

Besides this correlation with socially desirable behaviours, a second motivation driving the work of Galton, and contemporaries such as James Cattell, was the perceived need to identify and nurture those individuals, who by virtue of their potential as scientists, were viewed as essential to the advancement of society. By 'society' they were typically

thinking of industrialized Western societies and the principal method of measuring scientific achievement was in terms of the reputation a scientist enjoyed among his/her peers. Thus, one of the very first databases to be used for a league table was Cattell's American Men of Science (Cattell 1906) in which he listed biographical details of 1000, rising to 34,000 in 1944, American scientists. The belief that more and better scientists held the key to prosperity and progress was shared by many intellectuals at the end of the nineteenth century, and not just by scientists themselves. The belief that heredity was the key to this was also a widely held assumption (Sutherland 1984). Galton himself was primarily an empirical experimentalist and his contribution, also taken up by Cattell, was to propose ways in which one could identify such (potential) scientists by virtue of measuring the characteristics of families, institutions, regions, etc. With the development of sophisticated devices for measuring 'mental ability', starting with the Binet-Simon tests in 1905, the identification of talented individuals was about to become the subject of a scientific specialism in its own right – psychometrics.

For example, to study gifted children, Lewis Terman and his colleagues (Terman & Oden, 1959) selected about 1,500 high school students who scored in the top 1% on the Stanford-Binet and similar IQ tests (i.e., who had IQs of about 135 or higher), and tracked them for more than seven decades (the children became known as the "termites" and are still being studied today). This study found, first, that these students were not unhealthy or poorly adjusted but rather were above average in physical health and were taller and heavier than individuals in the general population. The students also had above average social relationships—for instance, being less likely to divorce than the average person (Seagoe, 1975). Terman's study also found that many of these students went on to achieve high levels of education and entered prestigious professions, including medicine, law, and science. Of the sample, 7% earned doctoral degrees, 4% earned medical degrees, and 6% earned law degrees. These numbers are all considerably higher than what would have been expected from a more general population. Another study of young adolescents who had even higher IQs found that these students ended up attending graduate school at a rate more than 50 times higher than that in the general population (Lubinski & Benbow, 2006).

From these and many other studies, the idea that IQ testing has been thoroughly discredited in the scientific profession—an idea that appears in most commentary on Richard Herrnstein and Charles Murray’s *The Bell Curve* (1994)—is also incorrect. For example, in 2014, Stephen Hsu, a Michigan State University physics professor, argued in the mainstream science magazine *Nautilus* that Spearman’s *g* can be quantified with standardized tests and has a genetic basis. Hsu called for editing the genomes of human embryos to produce “super-intelligent humans” with “more than 1,000 IQ points;” failure to do so would apparently produce “inequality of a kind never before experienced in human history.” In 2021, George Church, an influential Harvard Medical School professor known for working on genome sequencing and editing, told the *Wall Street Journal*: “I don’t see why eliminating a disability or giving a kid blue eye or adding 15 IQ points is truly a threat to public health or to morality.” Some medical ethicists argue that the outcome—controlling births in order to reduce the number of “defective” people in society—is identical to that issuing from the old eugenics’ movement. According to this view, it makes little difference whether state legislation or social and economic pressures force people to make reproductive decisions they might not otherwise make.

3.2.2. Response to internal and external threats

Today countries with a major internal or external threat have also turned to gifted/talented education as a way to aid the state in developing the necessary resources for survival. Russia is a typical example where external threat forced the country to launch Gifted and Talented [GAT] programs. For example, the precursors of the modern version of the Gifted and Talented [GAT] system in Russia can be traced to the nineteenth century, when the Astronomic Society of the Russian Empire held the first “Students’ Olympics of the Mind” (Ushakov, 2010), known hereafter as Academic Olympiads or simply Olympiads. A critical role in re-introducing these Olympiads to Russian/Soviet education was played by Boris Delone, a well-known mathematician and academician, who organized the first Olympiad in mathematics in St. Petersburg (then Leningrad) in 1934. Math Olympiads were joined by Physics and Chemistry Olympiads in 1938, when the system had gained momentum, but it was interrupted by World War II and resurrected only in the late 1950s. As Grigorenko, (2017) states, the

spirit of that time was different, though, charged by ongoing competition in technological developments with the West. The country needed a steady influx of qualified scientists and engineers, so as to maintain that influx and to remain on top of the Olympiads. Four specialized boarding schools for children and adolescents with gifts in math and science were established in Moscow, Leningrad, Kiev, and Novosibirsk in 1963. These schools were “satellites” of the major federal universities in these cities and, therefore, students at those schools were taught by university personnel.

While GAT developments in Russia were charged by a perceived fear of ongoing competition in technological developments with the West, the United States of America's fear was real and not imagined. A significant historical event that triggered interest in gifted education in the USA is the launching in 1957 of the Russian satellite Sputnik. To many in the United States, the launch of Sputnik was a glaring and shocking technological defeat that Russia's scientific minds had outperformed ours (Tannenbaum, 1979). Suddenly, reports criticising American education and, particularly, its ignoring of gifted children became popular. Tannenbaum (1979) referred to the aftermath of Sputnik as a "total talent mobilization." Gifted students were identified, acceleration and ability grouping were installed. Academic course work was telescoped (condensed). College courses were offered in high school. Foreign languages were taught to elementary school children. New mathematics and science curricula were developed. Funds, public and private, were earmarked for training in science and technology. In high school there was a new awareness of and concern for high scholastic standards and career mindedness. Bright and talented students were expected to take tough courses to "fulfil their potential and submit their developed abilities for service to the nation" (Tannenbaum, 1979, p. 12).

In South Africa it can also be argued that what gave resurgence of interest on gifted education post 1994 was the threat to global competitiveness posed by poor performance in mathematical sciences in the wake of the 4IR. Annually the South African Minister of Education announces the Matric pass rates which have been praised for a steady rise from 62,6% in 2008 to a record 81,3% in 2019. However, performance in mathematics and science have either stagnated or deteriorated over the same period.

Yet the ability of all learners to succeed in today's technically orientated work environment is increasingly dependent on their understanding of mathematical and computational sciences and their application in practical situations. In fact, these sciences have become essential for all learners, including those preparing to become technicians, engineers, educators, leaders in business and government, and more generally, for developing scientifically, mathematically and technologically literate citizens. This has not been highlighted in all the annual pass rates announcements prompting critics to describe the annual pass rates as a 'Matric razzmatazz' which ignored the reality of the 4IR. In his 2000 State of the Nation Address [SONA] the South African president then said:

Globally, in the last two decades, we have experienced an information technology revolution that is pervasive throughout the whole realm of human activity. Technological innovation and its social application will determine the capacity of nations to transform themselves. Therefore, special attention will need to be given to the compelling evidence that the country has a critical shortage of mathematics, science and language teachers, and to the demands of the new information and communication technologies.' (President Thabo Mbeki - 2000).

Against this background, it must be acknowledged that in South Africa three areas have since come to dominate expectations regarding what counts as successful schooling and a preparation for socio-economic life and further study. These are mathematics, science and technology education. Government acknowledged that the legacy of inequality persists in these key fields of study and limits both participation and the release of talent potential. The Department of Education, in collaboration with the Departments of Arts Culture, Science and Technology and of Communications, then committed themselves to address these structural problems that retarded provision of a high-quality education experience in mathematics, science and technology education. The National Strategy for Mathematics Science & Technology Education [NSMSTE] was then launched with the aim of identifying learners with exceptional ability [gifted] in mathematical sciences and placing them in the Dinaledi Schools.

Similarly, Milne & Mhlolo (2021) show that external threat was a major reason why gifted education was launched in Singapore. At independence, Singapore had multiple ethnic groups, multiple religious groups, no common language, no common school system and no common curriculum (MOE, Singapore, 2013, 2014). Lee Kuan Yew's greatest fear was that his little country would suffer from the ethnic and religious struggles that have foiled the development of so many other societies, including South Africa. Besides these ethnic struggles, Singapore has no natural resources and as such relies on its human resource for advancement and success. The discourses of crisis and vulnerabilities in Singapore also bred the national myth that it had to invest in its human resources because it had nothing else, leading to simple and flawed human capital theory analysis attributing Singapore's economic development to its educational policies (Gopinathan, 2014; Saner & Yiu, 2014; Tan, 2010). Hence as a small, vulnerable nation, Lee Kuan Yew realised that quality education could be one of the most important antidotes to this threat. Consequently, the country considered it advantageous to nurture the ability of talented children. Schools then became the place where the country produced the skills and knowledge that would enable the students to succeed and become independent of their socioeconomic status. This vision drove a series of measures that were put in place to realise the Singapore pledge: "One united people regardless of race, language or religion" (Yew, 2000). Similarly, Alfaiz et al (2022) argue that it is no accident that countries such as Israel and Taiwan, nations facing immediate internal or external threat, have some of the most highly developed gifted/talented programs in the world.

3.2.3. The Economics of Education

Closely aligned with the concern for survival is the interest many countries have in economic and technological development. International political and economic competition have caused many countries to see their welfare tied to the development of their scientific and technological potential. Gifted/talented education especially in STEM is seen as a necessary component of this drive for modernization. Kettler (2016) asserts that economists have become more interested in gifted education than educators themselves in the wake of current research suggesting that resource-based

interventions are failing to make positive change on student achievement not because such resources don't matter but primarily because administrators are not optimizing the use of their resources in the production of scholastic achievement. The economic policy argument for optimization asserts that resources ought to be allocated to those programs with demonstrated effectiveness in terms of student achievement. In this regard stakeholders ought to ask questions about inputs which are important, and how such inputs can be manipulated to effect change in student performance. To give convincing answers to such questions would be among the most important tasks for evaluators of educational processes. According to Wößmann (2015) ignoring this economic dimension of education would not only endanger the prosperity of future generations, but it would also have extensive backlash for poverty, inequality, social exclusion, and sustainable development. Hanushek (2020) has argued that an educational production function (EPF) could be used for studying the relationship between inputs and outputs of schools. Following this line of thought, Schreyer (2009) defined the output of the education sector as the effect of education on the level of knowledge, skills, and competencies of students which is also referred to as an investment in human capital (OECD 2010). This characterization of educational output as investment in human capital dates back to Becker (1964), Mincer (1974), and Schultz (1961), and is further developed and implemented in a series of papers by Jorgenson & Fraumeni (1989, 1992, 1996). Following these studies, it has been shown that the returns to education are not homogenous but rather heterogeneous across the population suggesting that different student abilities impact the economy differently. Consistent with this view, it has been suggested that the efficient allocation of schooling investments should therefore be guided by the rate of return on investment and in education this depends on individual traits, such as ability. Such studies have shown how gifted students provide an exceptional rate of return for the financial investment made in them by the state. In this regard, Kottmeyer (2011) was interested to measure the different levels of returns on investment from the level 1 and 3 of his mathematical capabilities. He then used modelling to compare the impact on economic growth of a 10% improvement in students who were 100 points below the mean (level 1) on TIMSS to those 100 points above the mean (level 3). The results showed that the 10% improvement in the higher performing group had 4 times positive impact on economic

growth than a similar improvement in the lower performing group. Similarly, Terman's Genetic Studies (Friedman and Martin 2011) and the longitudinal Studies of Mathematically Precocious Youth—SMPY (Lubinski et al., 2014) are arguably among the most famous longitudinal studies in psychology to date that have tracked gifted youth for more than five decades with the aim of affirming this thought. Results from these studies have confirmed beyond any reasonable doubt that talented males and females indeed became the critical human capital needed for driving modern day, conceptual economies. So, from both an economics of education and human capital development perspective many countries believe they should be concerned about the education of their gifted learners because it can be shown that they are the component that produces the largest variance on economic growth consequently giving the best return on investment. In a similar way that society has been trying to figure out which skills matter in the 21st century KBE, researchers have also posed questions for education about which subject(s) matter in the development of skills needed in the fourth industrial revolution (4IR). There is a general consensus in the literature that connects innovation to the cluster of subjects related to science, technology, engineering, and mathematics education (STEM) (Lubinski & Benbow, 2021). Empirical evidence has actually shown that the positive impact on a country's Gross Domestic Product (GDP) can be isolated mainly to STEM-related achievements as opposed to achievements outside the STEM fields, suggesting that STEM-related achievements are the main drivers of national affluence in terms of creativity and innovation (Tanenbaum, 2016). Deeper analysis of STEM skills and their relevance in the 21st century knowledge-based economy have shown that the truly extra ordinary advances in STEM have not been the work of typical or average individuals in the STEM workforce. Rather, talented, and committed individuals within STEM have produced such advances (McCabe et al., 2020). Similarly, Kottmeyer (2011) used modelling to show that a 40-point improvement from the mean TIMSS scores in math, science and reading would create a 5% improvement in GDP over 20 years. These results confirm earlier conclusions that countries with relatively more STEM skills grow faster than countries with relatively less STEM related skills (Hanushek & Wößmann, 2007). Consequently Wößmann (2017) used the analogy of the game of scrabble to conclude that individual elements of STEM know-how or capabilities are like letters of

the alphabet, while products needed in the 21st century knowledge-based economy [KBE] are like words in this game of scrabble. His argument was that the fewer the letters (capabilities) the country has, the fewer the words (products) the country can make and vice versa. Similarly, in their more recent paper entitled “Intellectual Precocity: What Have We Learned Since Terman?” Lubinski & Benbow (2021) have synthesized numerous studies done over the past 50 years, which have reached some consensus that individuals who pursue STEM disciplines possess a different intellectual design space for problem solving and creative thought. In South Africa this view is also shared by the Department of Basic Education who state in the Action Plan to 2014, that poor performance in STEM has caused a shortage of people who are able to study for professions such as medicine, financial management and engineering. This also limits South Africa’s capacity to come up with new technological innovations that can improve the global competitiveness of the country (DBE, 2011). Similarly, in a diagnostic report by the South African Presidential Commission on the Fourth Industrial Revolution [PC4IR], (2020) it was noted that from 2010 – 2017 the percentage of matriculants passing with a Bachelor’s score (>50%) in mathematics remained below 26% yet the majority of the ICT skills require mathematics as a prerequisite. The PC4IR lamented that this puts South Africa in a position where regardless of the high number of youths we have, not enough are eligible to be skilled in these critical fields to meet the 4IR ICT skills demand. According to Alfaiz et al (2022) the efforts in establishing gifted/talented programs in the Soviet Union, the United States, West Germany, the People’s Republic of China and indeed most of the developing countries can be seen as a major outgrowth of this concern.

3.2.4. Mediocrity in Inclusive Education

A third factor contributing to the development of gifted/talented programs is the realization that mass education has in many cases become mediocre education and that many of the brightest students are disinterested and bored in an educational process that teaches to the average. According to Mhlolo (2022), in South Africa, there is evidence to show that setting of low targets both nationally and internationally, limited time on task, poor curriculum coverage, lack of progression in abstraction and cognitive

demand, failure to improve the top-end of performance scores in mathematical sciences are all rooted in the egalitarian desire to move with “everyone” at the pace and cognitive levels of at worst the slowest but at best the average students. Within the doctrine of egalitarianism, the assumption is that all children have abilities, hence the economic pressure on government is for all learners to have equal access to the educational opportunities that would be available. The egalitarian typology is characterized by a one-size-fit all resource- based provision where the core curricula expect all pupils to learn the same things, at the same time and by the same means and methods despite pupils having different abilities and needs. Proponents for this “average” practice argue that such an approach increases access and participation but critics moan that it is wasteful in terms of achieving excellence as it perpetuates mediocrity and defeats the whole purpose of human capital development. Hanushek & Wößmann (2020) have apprised that in developing countries the discussions on development policy often simplifies and distorts this truth by focusing most attention on ensuring school enrollment for everyone and losing sight of the importance of the quality of education. Similarly, Milne & Mhlolo (2021) show how the demise of apartheid lead to the implementation of compulsory education for all South African children and the elimination of segregated schooling practices. These changes went hand in glove with the closure of many centres for giftedness and rejection of gifted education as part of the legacy of the previous oppressive and exclusionary regime (Oswald & De Villiers, 2013; Roy & Wallace, 2007). The subsequent Education White Paper 6 (Department of Education, 2001:10) outlined the government’s new policies for a single, undivided education system for all learners, including those with disabilities, in the hopes that inclusive education would provide “a cornerstone of an integrated and caring society.” However, the reality is that inclusive education has excluded gifted learners. Studies indeed confirm this as noted in Pretorius & De Villiers’ (2009) investigation on the perceptions of South African primary school teachers and principals about the inclusion of gifted learners in mainstream classrooms. Pretorius & De Villiers warned of the negative effects such as the overloading of teachers in over-crowded classrooms, which would leave the gifted learner with minimal attention in such an egalitarian and equalising approach to education. Although research was done to highlight the needs of other gifted learners in the education system and a motivational report on the

establishment of special schools for Black gifted learners was published in 1988 (Taylor & Kokot, 2000), research on gifted education declined dramatically after democracy in 1994. Several task teams have been appointed in post-apartheid South African education by the President, Minister of Basic Education and the Department of Science and Technology (DST) to investigate the challenges faced especially in the implementation of mathematics, science and technology (MST) strategies. Their findings were that provincial education departments often seem to focus on underperforming schools to the neglect of gifted learners and learners with MST potential. A recommendation from the DST report was that vigorous mathematics talent searches were needed at school level, particularly in the rural areas where there is a huge reservoir of untapped talent. The focus on rural areas was justified when one considers that existing social and economic forces assure that the nation's best students continue to become more concentrated in the elite schools, which is not consistent with the country's democratic values. More recently the National Planning Commission (NPC) recommended that opportunities for excellence be provided to the most talented students (NPC, Republic of South Africa [RSA], 2012). In the preamble of the National Development Plan (NDP), the NPC envisages a South Africa where we participate fully in efforts to liberate ourselves from the conditions that hinder the flowering of our talents (Vision 2030). The plan states that schools are where talent is identified, career choices made, and habits learnt. Similarly, in the more recent South African curriculum documents inclusivity is now foreground and the gifted learner is mentioned as one category of exceptionality that should become the central part of the organization, planning and teaching at school (DBE, RSA, 2011). All these recommendations emerged from the realization that South Africa's collective failure to prioritize the development of its most talented students could be one of the major reasons why there is a crisis in the education system. According to Alfaiz et al (2022) both laymen and professional educators in many developed countries have come to this conclusion. This realization has caused countries such as the United Kingdom, Australia, Canada and the United States to attempt individualized, enrichment models which provide special attention to the gifted/talented student while still maintaining the egalitarian nature of the educational system. Many countries, as they have expanded their secondary systems to include all, have retained or developed special curricula for students with

advanced intellectual, artistic or athletic abilities. West Germany, Japan, the Soviet Union, the People's Republic of China, France, and even the Scandinavian countries have made some special provisions at the secondary level for those who exhibit special gifts or talents.

3.2.5. Efforts by the Private Sector

The fifth factor contributing to the growth and development of gifted/talented education has been the efforts of the private sector. In South Africa private sector involvement in supporting gifted education programs can be traced back to 2001, when as part of the National Strategy for Mathematics, Science & Technology Education, it was resolved that learners with exceptional ability in STEM were to be identified and nurtured in the 102 dedicated schools' program. Major private partners in the resourcing and educator development activities of the NSMSTE included Microsoft, Telkom, Multichoice and USAID, who signed a joint memorandum of understanding with the Minister of Education.

A host of other countries such as Canada, the United States, Australia, West Germany, and the Philippines has a number of private organizations which cater to the needs of gifted/talented children. Besides private organizations, private schools, youth organizations, and entrepreneurial endeavors all exist which serve gifted/talented youth. Private schools, as centers of excellence, have had a long history in a number of countries. For example, in South Africa Radford House is the only school which is formally recognised as a school for the gifted which was founded by the Kokot family in September 1995. It was in answer to the pressing educational, social and emotional needs of gifted and high-potential learners who were neither understood nor catered for in the schooling systems present in South Africa. Professor Shirley Kokot was responsible for teacher training programmes in Gifted Child Education and Special Needs Education at UNISA for over twenty years. Their motivation was that there are many bright young children who are struggling or unhappy in the mainstream education system today because, simply-put, they are a little bit different. Bright or "gifted" children tend to be highly sensitive souls who abhor repetition and are quickly frustrated by

traditional teaching methods. These are people who function on an intense level, whether when questioning a teacher or parent, engaging with peers or assessing themselves. They need, more than most, an environment which has structure, but clear communication and fair application of rules. They crave stimulation, and mentorship. They are born with the ability to reach the stars, but too often have no idea how to get there. The Radford House dream was to build a school which brought the fun back into the learning process. To nurture the brightest of minds in an environment where there are fewer limits imposed on the children, and where knowledge and thought are embraced as a wonderful opportunity, rather than a chore imposed by parents or legislation. To qualify for enrolment at Radford, pupils must undergo an intellectual evaluation conducted by a registered educational psychologist. The authorities look at an IQ of no less than 120,” says Kokot. “The child is then invited to spend at least a week at the school to assess whether they will be able to embrace the accelerated style of learning. The child is enrolled only when the teacher, child, psychologist and parents agree that the school and its approach will be suitable in the long-term.

Besides Radford House there is evidence to show that the top 200 high schools in the country produce 97% of the mathematics distinctions (Spaull, 2019). Although these schools are not set up specifically for gifted children, parents tend to choose such high performing schools for their gifted children. The majority of these schools are private schools who charge significant fees. Parents and other interested individuals have banded together in organizations which sponsor a variety of enrichment activities for gifted and talented youth.

3.2.6. The evils of egalitarianism

The sixth factor is that the focus on egalitarianism and fear of elitism has caused many countries to design gifted/talented programs for disadvantaged youth. Individuals regardless of background are given special attention if they reveal special talent. By providing these programs, governments cannot be accused of perpetuating a social or economic elite. This concern for the disadvantaged gifted has caused countries such as Israel to create special schools for them, the United States to begin organizations

dedicated to advancing the talents of this group, and the Soviet Union to search the rural hinterlands in hopes of locating gifted/talented youth. From Australia to Brazil, fledgling programs have been designed specifically for the disadvantaged gifted.

3.3 A global view on Professional Development for gifted education

Although there seems to be a global consensus on the view that we all rely on the contributions of gifted and talented adults, educators worldwide receive little information about how to educate gifted and talented children. Yet gifted and talented children thrive when they are taught by teachers who understand the ways that their learning and their social and emotional needs differ from their peers of the same age and who know how to address those needs. Research (Plunkett & Kronborg, 2007; Rogers, 2007; Rowley, 2012) has clearly shown the benefits for students who are gifted having teachers who have participated in training in gifted education. Lassig (2009) demonstrated a link between training in gifted education and teachers' attitudes towards students who are gifted (high potential), talented (high performing) and gifted education programs. Concerned about this global problem where most of our new teachers leave teacher training lacking essential skills to deliver foundational strategies needed for gifted students, in 2020 the World Council for Gifted and Talented Children (WCGTC) felt the need to compile a guiding document entitled: "Global Principles for Professional Learning in Gifted Education," which was intended to help remedy this pervasive gap in educator preparation by guiding policy and practice in professional learning about gifted education. The document was released in 2021 after having been developed collaboratively by a committee of scholars and practitioners selected on merit and who comprised 24 experts from the following 19 countries in no specific order: Lebanon, New Zealand, Jamaica, Egypt, Hungary, USA, Turkey, UAE, Germany, Slovenia, South Africa, Italy, India, Australia, Canada, Scotland, Netherlands, Hong Kong and Israel. The scholars were all members of the WCGTC, and each member of the committee offered insight and ideas from their individual research perspectives. It was considered important to have a broad representation in order to produce a document that would be valuable in providing guidance for decision-makers in settings around the globe. This document is intended as a tool to create positive change on behalf of gifted students

locally, regionally, and globally. The principles can serve to urge educational leaders and policymakers to invest in teacher professional learning and gifted education. Policymakers should adopt policies that mandate the inclusion of gifted education in teacher education programs at international, national, regional, and local levels.

Figure 3.9 Global Principles for Professional Learning in Gifted Education

1. **Tiered Content.** Comprehensive professional learning programs recognize that all educators work with gifted students, so all educators need some degree of professional preparation to support the education and growth of gifted children, although the amount and type of content may vary according to each educator's role.
2. **Evidence-Based.** A quality professional learning program is based on best-practice and research, including the ways in which gifted students are uniquely different from other students as a core rationale for differentiated services.
3. **Holistic.** Professional learning in gifted education should address the whole child, including academic, social, and emotional needs.
4. **Broad.** A thorough professional learning program includes information about different levels of giftedness, different forms of giftedness, varied methods of identification, different program models, and options for modifying curriculum and instruction.
5. **Equitable.** Professional learning programs in gifted education should address the needs of students from different racial, cultural, ethnic and indigenous groups, genders, and sexual orientations. Recruiting and retaining educators from representative diverse backgrounds, should be a priority.
6. **Comprehensive.** Many school personnel affect the lives of gifted children, directly or indirectly. A plan for professional learning in gifted education must therefore include provisions for educating administrators, counselors, psychologists, special educators, and others about the needs of gifted students.
7. **Integral.** Professional learning should present gifted education in the context of an entire school program, emphasizing that gifted students are the responsibility of the whole school community and not just the educators charged with specific responsibilities for serving gifted students.
8. **Ongoing.** A professional learning plan in gifted education should provide ongoing opportunities to refine and extend existing knowledge and skills through in-service programs and other professional learning experiences throughout a career.
9. **Sustainable.** Professional learning in gifted education should be built into educational policy of the state, region, province and/or country. Programs should be monitored regularly, and accountability systems should be in place. Collaboration between all stakeholders—policymakers, school authorities, community members, higher education faculty, and others—is actively encouraged.
10. **Empowering.** Professional learning in gifted education should prepare educators to be effective supporters, promoting gifted students and the services they require.

These principles outline an infrastructure for preparing all educators to support gifted children in their classrooms across the world, regardless of their educational setting.

This document is filled with guidance for a diversity of stakeholders including educators, policymakers, professional learning providers, and leaders in teacher preparation programs who are interested in preparing all teachers to appropriately educate gifted and talented children across the globe. According to the WCGTC (2021) our world will be a better place as we develop children and young people's talents and potential to the highest levels.

3.3.1. Gifted Education in South Africa

Prior to 1994, South Africa was one of the first (few) sub-Saharan countries that paid particular attention to gifted education, but unfortunately, repressive Bantu education, which was the law of the land, did not allow for the identification of non-white learners who might qualify, if tested, for participation in existing gifted and talented programs (Christie, 1991; Nkabinde, 1997). Hence, learners who presented certain exceptional intellectual characteristics under the repressive Bantu education went unrecognised (Scott, Davis & Osman, 2009). Due to these elitist views associated with apartheid education, in post-apartheid South Africa education, stakeholders have been hostile to and resentful of gifted education programs which are critical for academic talent development (Kokot, 2011). White Paper 1 on education transformation, released shortly after the advent of democracy in 1995, described the devastating legacy of apartheid on MST education. Though in certain respects the situation has improved since 1995, according to DBE (2012:3) it was sobering that what the 1995 White Paper said is still to a large degree applicable to date:

There is a dearth of Black students with science and mathematics qualifying for normal entry to higher education, fewer still continuing in mathematics and science-based programmes, and a trickle entering mathematics and science-based professional and technological fields in the economy. Mathematics and science programmes in universities and teachers' colleges therefore have a perennial shortage of high-quality Black candidates in these subjects ... If this cycle is wasteful from an educational point of view, it is catastrophic from the perspective of national developmental needs.

Cognisant of these challenges, President Thabo Mbeki, in his State of the Nation Addresses [SONA] during the opening of Parliament in 2001, emphasised the centrality of mathematics and science as part of the country's human resource development strategy. Subsequent to that speech, the National Strategy for Mathematics, Science & Technology Education (NSMSTE) was introduced in 2001 as a permanent and priority strategy. Its flagship program was the 100 dedicated schools which later became known as the Dinaledi Schools Project [DSP]. The vision of the project was to bring about a scientifically literate, technological fluent and numerically/mathematically literate society that empowers individuals to participate in the emerging knowledge-based economy and supports sustainable development. Three major thrusts of the strategy were:

- Raising participation and performance of the historically disadvantaged learners, especially girls, in Senior Certificate mathematics and physical science
- Provision of high-quality mathematics, science and technology education for all learners taking the first General Education and Training [GET] Certificate and Further Education and Training [FET] Certificate and
- Increased and enhanced human resource capacity to deliver quality mathematics, science and technology education.

The project was championed by the Deputy Minister of education who was himself a mathematician who continued to visit Dinaledi schools to motivate, inspire and better understand the dynamics of creating excellence in mathematics, science and technology education at school level. The strategy was premised on the view that: (a) an adequate supply of Grade 12 graduates with mathematical sciences was needed to enter higher education; (b) this could be better assured by focusing on mathematical science learners with exceptional potential in dedicated schools, rather than through a dilution of effort across the whole schooling system; (c) the dedicated schools would allow those with the most ability to study intensively; (d) talented individuals in mathematical sciences would rather be accommodated at successful schools. The dedicated schools would act as centers of excellence within their locality by accepting learners talented in mathematical sciences who would not otherwise be able to go to a Dinaledi school elsewhere.

The NSMSTE was implemented and periodically revised in five-year strategic action plans, the first of which was the 2001-2004 Action Plan. The second Action Plan (2005-2009) had its theme as: Consolidating, Deepening, and Widening the National Strategy for Mathematics, Science and Technology Education. Consistent with this theme, both the NSMSTE and its Dinaledi Schools Project [DSP] adopted the motto: “Creating tomorrow’s stars today”. Hence, it was hoped these schools would promote innovative learning and teaching strategies for mathematical sciences that were usually not found in mainstream schools. Although gifted education was dismantled post democracy in South Africa because it was considered an elitist idea, it can be argued that what anchored the NSMSTE of 2001 is typical of gifted education - which is the field of study devoted to understanding children who have been identified as gifted or talented and providing them with an educational environment designed specifically for their social, emotional, and academic needs. A decade later poor pass rates in mathematical sciences kept dogging the country hence in 2010 President Zuma set up another commission to investigate the challenges the country was facing. In terms of education the National Planning Commission (NPC) 2012 report was consistent with earlier recommendations as it made it clear that opportunities for excellence be provided to the most talented students (NPC, 2012) and that consideration should be given to expanding the Dinaledi Schools Initiative, which increases access to Mathematics and Physical Sciences in underprivileged schools (NPC, 2012: p. 305). Similarly in a base document to guide discussion on a new mathematics, science & technology [MST] strategy for South Africa, DBE (2012) reaffirmed its commitment to the NSMSTE emphasising once more that the skills shortfall has a prominent racial dimension, given that adequately trained Black South Africans were in extremely short supply in many occupations. The department further lamented that increased competition in the international trade of goods and services, coupled with the global mobility of individuals with skills, create new risks for any country that falls behind in the area of MST education. Not only was this a problem in terms of the post-apartheid transformation of society, it also makes compliance with the representativity goals of the Employment Equity Act difficult. The document then states that:

The obvious solution is to improve the MST foundations laid in schools, increase the number of learners leaving school with an MST specialisation and provide additional learning opportunities for exceptionally gifted children and youths (DBE, 2012:4).

A Mathematics, Science & Technology Education (MSTE) task team that followed up the NPC also lamented that the education system tended to focus more on learners with learning difficulties while ignoring gifted children who could take the country forward in terms of scientific development. The task team's recommendations were that MST talent development programs should be incorporated into the revised NSMSTE strategy and that at least one dedicated Mathematics and Science Academy or a special Mathematics, Science and Technology School should be established in each province (DBE, 2012: p. 48). In the five-year strategic Action Plan to 2014, the Department of Basic Education admits that one area where government needed to do more was to provide "exceptional learners" with greater access to focus schools. Focus schools are conceptualised here as schools that pay special attention to specific subjects such as mathematics, so that learners who do "very well" in these subjects can spend more time on them and be taught by teachers with additional training and skills in these subjects. The plan goes on to say that it is important for parents and teachers to recognize who is performing exceptionally well, or who has the potential to do this, and then to make sure that these learners are given the right support to develop their strong areas further. In the Department of Basic Education 2018/2019 annual report, the foreword by the Minister of Education reads:

When talented children do not participate in school, or drop out before achieving their potential, this is a grossly inefficient use of a country's human capital (DBE, 2019: p. 16).

In an interview with Professor Maree this is what the late Archbishop Desmond Tutu had to say about gifted children in South Africa:

We should do all we can to make our children want to aim for the stars. Every child should seek to be the best that he/she can be. We cannot afford to play ducks and drakes. Where you have children who are particularly gifted, it would be criminal not to want to develop their potential to the highest possible extent. We are not looking for uniformity...we want to ensure that every child has a basic education, but we mustn't make a virtue of mediocrity. We must produce the best possible children in every possible sense (Maree, 2007: p. 6).

More recently government launched the three-stream model curriculum whose objectives are, inter alia, to implement a curriculum that will meet the diverse needs of South Africa's youth, to promote skills acquisition and empower creativity. The launch of the model on 8 May 2018, saw the Department of Basic Education committing itself to the National Planning Commission's [NPC] recommendation that the Dinaledi Schools program should be expanded. Let us recall that as early as 2004, the Abt Associates Inc. report (Makhene, Oki & Statman, 2004) on the 2001 National Strategy for Mathematics Science & Technology [NSMSTE] had also recommended the creation of a regional resource and a regional pride in the Dinaledi Schools project. In 2010 the World Bank report by Blum et al., (2010) also recommended that the Dinaledi Schools program should be expanded and similarly the MSTE task team (DBE, 2013) also recommended the same thing. Even if these recommendations might not have been based on tangible evidence given the challenges faced in the implementation process, the mere argument that, *in order to increase the number of mathematical sciences graduates there was need to identify gifted learners and nurture them in dedicated schools*, sounds logically correct. In fact, Finn (2013:14) would also argue in favour of gifted programs thus:

It's morally correct; it's educationally sound; and it's economically beneficial. And to paraphrase Henry Kissinger, it has the additional advantage of being politically shrewd.

However, over and above the intuitive logic in the moral correctness and educational wisdom in the aims and objectives of the NSMSTE, this current study was also motivated by the practical evidence showing that the idea is feasible. In research one aspect that has received attention from reviewers is *how* applicants try to establish the plausibility that their proposed project has practical credence. Hence in gifted education, a call for action from Professor Julia Roberts, [former president of the World Council for Gifted & Talented Children WCGTC, 2021], emphasises the need for researchers to make the connections visible for decision-makers to be convinced in the practical rationality of these gifted programs. In her own words she said that researchers should not assume that someone else would do that for them. Against this background, the question is: What practical evidence is there to show that the recommendations to expand the Dinaledi project are indeed feasible.

Two critical sub-questions in gifted education will be addressed from the evidence i.e. (1) who normally lobbies for gifted children and (2) do such programs really work in the South African contexts? At the University of the Witwatersrand [Wits] a Talent Targeting Programme [TTP] was founded in 2006 by Prof Loyiso Nongxa who is still its custodian to date. Its goal was to give learners from disadvantaged backgrounds with strong academic potential the best possible chance of success in pursuing higher education. The TTP was launched in 2007 with a cohort of 267 Grade 10 learners from three provinces Gauteng, Limpopo and Mpumalanga. Over the years, the programme has expanded and now enrolls nearly 2300 learners from nine provinces. At Wits the project has also grown from just a community engagement project into a Student Equity & Talent Management Unit [SETMU] which receives generous support from the British Petroleum South Africa [BPSA] Education Foundation Trust, the Industrial Development Corporation, the Department of Science and Technology, and Primedia. Why did Prof Loyiso Nongxa have this interest one might ask? Gifted education falls under the broader domain of human rights and many human rights defenders, in every region of the world are usually those who share trials and tribulations in common with the victims and in many cases have themselves been subject to violations of those human rights they lobby for. In gifted education empirical studies have also confirmed that some gifted children feel pressure to “give back” because they feel so fortunate to have their own

intellectual gifts recognised and nurtured. So let us see if any of these attributes are mirrored in Prof Nongxa's academic career.

In terms of being gifted, although used in a different context, Judge Cameron's words are congruous with Nongxa's star aptitudes whom he described as fulfilling the requisite criteria [of being gifted] with such distinction that further search procedures would not be justified. Prof Loyiso Nongxa, a Mathematician of the African Diaspora and a global luminary in the field, grew up in rural Transkei, where he did what the other children in the village did - he tended his father's sheep, ploughed and harvested. He matriculated not only with distinction but as the top matric student in South Africa in 1972. He obtained his first degree in mathematics and statistics with the award of best student in the history of Fort Hare University. Professor Tom van Dyk, his first-year maths professor at the University of Fort Hare speaks of Nongxa's star quality, saying that in his 30 years of teaching, Nongxa was "one of the best, if not the best, student ever. If he scored lower than 90%, we wanted to know what was wrong," Van Dyk recalls. It did not come as a surprise that Nongxa's Master's degree in mathematics earned him South Africa's first Black Rhodes Scholarship holder which enabled him to pursue a D. Phil in Mathematics at Oxford University. He completed it at a tender age of 28 and in record 3 years' time and went on to hold the title of Honorary Fellow at Oxford University. It is important to note that *Honorary Fellowships* are awarded to those who have achieved distinction in academia or public life and almost all have a prior association with the college as former students. Nongxa then became the first black Vice Chancellor [VC] at Wits, and a newspaper article of 18 May 2003 carried the heading: *From rural herdboy to top of the academic pile*. He has since held visiting appointments and fellowships at the universities of Harvard, Connecticut, Colorado, Illinois and Baylor (Texas) besides chairing the National Research Foundation [NRF] and being the Vice President of the International Mathematics Union [IMU].

It is neither possible nor the intention to document Nongxa's complete list of accolades, but it is important to note that Nongxa refused to do an extra year that was expected from most international postgraduate students at Oxford University. People would then ask why? In Nongxa's own words: This reinforced the stereotype of Black students

being viewed as academically weak compared to their counterparts. In Mathematics, more than any other field of study, we have heard proclamations and statements similar to, "The Negro is incapable of succeeding or African people were two grades below Anglo-Saxons' position in the normal frequency distribution of general mental ability." Nongxa says, he was set on proving that maths "was not a function of race and gender". Let us recall that Sir Francis Galton's eugenics fell out of favour with many scholars because of its association of intelligence with race. Such humiliation was more agonising in South Africa given that Sir Galton made those claims after visiting the region and that the apartheid government later entrenched the same view. It is clear in all his career that Prof Nongxa being mathematically gifted himself shared this humiliation with learners of similar ability. One author describes Nongxa's 'obstinacy' as a student and his unwavering belief in his intellectual prowess as having followed him where he now sits at the upper echelons of mathematics leaders.

Given that Prof Nongxa himself is emblematic of this mathematically gifted youth from previously disadvantaged backgrounds, it would therefore come as no surprise that he would have been interested in championing their needs locally, regionally and internationally. In his own words he described himself as a "lobbyist" and as a "salesperson". In one of his reflections, he said: *The idea that there are academically gifted students in marginalised communities who have the potential to succeed has not received sufficient attention in various interventions aimed at improving educational outcomes. We believed that the desire to succeed was not a function of any social construct, and that lack of social, economic or cultural capital hindered students from marginalised communities from realising their true academic potential.*

Although Nongxa referred to various interventions aiming at improving educational outcomes it is not a secret that the specific focus was on Dinaledi schools. This is evident in that the aim of the Wits TTP programme was to identify students in rural and peri-urban communities who were attending Dinaledi schools and who had shown the potential to succeed academically if they were provided with support for the last 3 years of their high school education. According to Zena Richards the director of the Student Equity & Talent Management Unit [SETMU]:

As a Unit we depart from the notion that equitable access to educational opportunities is a core value in the South African education landscape due to the blatant disparities in the previous educational dispensation of the country. Subsequently, existing gaps in the performance of learners with academic potential, and in particular those who come from disadvantaged communities due to these limited opportunities, should become a critical priority to ensure equitable access and probability of success before entering into higher education.

As a social justice practitioner, Zena's involvement in the TTP has enabled her to confirm the advocating for and facilitating for equity in access to educational opportunities for all. She said this was an arduous task requiring grit, persistence, passion and an unwavering belief in human potential.

A weakness identified in many evaluations as well as task team reports was that learners with potential were never identified into the Dinaledi Schools despite the project having been conceived as a mathematics & science dedicated schools' project. True to Nongxa's concern that gifted students had not received sufficient attention, the Wits TTP project used a 65% pass at Grade 9 as one of its selection criteria.

Now that the reader knows that gifted people normally lobby for gifted children, the next question is whether these programs are beneficial. In this regard the TTP impact is exceptional. Since its inception, the project has supported 3022 learners from across the country and boasts a 92% access rate to university. Project Director, Zena Richards, told *Wits Vuvuzela*, that it is not difficult to see the impact of the TTP. "We are seeing the results of our investments," she said. A total of 103 schools around the country are currently involved in the programme ensuring that TTP has a "geographic footprint all over South Africa", according to Richards. Below I provide 6 figures with infographics that summarise the success story of the TTP since its inception in 2007.

Figure 3.10 Donors and beneficiaries on the TTP as of 2019 [Source SETMU Annual Report 2019]

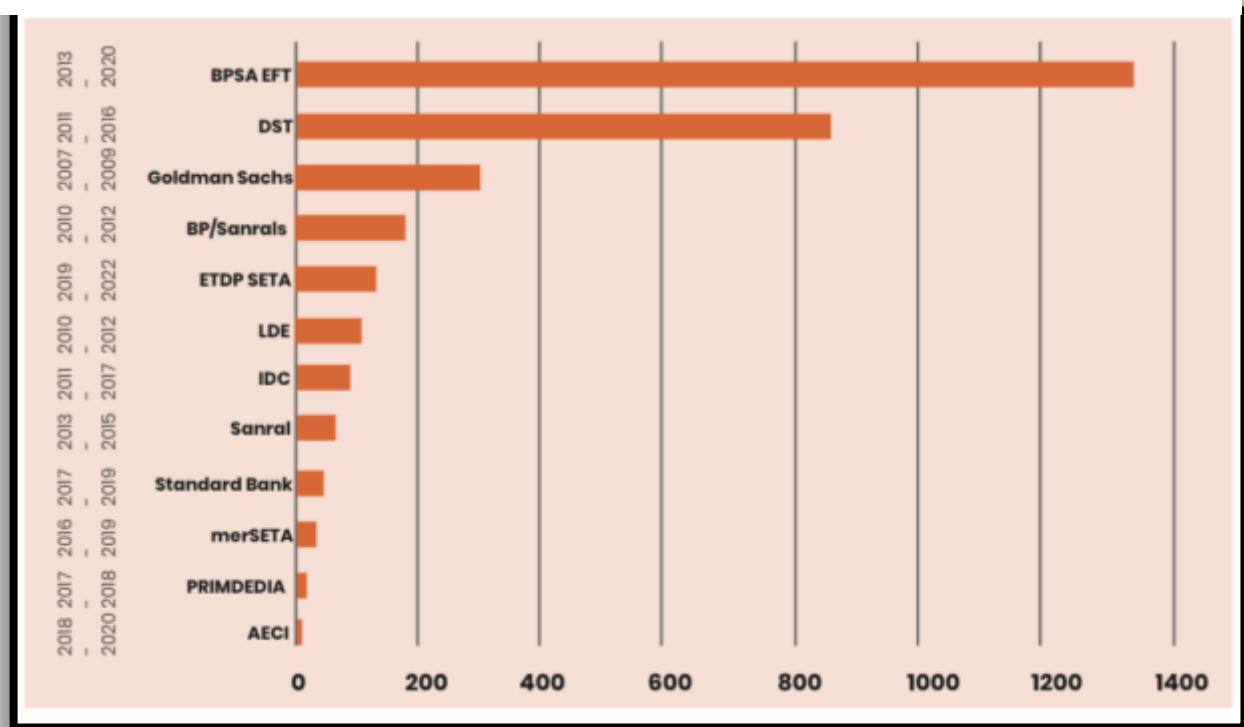


Figure 3.11: Map showing locations of TTP feeder schools [2007- 2020].

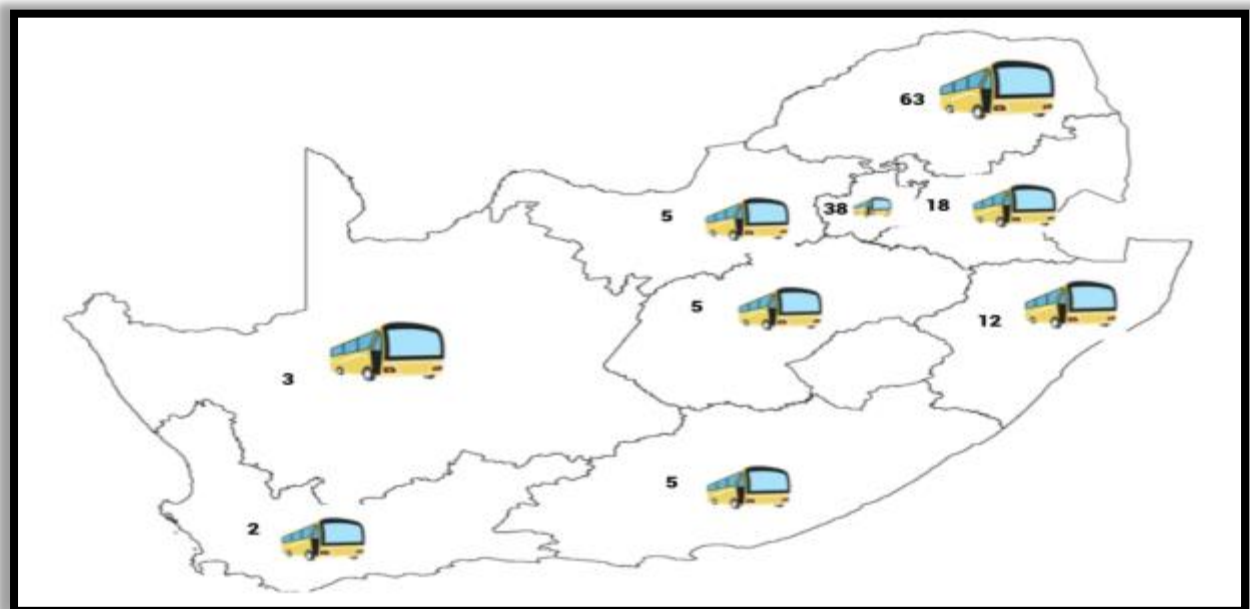


Figure 3.12 Rates of access to university by learners on the TTP [Source SETMU Annual Report] 2019].

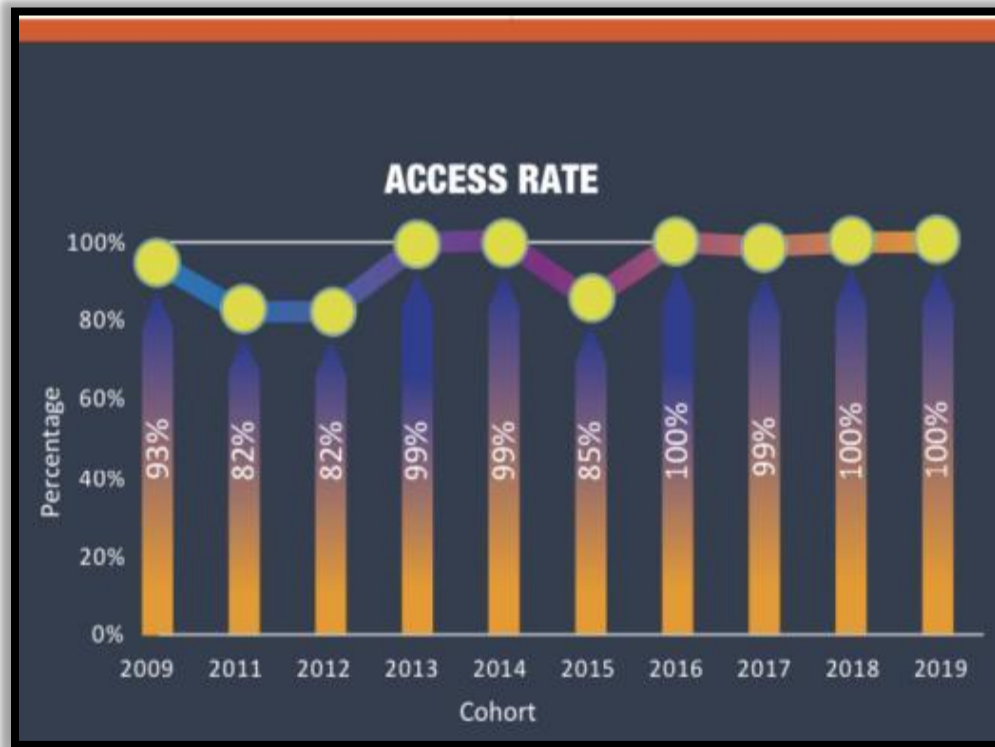
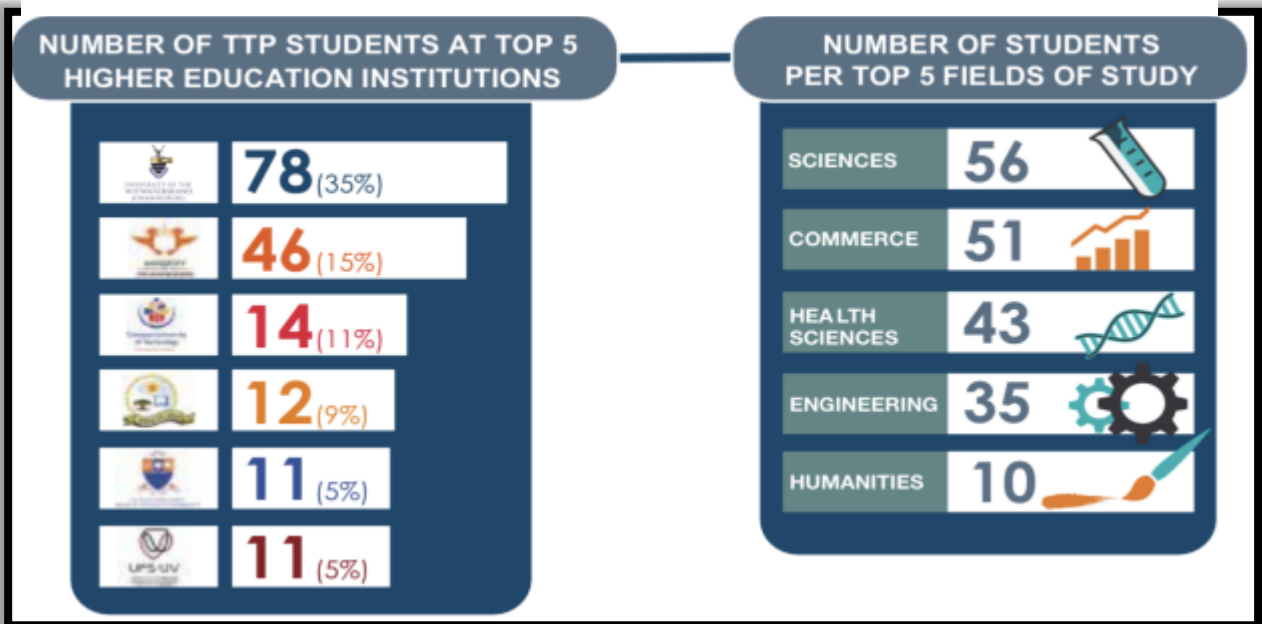


Figure 3.13 Performance of learners on the TTP [Source SETMU Annual Report]



Figure 3.14 Distribution of TTP alumni by university and fields of study as of 2020[Source SETMU Annual Report 2019]



Some highlights of the success stories are that the country's 2012 Matric Top Learner,

Figure 3.15 The 2022 cohort of the TTP in jubilation



Mmadikgetho Komane, was one of the TTP Learners that graduated from the programme. Prof Nongxa must have been proud to learn that exactly 4 decades after himself got the best national student award he also contributed to someone getting that same award. Mmadikgetho the 18-year-old girl from Glen-Cowie Girls High School in Limpopo was rated the best overall learner in the country by scoring 100% in Mathematics, Physical Science and Accounting. She also received distinctions in

SePedi, English, Life Orientation and Life Science. Mmadikgetho went on to study Actuarial Science at WITS University. A spokesperson for the sponsors BP South Africa said: This gives us comfort that our partnership with WITS is working exceptionally well, and we are committed to continuing with the programme for the next 5 years, touching over 1 000 learners' lives and changing their future. In 2020, the SETMU team was awarded the Vice Chancellor's Academic Citizenship Team Award. This award carries with it a grant of R100 000 (one hundred thousand rand) which can be used by the awarded team to further develop their academic citizenship activities in 2021. The TTP pass rate for 2021 was 97% with 90% of the learners achieving a bachelors pass. This is compared to the 76% pass rate of the NSC matric class that achieved 36% a bachelors pass.

In the **Figure 3.15** we see some of the forty-eight Grade 12 learners who completed the TTP and sat for the 2022 National Senior Certificate (NSC) exam – they achieved a 100% pass rate. They earned 140 distinctions collectively across all subjects.

Some alumni of the TTP whose lives changed for the better.

Figure 3.16 Some alumni of the TTP



So, what take home message do we carry from this TTP success story going forward? Answering this question is important given that DBE (2012) admits that (1) the fact that there was no statistically significant improvement in South Africa's average mathematics score in SACMEQ between the 2000 and 2007 waves of the programme is a stark reminder that the 2001 strategy did not succeed in bringing about the desired systemic change and (2) that clearly, this time we need to do things differently. They further

argued that if interventions are sufficiently focussed and are well documented, they are likely to inspire similar work at other levels of the system. They suggested that what was missing in South Africa's education transformation landscape was a few initiatives that could be considered role models of how to get things right. In order to do things differently and 'to get things right' there is need to identify what was done differently at the Wits TTP which made them successful. Let us recall that the NSMSTE and its Dinaledi Schools' Project were premised on two important conditions (1) that it would allow those learners with the most ability especially in mathematical sciences to study intensively in (2) dedicated schools with competent educators in the subjects. Neither of the two conditions were met in the implementation of the national strategy since 2001 given that those learners with most ability were never identified, and schools did not have competent teachers to teach the exceptional learners. In terms of identification and monitoring even David Silman who was director responsible for the Dinaledi Schools Project in the Department of Basic Education was on the news in 2013. He lamented that on the surface, it would appear that the programme has been successful, but in the years that it has been running, it has 'languished'. 'It has been like a wallowing ship without an engine', says Silman. One of the changes Silman recommended was that pupils should be monitored better through tests which are marked externally. However, what made the Wits TTP to be successful was that it met both conditions given that it used a 65% pass as its selection criterion and it trained teachers/tutors/mentors from those participating schools. So, not only do we learn that gifted learners are there in previously disadvantaged communities, but we also learn that indeed the Dinaledi Schools project has potential to change the lives of gifted children from previously disadvantaged backgrounds.

However, it is important to highlight to the reader the fact that in the case of the Wits TTP, learners were bused in from different schools to come to university for some 2-week residential sessions under the tutorship of short-term trained mentors. Empirical evidence has shown that ad hoc activities are insufficient, especially in gifted education (Collins, 2001) suggesting that we must purposefully incorporate gifted education into the student experiences and afford students well-structured and ongoing opportunities to practice and hone their STEM skills. Nongxa himself recommended that such

interventions required sustained effort over a longer period of time. This current study was premised on the view that the NSMSTE could reap maximum benefits if the learners were taught for longer periods by competent teachers in their respective schools as was initially envisioned at the inception of the strategy. This can be achieved if we train more teachers who understand gifted children and evidence in the USA and Singapore suggests this is possible.

3.3.2. Professional development for educators for the gifted in South Africa

Coincidentally the University of the Witwatersrand has also contributed to this research agenda on teacher training for the gifted. The International Gifted Education Teacher Development Network, also known as Iget-Network is a membership organization co-founded in Johannesburg, South Africa by five culturally diverse and accomplished educators (Scott, Davis & Osman, 2009). When Iget-Network was formed in 2007, four of the five co-founders resided in South Africa and the fifth was a visiting professor from the United States. The Iget network organization emerged from the understanding that in present day South Africa, education policy does not address gifted education for any group of learners (Education White paper 6, 2001). As such, teacher education students, educators and co-founders alike were presented with the challenge of ascertaining answers to very apposite questions, essentially, “can we make a case for the inclusion of gifted education within South Africa’s education policy” and “how can we work together to bring best practices in gifted education to the South African schools”. The network was essentially an out-growth of the elective course, “Education for Diverse Gifted Learners” taught for two years to final year teacher education students in the School of Education at the University of the Witwatersrand (Wits). The network is likewise a result of data collected from practicing teachers and numerous conversations with enlightened and knowledgeable educators within the Johannesburg area community (Scott, 2008).

The overwhelming response and interests among student teachers to “bring back” gifted education to South African classrooms led the co-founders to organize a network of individuals willing to make a difference in the lives of children not being recognized as

gifted by their classroom teachers or school districts. Hence, when the American co-founder and visiting scholar returned to the states she vowed to investigate programs and services in the United States that have a history of success with populations of culturally diverse gifted learners. Once such programs and services met certain criteria the question became could they be duplicated within a South African educational context

Criteria set by the co-founders was essentially:

- a means by which teachers could assist in identifying culturally diverse gifted learners at the primary school level;
- an embracing of the network objectives to identify schools in the Johannesburg area where ongoing teacher training is needed;
- an avenue where children can benefit from programming that would guide them into feeder schools that provided continued enrichment opportunities; and
- to address the educational needs of low-income culturally diverse learners

IGET teacher and program development goals reflect Project U-Stars objectives to train teachers in recognizing, nurturing and responding to the needs of gifted and talented learners; and program development activities describe outreach efforts where the presenters design such programming as Level 1 and Level 2 seminars specifically organised for whole school districts, colleges and universities and departments of education. The cyberspace mentorship programs designed to put new teachers in touch with American gifted education specialists via technology such as email or Skype (Huang-Nissen, Lin & Lee, 1999; Iget-Network, 2008). The needs assessments are carefully designed to capture what type of programming/training is best suited for a particular country.

Level 1

This introduction involves making a case for gifted education in the country in question. It includes an examination of theory, research, history, philosophy, definition and practice as these relate specifically to culturally diverse gifted learners. Course content

also included instruction on the philosophy and psychology of educating gifted learners who represent various racial and cultural diverse groups. The course, having an American historical perspective on culturally diverse gifted learners presented Wits teacher practice students with a foundation to gifted education applicable and relevant to a South African context. For instance, within the United States critical issues related to identification, appropriate educational needs and program participation of black gifted learners are addressed in the educational literature from the mid 1930s. This seminar course concludes with an introduction to characteristics of gifted learners. As Level I provides the foundation to the study and practice of gifted education it is a pre-requisite to all subsequent seminars. Designed for all educators and parents.

Level II

Provides an in-depth examination and analysis of characteristics of gifted learners-as these relate to early recognition/identification with specialized teacher observation instruments, multiple criteria and case study critique. Designed for all educators and parents.

Level III

Instructional strategies provide participants with best practice instructional techniques and strategies. In-depth coverage, demonstration and practice of classroom differentiation and other strategies are included. De-signed specifically for the classroom teacher and teacher education students (Baytops, J.L.& Reed, D., 1997)

Level IV

After children have been recognized/identified by their teachers and teachers are consistently incorporating teaching strategies that challenge learners within the classroom, extra-curricular activities external-to the school setting are carefully crafted and designed by Level III participants. Instruction includes an in-depth examination of

best practices in program provisions for gifted learners. Designed for all educators and parents (Iget-Network, 2008).

3.3.3. What can we learn from the leading countries on gifted education.

The first research question for this study makes reference to content which is common among some selected global universities' teacher training modules for gifted education. This suggests that the literature review chapter would be incomplete without gaining some insights from what other countries have to offer in terms of gifted education. Although the specifics of South Africa's education system remain explicit to South Africa, there is a global consensus on the view that lessons from other countries' education journey to supremacy can be generalised for other settings. In the new global educational policy-making mode of governing by examples and international benchmarking, stakeholders are eager to seek "ready-made, evidence-informed solutions to be borrowed from international 'reference societies'" (Lewis, 2017, p. 282). As scholars have noted, this environment of 'fast policy' not only codifies certain educational ideas as best practices but also significantly increases the rate and reach of policy diffusion (Lewis & Hogan, 2019). Proponents for comparative studies also assert that the real value in international studies lies not in the comparisons themselves, but in the insights that we may gain into our own education systems (Naroth & Luneta, 2015). For example, attempts have already started in South Africa to try to import some ideas from Singapore. One such attempt is where the Organisation for Educational Resources and Technological Training (ORT) joined forces with Bidvest and introduced Singapore Mathematics at six primary schools in the Alexandra township to test the project design and material for future use throughout South Africa and Africa. In addition, more than 80 South African schools are using Singapore Mathematics to improve their mathematics learning outcomes. Globally the Singaporean approach to math has become well-known and exported to other countries all over the world including the United States, the United Kingdom, Canada, New Zealand, Chile, Israel, the United Arab Emirates, the Netherlands, Indonesia, and Bermuda (Davie, 2020; Garelick, 2006; Wong & Lee, 2009). On the other hand, the design of Singapore's education system also owes a lot to lessons from other parts of the world (Organisation for Economic

Cooperation and Development [OECD], 2010). Ironically, Singapore looked to Africa for lessons on how to grow its economy as confirmed by Kenya's former Prime Minister (2008–2013), Raila Odinga, in his recalling of a visit to Kenya by a team of Singaporeans who wanted to learn "our" lessons, since "we" were then a more developed country than they were. In 2008, 41 years later, Odinga took a study trip to Singapore with six ministers to learn from that country's experience. These studies confirm the wisdom in doing comparative studies and from that perspective this study was guided by three important issues (a) which countries are considered as leaders in gifted education (b) what is their historical development of gifted education as well as its rationale and then (c) what is the structure of their teacher development programs for teachers for the gifted.

3.3.4. Gifted Education in the United States of America [USA]

The USA has a longer history of gifted education than many other countries, since the first school for the gifted was established in Worcester, Massachusetts in 1901. Since then, the education of the gifted child has received much attention and publicity in the USA over a number of years. Given its century-old head-start in gifted education, American practice has almost become an accepted benchmark, at least in the Western World" (Freeman, 2002:5). A significant historical event that predated the 1970s resurgence of interest in gifted education is the launching in 1957 of the Russian satellite Sputnik. To many in the United States, the launch of Sputnik was a glaring and shocking technological defeat Russia's scientific minds had outperformed ours (Tannenbaum, 1979). Suddenly, reports criticising American education and, particularly, its ignoring of gifted children became popular. For example, as early as 1950, an Educational Policies Commission noted that mentally superior children were being neglected, which would produce losses in the arts, sciences, and professions. In a book entitled *Educational Wastelands*, Bestor (1953) charged that "know-nothing educationists" had created schools that provided "meagre intellectual nourishment or inspiration," particularly for bored gifted students. Tannenbaum (1979) referred to the aftermath of Sputnik as a "total talent mobilization." Gifted students were identified. Acceleration and ability grouping were installed. Academic course work was telescoped (condensed). College courses were offered in high school. Foreign languages were

taught to elementary school children. New mathematics and science curricula were developed. Funds, public and private, were earmarked for training in science and technology. In high school there was a new awareness of and concern for high scholastic standards and career mindedness. Bright and talented students were expected to take tough courses to "fulfil their potential and submit their developed abilities for service to the nation" (Tannenbaum, 1979, p. 12).

Given its century-old head-start in gifted education, the USA became our destination of choice for a National Research Foundation [NRF] funded study visit. Specifically, we chose the Western Kentucky University because (1) it houses to date the headquarters for the World Council for Gifted & Talented Children [WCGTC] (2) it houses the National Centre for Gifted and Talented Studies (3) it houses the Carol Martin Gatton Academy for Mathematics & Science. From 2011 to date the headquarters for the World Council for Gifted and Talented Children [WCGTC] has been housed at the Western Kentucky University in Bowling Green USA. Nationally WKU houses The Centre for Gifted and Talented Studies across all disciplines. Consistent with that vision and mission, the Center for Gifted Studies has been serving children who are gifted and talented, their educators, and their parents for more than thirty-five years. For four consecutive years and five times overall, WKU has been named a top producer of Fulbright U.S. Students and earned more than 35 recognitions for academic programs. The Center provides exciting educational opportunities for gifted young people, rigorous professional development for teachers, and support for parents of gifted young people. The Center has become one of the preeminent advocates for gifted education in the United States. The Center believes that when gifted young people meet their extraordinary potential, our communities, our state, our nation — even our world — become better places. That is why each school year, the Centre renews its commitment to encouraging excellence by providing quality programming and resources for gifted students, their teachers, and their parents.

The Gatton Academy is a member of the National Consortium for Specialized STEM Schools (NCSSS), made up of over 100 high schools and programs who share a commitment to providing advanced STEM learning opportunities, providing students

access to research, and paving the way to greater science learning through internships, STEM summer programs, and STEM-focused competitions (Bonds, 2013). Because of their high-ability students and thoughtful, research-driven pedagogical strategies focusing on hands-on, applied, and experiential learning, the Consortium serves as a repository of exemplar models. The schools and programs of the Consortium have been referred to as the “crown jewels” (Subotnik et al., 2010) of districts and states and serve as beacons of excellence that lawmakers look to for developing tomorrow’s STEM leaders (Bonds, 2013). Since its inception, The Gatton Academy has been imagined as a leader among programs. The program is a top-sought destination by students from around the Commonwealth. The Gatton Academy strives to be a model for the nation and internationally for what is possible in public education. Its program’s model has been named America’s Best High School in 2012 and 2013 by Newsweek and the Daily Beast (Newsweek, 2013; Streib & Yarett, 2012). In 2014, the program was once again named America’s Best High School by the Daily Beast, in addition to being named America’s Most Rigorous High School (The Daily Beast, 2014). Recently, the Gatton Academy made its 10th consecutive appearance on Jay Mathews’ list of top-performing schools with elite students (Mathews, 2019). Among program leaders in The Gatton Academy, their philosophy has been to address good ideas with the mantra, why not? A small program, our vision for what our program can become is impossible if we work alone. Our partnerships are cornerstone to what we have accomplished thus far since our 2007 opening and for the vision of what our program can be. Our footprint is ever-expanding. As new ideas come, the question Why not? is posed, and new partners are enlisted to help create fresh initiatives for students. More specifically to STEM the Western Kentucky University houses the Gatton Academy for Mathematics & Science year STEM program for gifted.

The Centre for Gifted Studies has been serving children who are gifted and talented, their educators, and their parents for more than thirty-five years. For four consecutive years and five times overall, Western Kentucky University has been named a top producer of Fulbright U.S. Students and earned more than 35 recognitions for academic programs. The Center provides exciting educational opportunities for gifted young people, rigorous professional development for teachers, and support for parents of

gifted young people. Under the direction of Dr. Julia Roberts, The Center has become one of the preeminent advocates for gifted education in the United States. The Center believes that when gifted young people meet their extraordinary potential, our communities, our state, our nation—even our world—become better places. That is why each school year, the Center renews its commitment to encouraging excellence by providing quality programming and resources for gifted students, their teachers, and their parents.

More specifically to STEM the Western Kentucky University houses the Gatton Academy for Mathematics & Science. The Academy is Kentucky's first residential 2-year STEM program for gifted and talented juniors and seniors. Established in 2007, students at the Gatton Academy enrol as juniors and are full-time WKU students pursuing their inters test in advanced science, technology, engineering and mathematical careers.

In 2019 the Gatton Academy of Mathematics and Science was named on the Jay Mathews' list of top-performing public schools with elite students for the tenth consecutive time. Being recognised as a top performing school with elite students for ten appearances is definitely noteworthy, said Dr Julia Roberts, Executive Director of the Gatton Academy and Mahurin Professor of Gifted Education. With such credentials, this positions WKU as an ideal institution for us to partner with as we go forward in our attempts to provide appropriate support for gifted learners in South Africa.

The Gatton Academy is a recipient of the 2022 Inspiring Programs in STEM Award from *Insight into Diversity* Magazine and the Innovation Partnership Award from the National Co.

3.3.5. Teacher development in the USA's gifted education

The United States has come a long way in recognising the benefits of specialised teacher training in gifted education and has teacher endorsement and certification in gifted education in 28 of the 50 states (Karnes, Stephens & Whorton, 2000). Admittedly the USA has many centres for gifted education which include the Joseph Renzulli

Centre for Giftedness at the University of Connecticut as well as the Vanderbilt University Centre for Gifted education, however the researcher considered it sufficient to gain some insights on teacher training and development from only three important institutions: (a) the National Association for Gifted Children [NAGC] (b) American Psychological Association, Center for Psychology in Schools and Education (APACPSE) (c) the Western Kentucky University which houses the Headquarters for the World Council for Gifted & Talented Children, the USA National Centre for Gifted Education, as well as the Gatton Academy for Mathematics & Science. The justification for the choice of these three sources was as follows: (a) that the NAGC (1996) developed a set of standards for post-graduate programs in gifted education across the United States (b) that APACPSE standards were developed from a coalition, operating in the mode of a National Institute of Health consensus panel and (c) that the National Center for Gifted Studies at the Western Kentucky University [WKU] has been serving children who are gifted and talented, their educators, and their parents for more than thirty five years. For four consecutive years and five times overall, WKU has been named a top producer of Fulbright U.S. Students and earned more than 35 recognitions for academic programs. The WKU Center for Gifted Studies has therefore become one of the preeminent advocates for gifted education in the United States.

NAGC standards for postgraduate programs in gifted education

National standards for gifted education teacher preparation programs reflect what the field of gifted education, led by NAGC, determines as essential for gifted education specialists to know and be able to do. The standards, which were developed with the Council for Exceptional Children, are the foundation for the knowledge and skills needed in teacher candidates in gifted and talented education. These principles and standards provide benchmarks by which gifted education professionals practice and professionally evaluate each other and include the following topics, concepts and ideas.

Foundations

Historical foundations of gifted and talented education including contributions of certain individuals from diverse backgrounds e.g.

- Galton's (1865) general laws of distribution
- Spearman's (1927) general intellectual ability
- Catell's (1963) fluid and crystal intelligence
- Guilford's (1967) information processing model
- Sternberg's (1985) triarchic model of intelligence
- Gardner's (1993/1994) multiple intelligence
- Key philosophies, theories, models and research supporting gifted and talented education.

Development and characteristics of learners:

Gifted students have varied characteristics which have an effect on their development i.e.

- Cognitive characteristics
- Physical characteristics
- Emotional characteristics
- Social characteristics

Individual learning differences:

Educators of the gifted must be aware of the diverse influences on student behaviour and these include:

- Student's race
- Student's culture and language
- Student's gender and sexual orientation
- Socio-economic background e.g. poverty
- Student's learning ability and learning style
- Student's personality
- Student's physical disposition

Instructional Strategies:

Curriculum strategies for gifted students include:

- Pre-assessment in order to adjust instruction that is consistent with the individual student's progress.
- Acceleration
- Enrichment
- Grouping
- Problem based learning.
- Curriculum compacting
- Extra-curricular activities

Learning Environments and Social Interactions

The classroom needs to be a place where gifted students can:

- learn about and respect different social and cultural norms and language diversity.
- Promote self-esteem of students
- Guard against unrealistic expectations from both the teacher and parents
- Identify and be receptive to different copying styles of students.
- Support the self-efficacy of the students.

Language and communication

Ways that educators can promote verbal development in gifted students is by

- differentiating the curriculum
- encourage open communication between the students, parents and teachers.
- analogical reasoning
- studying other languages
- use research based strategies

Instructional planning

- Consider gifted students' cultural, linguistic and intellectual differences
- The need for considering the student's interest
- Consider the environmental and natural catalysts
- Curriculum differentiation
- Development of higher-level thinking skills

Assessment

Assessments are vital for decision making when working with gifted students.

- For identification – use of multiple measures and alternative assessment
- For monitoring academic progress
- For adjusting instruction

Professional and Ethical Practice

- Educators for the gifted students are guided by the ethical and professional practice standards of the profession.
- Teachers' personal and cultural frames of reference create biases especially for teachers not trained on gifted education.
- Maintain confidential communication about individuals with gifts and talents
- Conduct activities in gifted education in compliance with the laws, policies, and standards of ethical practice.

Collaboration Research

- Teachers need to collaborate with various individuals and organisations
- Parents can detect early signs of giftedness in their young children
- Communities can provide other types of learning opportunities
- Mentors can provide the critical motivation for students to advance
- Collaboration with schools and business partners can create growth opportunities
- Collaboration with other specialists especially where the gifted student is also disabled

Federal and state mandate

NAGC is of the view that as long as gifted education is not protected by federal and state mandate, advocacy will be weakened. The field is only as strong as the linkages among state policies, university preparation of personnel and local practice. In her own words Julia Roberts, the then President of the WCGTC as well as NAGC legislative chairperson had this to say:

Legislative advocacy is something that's very close to my heart because that's where we get things to happen for gifted children; whether we're talking about advocacy at the school level, the district, state, or the national level. At this particular time, I happen to be the legislative chairman for the National Association for Gifted Children [NAGC], and I appreciate the fact that it requires numbers of advocates and people who know what they're talking about. Gifted children have needs that require advocates working in homes, schools, universities, industry and communities to ensure their needs are met. Consequently, at the time of the researcher's visit in 2019, the United States was experiencing a wave of educational policy at Federal (National), State (Provincial) & Local (District) levels that support gifted education. For example, in 1993 the U.S. Department of Education published National Excellence: A Case for Developing America's Talent which recommended the following steps to better support gifted students:

- *set challenging curriculum standards,*
- *provide more challenging opportunities to learn,*
- *increase access to early childhood education,*
- *increase learning opportunities for disadvantaged and minority children with outstanding talents,*
- *broaden the definition of gifted, emphasize teacher development and match world performance (i.e., learn from other nations and work to match high achieving counterparts around the world).*

APA Principles for preK-12 Creative, Talented, and Gifted Students' Teaching and Learning

The American Psychological Association, Center for Psychology in Schools and Education (APACPSE) (2017) presented a gifted education supplement with a list of what they considered the most important principles from psychology—the “Top 20”—that would be of greatest use in the context of preK–12 classroom teaching and learning, as well as the implications of each principle as applied to classroom practices for gifted students. In **Figure 3.17** each principle is named and described, relevant supporting literature is provided, and its relevance for the gifted classroom is discussed. Their advice is that gifted children, like all children, are best taught when the Top 20 principles included in this document are in place and supported by the administration and faculty.

The method to derive the Top 20 principles was as follows: The coalition, operating in the mode of a National Institute of Health consensus panel, engaged in a series of activities. First, each member was asked to identify two constructs or “kernels” (Embry & Biglan, 2008) from psychology thought to be most essential for facilitating successful classroom teaching and learning. This process led to the identification of approximately 45 kernels/principles. Several national blueprint publications related to teaching were then analyzed to assess whether each of these principles also had been identified by the broader community of educators as critical to teacher practice. Cross-checking analyses were conducted on APA’s standards for high school curriculum in psychology; the PRAXIS Principles of Learning and Teaching examination from the Educational Testing Service; documents from the National Council for the Accreditation of Teacher Education; the InTASC (the Interstate Teacher Assessment and Support Consortium) standards; a popular educational psychology textbook; and the National Association of School Psychologists’ Blueprint for Training and Practice. These documents were searched for evidence of what teachers were expected to know or be able to do and whether these expectations could be linked to the principles that the coalition had identified. There was support for all principles in one or more documents. Hence, all were retained for the next step in the validation process. To identify the most important of the 45 principles/ kernels, the coalition used a modified Delphi process (modelled after the Institute of Medicine’s report *Improving Medical Education: Enhancing the Behavioural and Social Science Content of Medical School Curricula*). Using a scale

system, four coalition members rated each of the principles and assigned each a high, medium, or low priority score (1–3). Mean scores for each item were calculated. On the basis of the mean scores, low-priority principles were discarded, leaving 22 principles. These were then analyzed for their relation to each other and were synthesised into the final 20 presented here in **Figure 3.17**.

Figure 3.17 Top 20 Principles from Psychology for PreK–12 Creative, Talented, and Gifted Students' Teaching and Learning (Source: APACPSE, 2017)

PRINCIPLE 1 Students' beliefs or perceptions about intelligence and ability affect their cognitive functioning and learning.	PRINCIPLE 12 Setting goals that are short-term (proximal), specific, and moderately challenging enhances motivation more than establishing goals that are long-term (distal), general, and overly challenging.
PRINCIPLE 2 What students already know affects their learning.	PRINCIPLE 13 Learning is situated within multiple social contexts.
PRINCIPLE 3 Students' cognitive development and learning are not limited by general stages of development.	PRINCIPLE 14 Interpersonal relationships and interpersonal communication are critical to both the teaching–learning process and the social development of students.
PRINCIPLE 4 Learning is based on context, so generalizing learning to new contexts is not spontaneous but instead needs to be facilitated.	PRINCIPLE 15 Emotional well-being influences educational performance, learning, and development.
PRINCIPLE 5 Acquiring long-term knowledge and skill is largely dependent on practice.	PRINCIPLE 16 Expectations for classroom conduct and social interaction are learned and can be taught using proven principles of behavior and effective classroom instruction.
PRINCIPLE 6 Clear, explanatory, and timely feedback to students is important for learning.	PRINCIPLE 17 Effective classroom management is based on (a) setting and communicating high expectations, (b) consistently nurturing positive relationships, and (c) providing a high level of student support.
PRINCIPLE 7 Students' self-regulation assists learning, and self-regulatory skills can be taught.	PRINCIPLE 18 Formative and summative assessments are both important and useful but require different approaches and interpretations.
PRINCIPLE 8 Student creativity can be fostered.	PRINCIPLE 19 Students' skills, knowledge, and abilities are best measured with assessment processes grounded in psychological science with well-defined standards for quality and fairness.
PRINCIPLE 9 Students tend to enjoy learning and to do better when they are more intrinsically rather than extrinsically motivated to achieve.	PRINCIPLE 20 Making sense of assessment data depends on clear, appropriate, and fair interpretation.
PRINCIPLE 10 Students persist in the face of challenging tasks and process information more deeply when they adopt mastery goals rather than performance goals.	
PRINCIPLE 11 Teachers' expectations about their students affect students' opportunities to learn, their motivation, and their learning outcomes.	

These Top 20 were then placed into five areas of psychological functioning. The first eight principles (1 – 8) relate to cognition and learning and address the question: *How do students think and learn?* The next four (9–12) discuss the question: *What motivates students?* The following three (13–15) pertain to the social context and emotional

dimensions that affect learning and focus on the question: *Why are social context, interpersonal relationships, and emotional well-being important to student learning?* The next two principles (16–17) relate to how context can affect learning and address the question *How can the classroom best be managed?* Finally, the last three principles (18–20) examine the question: *How can teachers assess student progress?*

Western Kentucky University Gifted & Talented Endorsement Programs

Western Kentucky University offers a Gifted and Talented Endorsement, designated on the teaching certificate, which provides the opportunity to work directly with groups of gifted children K-12. Currently, it is the only Kentucky institution that has offered the complete sequence annually since 1984. Specializing in gifted education proves extremely valuable for classroom teachers, counsellors, gifted resource teachers or administrators. The endorsement requires the following four classes, three of which are offered online.

Figure 3.18 Western Kentucky Endorsement Program

GTE536	Nature and Needs of Gifted, Creative and Talented Students ➤ terminology, ➤ theories, ➤ issues, and ➤ general approaches in educating gifted, creative, and talented young people.
GTE537	Curriculum, Strategies, and Materials for Gifted Students ➤ curriculum and the learning environment in meeting the unique and advanced needs of gifted students. ➤ Strategies particularly suitable for the gifted.
PSY432	Psychology of the Gifted and Creative ➤ Identification of gifted children and adults with emphasis on educational Programs for the maximum development of giftedness.
GTE538	Practicum for Teachers of Gifted Students ➤ A candidate should have successfully completed the aforementioned modules in order to enrol for this practical component of the endorsement; ➤ The practical training takes place over two weeks and entails supervised experiences that allow teachers to apply the knowledge and skills they learned during the theoretical part of the program; ➤ The practical training can only take place at the WKU campus during the learner summer camps in June. This is to ensure that lecturers can assess and monitor the students.

The College of Education and Behavioural Sciences at Western Kentucky University offers the MAE in Gifted Education and Talent Development. The MAE has two pathways – one leading to certification and the other with a research focus. The pathway leading to certification (Rank II and Gifted Endorsement) includes 18 graduate hours in gifted education and talent development. Educators pursuing the 31 credit-hour Advanced Certification for Teacher Leader concentration may be completing the graduate program to continue in a teaching position or to become a curriculum coordinator. Counsellors, principals, librarians, and other specialized teachers will enhance their knowledge and skills in a concentration that leads to Rank II certification and the gifted education endorsement.

Figure 3.19 Western Kentucky University Advanced Certificate for Teacher Leadership

PSY432G	Psychology of the Gifted and Creative
GTE 536	Nature and Needs of Gifted, Creative, and Talented Students
GTE 537	Curriculum, Strategies, and Materials for Gifted Students
GTE 538	Practicum for Teachers of Gifted Students
GTE 539	Assessment and Identification of Gifted and Talented Students
GTE 540	Developing Creativity and Leadership in Gifted Youth
TCHL 500	Foundations of Teacher Leadership
TCHL 545	Class Instructional Strategies
TCHL 555	School and Class Assessment
TCHL 559	Action Research Design
TCHL 560	Action Research Capstone in Teacher Leadership

3.3.6. Gifted Education in Singapore

As educational programs for the development of gifts and talents in the world take on new forms and focus, a recent effort is the provision of integrative programs across disciplines. In the United States and Korea, the tendency is to offer a curriculum or subject involving science, technology, engineering, and mathematics, or STEM fields (e.g., STEM Education Coalition, 2012); at times, art is also included (STEAM). Singapore is no exception as interdisciplinary lessons have been increasingly used to promote learning and discovery in recent years. An example is a competition in the GEP curriculum called "Creative and Heuristic Applications of Science (CHAOS)" (MOE,

Singapore, 2012). The nation has seen considerable expansion and diversification of its programming options and provisions for a wider range of gifts and talents in the last decade in particular. There is also now some diversity in identification procedures across domains of talent. Talents in nonacademic domains like dance, theatre, music, visual arts, and sports are now identified and enhanced through rigorous talent development programs. All programs for high-ability youth offer a differentiated curriculum aimed at developing targeted cognitive and social-emotional abilities as well as specific character traits (MOE, Singapore, 2004).

According to Chew (2012), we continue to see practices once reserved for top-performing students extended to all schools in Singapore. Sometimes the focus is on developing creative thinking whereas other schools choose to carve a niche for themselves in a specific talent domain like dance, digital media, or environmental science (Chew, 2012).

In the past 20 years, Singapore has firmly established its reputation in the global education policy space as one of the best education systems in the world. Its branding as an education ‘success’ has been legitimised and reinforced by consistent performance at the top of various international large-scale assessments (ILSAs) from the mid-1990s to now. Singapore consecutively topped the Trends in International Mathematics and Science Study (TIMSS) in 2015 and 2019 in both math and science, building upon a history of appearing in the top ranks since joining TIMSS in 1995. Its success has been replicated on the Programme for International Student Assessment (PISA) and Progress in International Reading Literacy Study (PIRLS) as well, ranking 1st on PISA 2015 and 2nd on PISA 2018 in all three subjects— mathematics, reading, and science. Alongside Ontario-Canada, Shanghai-China, Hong Kong, South Korea, and Finland, Singapore is part of the High-Performing Education Systems (HPES) consistently referenced in global policy discourses as ‘educational stars’ for other countries to follow (Deng & Gopinathan, 2016).

With specific reference to the quality of education, Prime Minister Lee Hsein Loong, told citizens in one of his May Day speeches: “To survive, you have to be exceptional.” The

alternative, he warned, was being “pushed around, shoved about, trampled upon; that’s the end of Singapore and the end of us”. Consistent with this view, he pledged his vision to build an inclusive society and consistent with that vision inclusivity has become the rhetoric in Singapore’s educational landscape as well as the larger social context (Lee, 2014). What makes Singapore’s inclusive education different from that in other countries including South Africa is that Singapore’s inclusive education was conceptualised with many peaks of excellence (Lee, 2006) hence it is built on an ability-driven education system in which students are nurtured in different academic streams based on their strengths and talents. The aim of the MOE who oversees the development of the entire system is to help students “discover their own talents, to make the best of those talents, to realise their potential, and to develop a passion for learning” (MOE, Singapore, 2012:1). Singapore’s effort to broaden conceptions of giftedness and develop national talent is illustrated in that the MOE has a mainstream system known as the Global Provider (GP) then the Gifted Education Program (GEP), the Special Education (SPED) and Special Schools (SS). The Singapore GP education system has a mainstream curriculum, which is differentiated to accommodate the 4% High Ability Learners who do not make the grade for the GEP program. There are SPED Schools, which provide customised educational and training programmes to cater for the diverse needs of children with special educational needs and the enriched curriculum in Gifted Education Programs, which is taught by teachers selected and trained by the MOE’s Gifted Education Branch (Milne & Mhlolo, 2021). The above developments have meant that Singaporeans do not associate gifted education with class differentiated access to the best schools. Singapore officially initiated “gifted education” in 1984 for two reasons, the first of which was educational as it was believed that intellectually gifted children need a high level of mental stimulation and challenge, which may be difficult to address in a regular classroom setting. The second reason for gifted education in Singapore was socio-political. As a small, vulnerable nation, the country has no natural resources and as such relies on its human resource for advancement and success. Hence, the country considered it advantageous to nurture the ability of talented children and from this perspective, the stated purpose of gifted education continues to be “to prepare talented youth for responsible leadership and service to country and society” (MoE, Singapore, 2013).

The central operating ideal in Singaporean education is meritocracy, which also becomes the standard expectation for all other areas of Singaporean society. Success is seen to be solely determined by talent and hard work, and the government argues that it provides equal opportunities for all students to succeed, again on the basis of ability and efforts, regardless of their social and economic backgrounds. Possessing good academic credentials then becomes the key to good careers, social mobility, and future success (Deng & Gopinathan, 2016). Although the neutrality of meritocracy has its own share of problems, the Singaporean education system is still a highly competitive, pressure-cooker environment that operates around high-stakes exams: beginning with the Primary School Leaving Exam (PSLE) at the end of grade 6, then the 'O'-levels after four years and 'A'-levels after six years of secondary education. PSLE results determine whether students are streamed into special, express, or normal streams for secondary schools. The most gifted students can enter Integrated Programs that allow them to proceed straight to A-levels without needing to take the O-level exams, which provides them with more time to enjoy enrichment activities (Kenway & Koh, 2013; Lim & Apple, 2015). The local term 'kiasuism' means 'the fear of losing out' and captures the essence of this hyper-competitive education culture (Kenway & Koh, 2013). Culture of valuing education: the ideology of meritocracy and the high societal value placed on education is without a doubt a key pillar of Singapore's education success. Starting from the introduction of the Thinking Schools, Learning Nation (TSLN) reform in 1997, a consistent goal of education has been equipping and preparing students for the knowledge economy by building on their individual abilities, talents, and competitiveness (Tan & Dimmock, 2014).

Another critical lesson from Singaporean education, especially for countries struggling with improving their mathematical sciences, has been how the country responded to the challenges related to the vernacular languages. For example, in South Africa, Shay, et al., (2020) in their report from a research project entitled: Courses Impeding Graduation [CIG] their findings reveal that these courses are working for White, English/Afrikaans home language students but 'not working' for students who are Black, and others who are not English/Afrikaans home language speakers. Informed by existing research (Prediger, Erath, & Moser, 2019) the researchers on the CIG project speculate that

academic literacy skills in English [the official Language of Learning and Teaching-LOLT] are the primary obstacles for students with weaker performance. There has also been other research and development projects to investigate the role of language in Mathematics concept development. Empirical evidence shows that using English as a medium of instruction tends to disadvantage some students whose first language was not English. This issue of language in the teaching and learning of mathematics has been identified as a national problem in South Africa but perhaps it is how the country has responded to the problem that sets it apart with the Singapore's strategy. In South and according to the Presidential Commission on the Fourth Industrial Revolutions [PC4IR] (2020) as we consider the future of South Africa, it is essential to embrace the language of choice as it also references a crucial difference in the way in which we will participate in the future, as free and fully informed protagonists in our future. Perhaps it is this 'language of choice' approach that is also drawing the country back especially in the teaching and learning of mathematical sciences. In South Africa there are about 11 official vernacular languages, a situation which complicates this issue of language of choice as well as attempts at code switching that have been tried [without success] in an effort to cater for the needs of learners who found it problematic to learn mathematical sciences in English.

Just like South Africa, at independence, Singapore had multiple ethnic groups, multiple religious groups, no common language, no common school system and no common curriculum (MOE, Singapore, 2013, 2014). Lee Kuan Yew's greatest fear was that his little country would suffer from the ethnic and religious struggles that have impeded the development of so many other societies, including South Africa. The country took a bold decision to use English as a medium of instruction and when compared to other East Asian 'reference societies,' the use of English provides Singapore with a comparative advantage. For example, in a case study on why the United Arab Emirates [UAE] decided to borrow Singapore's policy expertise, a participant explained: *When we looked to the east, Singapore shone out brightly not because [they] are more capable or whatever but because [they] use English as the medium of instruction, administration and commerce and business* (Aydarova, 2013, p. 294)

3.3.7. Teacher Development in Singapore's Gifted Education

Both the Singaporean and other global actors are consistent in their message that teachers play the key role in explaining Singapore's education success. For example, when Andreas Schleicher, the head of OECD PISA and OECD Indicators of Education Systems program, visited Singapore in 2011, Professor Lee Sing Kong (Director of NIE) remarked, "As a teacher educator, I want to first start by stating that at the heart of Singapore's educational success is the quality of our teachers" (Avila et al., 2012, p. 28). The MOE's Corporate Brochure on education in Singapore also acknowledges, "Quality teachers and first-rate instruction are highlighted... as the key reasons for the success of the Singapore education system" (Ministry of Education Singapore, 2015, p. 7). In the international literature on Singaporean education, the role of teachers has been widely acknowledged (Darling-Hammond & Rothman, 2011; OECD, 2011, 2017). In the PISA for Schools report, provided to every single school enrolling in this OECD program no matter their country or context, the box dedicated to explaining Singaporean success highlights "the importance of recruiting and training good teachers" (OECD, 2017, p. 74). Rigorous selection and recruitment into initial teacher training programs: only the top 30% of each student cohort qualify to apply to these programs, and only half of this number pass the selection interview. Once admitted into teacher training programs, student-teachers immediately get tuition remission plus a monthly salary all through their pre-service preparation. Their starting salaries are at equivalent levels to entry-level doctors and lawyers. This helps attract the best and brightest into teaching and ensures that teaching is a highly respected profession. NIE's initial teacher preparation is an 'evidence-based, values-centric program' that pivots on a three-pronged set of values (V) with skills (S) and knowledge (K), a model which they have branded as the V3SK framework (NIE, 2012). The three value paradigms include: learner centeredness, teacher identity, and service to the profession and the community. To help student-teachers develop clinical experience, digital technologies are used to enable real-time access to classrooms, even during pre-service training. All new teachers tend to already have a degree. After a few years of working, they enrol in a Master's in education which is designed to frame their practical experience in the classroom with a coherent theoretical framework, and this is also financially supported

by the MOE. When the global education world looks for ready-made policy solutions, Singapore provides a consistent message as to what these solutions can be: the quality and effectiveness of teacher recruitment and training policies (assumed as the proxy for quality of instruction in the classroom), as well as the quality of leadership and policy-making. They deftly use ‘evidence- based policy’ branding discourse, such as how they characterise their mathematics curriculum as both “heavily researched-based” and based on the world’s best models and approaches (Davie, 2020). Importantly, discourses around Singapore’s success also emphasize how (supposedly) fast it has achieved its amazing progress in education: in just one generation (Reyes & Gopinathan, 2015). The HPES literature is eager to point out how Singapore’s mathematics and science achievement in the early 1990s was as mediocre as the United States (e.g., Leinwand & Ginsburg, 2007), but then it has turned around and captured the world’s attention with consistently strong showing on the ILSAs.

The inception and provision of the Gifted Education Program [GEP] in Singapore was piloted by the government's agency, the Ministry of Education [MOE], under the auspices of the Gifted Education Branch in 1984 (MOE, Singapore, 2012a). The initiative in 2004 to develop specialized schools to serve the top 5% of students in specific domains of talent further illustrates Singapore's broadening conceptions of giftedness and its efforts to develop national talent in nonacademic domains. The Singapore Sports School was launched in 2004, followed by the National University of Singapore High School of Mathematics and Science (NUS High), the School of the Arts Singapore (SOTA) in 2008, and the School of Science and Technology, Singapore (SST) in 2010.

Through the provision of an enriched curriculum, the GEP in Singapore seeks to meet the needs of pupils who are intellectually gifted. GEP was born in 1984 out of a need to provide educational opportunities to the intellectually gifted students so as to enable them to develop to their optimal potential. The intellectually gifted students have needs that are different from other students. They generally require a higher degree of mental stimulation. Research has shown that a regular classroom learning environment does not cater to these needs, and may ironically, allow these intellectually gifted students to

degenerate into underachievers in their schools. Singapore's most valuable resource is its people. It will be to the detriment of the country if the talents among its people are not harnessed and cultivated to ensure its future growth and prosperity. Thus, GEP exists to provide for the intellectual needs of the gifted students via its carefully tailored educational programmes and curriculum (Gifted Education Unit, 1995).

The GEP curriculum differs from the regular programme through enrichment in the following 4 areas:

- **content:** the basic facts, concepts and skills are extended beyond the basic syllabus in breadth and depth, covering more advanced topics whenever necessary. The different subjects are integrated to allow the students to have a holistic view of the nature of knowledge. The students are also encouraged to investigate real-life problem as well as examine the affective issues in the various subject areas. In recognition of the varying abilities among the gifted students, individual needs and interests of the students are given closer attention.
- **process:** the students are taught higher-level thinking skills and provided the opportunities for discovery learning and open-ended problem solving. Research skills for independent study are also imparted to them. The teaching strategies are varied to suit the different learning styles of the students. The spirit of co-operation and teamwork are also nurtured through small-group activities and peer teaching.
- **product:** the students are encouraged to investigate real-life problems, and to present what has been learnt in a variety of ways via creative expressions.
- **learning environment:** a supportive and pupil-centred environment is provided to encourage risk-taking and the exploration of challenging tasks and ideas. Out-of-school learning experiences such as field-trips, mentorship and community services programmes are also provided (Gifted Education Unit, 1995)

Teachers are selected for the GEP after a process of interview and classroom observation. The qualities which the GE Branch looks for in a teacher include strength in subject content, creativity, flexibility and proficiency in teaching. The selected teachers are then required to undergo a foundation course where they are exposed to the concept of education for the gifted, the principles of education for the gifted, and the principles of curriculum differentiation and affective education. This course is followed by a GEP Annual Conference whereby all GEP teachers attend workshops, review the GEP curriculum, and plan for the new academic year. The training and development of GEP teachers takes place on the job. GE Branch officers help the teachers via developmental supervision and regular meetings which discuss matters relating to the GEP curriculum and teaching strategies. The GE Branch also organises courses that are conducted by GE Branch officers, gifted education specialists and overseas consultants.

The National Institute of Education (NIE), Nanyang Technological University, Singapore believes in lifelong learning. In alignment with NIE's mission to excel in Teacher Education, the range of professional development programmes and courses offered by NIE to meet the needs of their various stakeholders is instrumental in enabling the fulfilment of this mission. In addition, one main feature of NIE's Teacher Education Model of the 21st Century is the consideration of teachers' needs on an enhanced pathway of professional learning (PL). NIE believes their professional learning programmes for teachers are instrumental in meeting teachers' aspirations.

Certificate in Differentiating Curriculum and Instruction for High Ability Learners

This certificate programme seeks to provide teachers from independent schools as well as those working in various educational settings with further professional development opportunities to enhance their knowledge and skills in meeting the needs of learners who have been identified as high ability learners (HAL).

IEC4008 High Ability in Learners: Understanding and Providing for them in the Regular Classroom

This course seeks to help teachers' gain a deeper understanding of high-ability learners (HALs), to develop an informed awareness of the learning needs of HALs; and begin to provide for the needs of highly able pupils in regular classrooms. Topics will include an overview of the cognitive and affective traits as well as learning needs of high ability learners; conceptions of intelligence and giftedness; issues around the identification and assessment of learning potential; and the rationale for differentiated instruction. Participants will be acquainted with some methods of instructional modification and strategies for engaging learners with high ability and for enhancing their learning in mixed-ability settings.

3.3.8. Gifted Education in Australia

One area in which the Australian Curriculum specifically caters for student diversity is in relation to gifted and talented students (Robinson & Dailey, 2014). There is no universally accepted way of defining gifted and talented students. However, Gagné's Differentiated Model of Giftedness and Talent (DMGT) is currently the most generally accepted definition in Australia. The Australian Professional Standards for Teachers [APST] emphasise the importance of catering for student diversity, with focus area 1.5 stating that graduate teachers must appreciate the importance of inclusion and be able to differentiate their teaching to cater to the vast learning needs across the gamut of student abilities. Additionally, focus area 4.1 requires teachers to support student participation, meaning that graduate teachers must employ strategies to encourage inclusive student participation and engagement in the classroom. Further, the policy framework for the Australian Curriculum is provided by the Melbourne Declaration on Educational Goals for Young Australians, with the main aims being to ensure that schools promote equity and excellence, thereby allowing all young Australians to become successful learners, confident and creative individuals and active and informed citizens. Hence inclusive education, including for the gifted, is also a national consideration.

Coincidentally at the same time South Africa was launching its dedicated schools project in 2001, there was an Australian Senate inquiry into the education of gifted children which recommended that teachers needed more professional education in the characteristics and needs of gifted students, with untrained teachers having difficulty recognising giftedness in children other than those who were well-behaved and belonging to the dominant culture (Robinson & Dailey, 2014). The inquiry recommended that the training should focus on strategies for teaching gifted students as well as identification techniques, especially in relation to identifying gifted children who have disadvantages such as Indigenous background, rural isolation, physical disability or low socio-economic status. The document provided by the Queensland Government now specifies that teachers must look for gifted and talented students within all groups of learners, including the disadvantaged. However, even though such policies exist, research still shows that schools struggle to interpret state and sector gifted education policies.

As early as 1988 a nationwide Senate Enquiry into the education of gifted students in Australia (Senate Select Committee on the Education of Gifted and Talented Children, 1988) identified groups of gifted students who were at particular risk for non-identification.

- gifted children from economically disadvantaged backgrounds
- culturally diverse students learning English as a second language.
- children who were gifted but with a learning disability.
- gifted students with physical disabilities - for example visually impaired or hearing impaired gifted students.
- gifted students in geographically isolated areas
- gifted students whose love of learning had been dimmed by years of repetitive and unchallenging curriculum.
- gifted students who deliberately camouflage their abilities for peer acceptance.

In 2001, a second Senate investigation reported that the situation had changed very little in 13 years!

3.3.9. Teacher Development in Australian Gifted Education

According to the Tasmanian Association of the Gifted (2021) there are only a few universities that provide gifted education in Australia and even fewer that offer a subject at the undergraduate level. A good example is the University of the New South Wales. Research and longitudinal studies by Emeritus Professor Miraca Gross from the University of New South Wales [NSW], at the Gifted Education Research, Resource and Information Centre (GERRIC), has long received world-wide recognition through its Gifted and Talented Education Professional Development Package for Teachers (Gross et al., 2004). Gross's research has proven that acceleration has distinct positive social and psychological benefits for gifted learners (Gross et al., 2007; Gross, 1989, 1999, 2006; Gross et al., 2011; Hoekman et al., 1999). Given its long-standing recognition GERRIC is at the forefront of gifted research, learning and teaching in Australia hence it was considered for this study. The GERRIC course consists of six Modules:

Module One: Understanding Giftedness

Understanding the nature of giftedness and talent; what the terms mean; levels and types of giftedness. Cognitive and affective characteristics of gifted and talented students; ways in which these students may differ from their classmates - even if at first, we don't observe this.

Module Two: The Identification of Gifted Students

A range of practical identification procedures, with particular attention to procedures which are effective in identifying gifted students from culturally diverse and disadvantaged groups. We'll be emphasising the use of a combination of approaches rather than a single measure such as IQ testing or teacher nomination used in isolation.

Module Three: Social and Emotional Development of Gifted Students

Understanding the social and emotional characteristics and needs of gifted students. Ways in which gifted students may differ somewhat from their classmates in their social and emotional development. Supporting gifted students and their parents. Teaching

strategies and class structures which foster the development of positive social attitudes and supportive peer relationships in gifted students.

Module Four: Understanding Underachievement in Gifted Students

Understanding the causes of underachievement in gifted students. Identifying gifted underachievers and planning interventions designed to prevent and reverse cycles of underachievement.

Module Five: Curriculum Differentiation for Gifted Students

Teaching strategies and methods of curriculum differentiation which enhance the learning of gifted students in the regular classroom. Appropriate use of different enrichment models that international research has found to be effective with gifted and talented students. Practical applications of pre-testing, curriculum compacting and individualised programming.

Module Six: Developing Programs and Provisions for Gifted Students

Practical strategies for the establishment and monitoring of ability, achievement or interest grouping, and the many forms of accelerated progression. Particular attention will be paid to the effects of various strategies on students' academic and social development.

3.4 Summary from the literature review

Over the last twenty years, several researchers in the gifted education field have commented on the desirable characteristics of teachers of the gifted. After a comprehensive analysis of this literature the study concludes that these qualities can be grouped into five broad categories which are now provided as a summary of this literature review. These principles and standards provide benchmarks by which gifted education professionals practice and professionally evaluate each other.

3.4.1. Legal Framework and Policy Documents

Gifted education specialists advocate for policies and practices that improve programs, services, and outcomes for individuals with exceptionalities. According to VanTassel-Baska & Johnsen, (2007) as long as gifted education is not protected by federal and state mandate, advocacy will be weakened. They go further to state that the field of gifted education is only as strong as the linkages among state policies, university preparation of personnel and local practice. Advocacy for strong gifted education policies is also mentioned by the World Council for Gifted & Talented Children [WCGTC]. For example, in their 10 Global Principles (WCGTC, 2021), the 9th principle is on sustainability, and it states that professional learning in gifted education should be built into educational policy of the country, state, region, province or district/county. Similarly, in Australia, the Tasmanian Association of the Gifted (TAG) (2021) noted that The Commonwealth should propose that the Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA] develop a consistent policy encouraging suitable acceleration for the gifted. This followed one of the recommendations of the 2001 Report of the Senate Select Committee (Commonwealth of Australia, 2001). TAG lamented that in Australia, teacher training is mandated for special needs, Indigenous and English as a second language (ESL) students, yet there is no mandated training in gifted education. Their view was that the ongoing lack of commitment to delivering graduate teachers that have specific knowledge and meaningful, practical skills to identify, support and cater for gifted students tells us that teacher training in gifted education needs to be mandated. Similarly in South Africa, Milne & Mhlolo (2021) viewed the current recommendations about gifted education as a noble vision. However, their fear was that it might never translate into practice because the gap between policies and their implementation at the school level, is mammoth. For example, Dinaledi Schools were conceived as public entities which were expected to be centres of excellence admitting gifted learners that would otherwise not attend such a school elsewhere. While identifying/screening/testing would have been indispensable features of such a project, section 3(5) of the Schools Act (South Africa, 1996), clearly stipulates that the governing body of an ordinary public school may not administer any test relating to the admission of a learner to an ordinary public school,

or direct or authorize the principal of the school or any person to administer such a test. The very same Act also imposes restrictions on admitting learners from outside the feeder areas to public schools. This is a typical example of policy discontinuities or loose coupling which might have hampered effective implementation of the National Strategy for Mathematics, Science & Technology Education [NSMSTE]. The Centre for Development Enterprise [CDE] (2007) 'doubling for growth' report identified this as one of the legal restrictions which needed to be circumvented if the NSMSTE were to achieve its objectives. Yet, in Singapore for example, every new development or change in policy is complemented by enormous attention to the details of implementation – from the MoE, to the NIE, cluster superintendents, principals and teachers. The result is a remarkable exact implementation with relatively little variation among schools in Singapore (Milne & Mhlolo, 2021).

3.4.2. Psychology of Gifted Education

Gifted students differ from their peers because they learn more easily and in a shorter time, think at a more abstract level, engage with interest in topics they enjoy until they master them, and are able to direct their attention to multiple simultaneous activities (Winebrenner, 2000). Teachers often feel afraid to teach gifted and talented students because they have the impression that gifted students have excellent abilities and vast knowledge, but they are also arrogant and critical as well as know better than teachers and also easily get bored. This stigmatic thinking among teachers does not help the gifted children to excel and unleash their potential. These teachers' attitudes to gifted students can be changed if the schooling system provide appropriate training for teachers to teach those students (Gross, 2016). Development of expertise in gifted education therefore begins with a thorough understanding of and respect for similarities and differences in all areas of human growth and development.

Figure 3.20 The ups and downs of giftedness [Source: Strip & Hirsch, 2000].

THE UPS AND DOWNS OF GIFTEDNESS		
STRONG ASPECTS	THE OTHER SIDE	POSSIBLE CONSEQUENCES
<i>Show a greater level of understanding than peers of the same age</i>	Think their peers' way of reasoning and understanding is "silly", and express their opinion to them.	Peers avoid them; adults perceive them as too talkative. They lose friends.
<i>Verbal skills advanced for age</i>	They talk more than their classmates, who do not understand what they are talking about. They always want to talk, not giving others a turn.	Peers perceive them pretentious and superior to others, and exclude them. They become isolated.
<i>Creative thinking</i>	Solve problems in their own way, not the way taught by the teacher.	The teacher feels threatened, perceives them as disrespectful of the figure of authority, and decides to repress them, which sets the stage for rebellion.
<i>Thinks quickly</i>	They get bored easily with routine and may not complete their tasks. On the other hand, they may finish their activities quickly and wander around the room, looking for things to do.	The teacher may think that they are inattentive, negative, or have behavioral problems, and are a bad influence on their peers.
<i>High level of energy</i>	Can be very distracted, starting several tasks and not finishing any.	They may get worn out trying to accomplish too many projects at once. Their high energy may be mistaken for Attention Deficit Hyperactivity Disorder (ADHD). Medication may be suggested to "calm" them.
<i>Great power of concentration</i>	Sometimes spend too much time on a project; get lost in the details and miss deadlines.	Low grades, since assignments are not completed, which causes frustration for the child, its parents, and teachers.
<i>Thinking at the adult level</i>	Adult-level thinking is not accompanied by adult-level skills, such as diplomacy. May say things in a rude or disconcerting way.	Both peers and adults may find them rude, offensive, and tactless, and begin to avoid them.

Like all educators, teachers for the gifted should first respect individuals with gifts and talents within the context of human development and Individual learning differences. The qualities and characteristics peculiar to the gifted are thus seen as only one side of the coin, showing, on the other side, attributes that are not always looked on favourably by teachers or parents and that can lead to the vulnerability of the gifted. The possible problems commonly associated with the characteristics of talentedness and giftedness require careful attention by teachers, since they favour conflicting socio-emotional experiences in the course of their schooling, when their needs are not understood (Virgolim; Pereira, 2020).

Not only should teachers for the gifted understand advanced developmental milestones of individuals with gifts and talents from early childhood through adolescence, but they should also understand how exceptionalities can interact with development and learning, and create developmentally appropriate learning environments to provide relevant, meaningful, and challenging learning experiences for individuals with gifts and talents. Teachers for the gifted should have an understanding of the variations in learning and development in cognitive and affective areas between and among individuals with gifts and talents and apply this understanding to provide meaningful and challenging learning experiences for individuals with exceptionalities.

3.4.3. Learning Environments

Teachers for the gifted should create safe, inclusive, and culturally responsive learning environments so that individuals with gifts and talents become effective learners and develop social and emotional well-being. They should structure environments to encourage self-awareness, self-regulation, self-efficacy, self-direction, personal empowerment, leadership, and self-advocacy of individuals with gifts and talents, and directly teach them how to adapt to the expectations and demands of differing environments. They should demonstrate an understanding of the multiple environments that are part of a continuum of services for individuals with gifts and talents, including the advantages and disadvantages of various settings and teach students to adapt to these environments.

3.4.4. Instructional Strategies

The professional knowledge base in general education clearly indicates that educators' understanding of the central concepts and structure of the discipline and tools of inquiry related to the academic subject-matter content areas they teach makes a significant difference in student learning. Within the general curricula, beginning gifted education professionals have to demonstrate in their planning and teaching, a solid foundation of understanding of the theories, central concepts and principles, structures of the discipline, and tools of inquiry of the academic subject-matter content areas they teach so they are able to organize knowledge, integrate cross-disciplinary skills, develop meaningful learning progressions and collaborate with other educators.

Educators for the gifted students should also be able to use and interpret assessments to select, adapt, and create materials to differentiate instructional strategies and general and specialized curricula to challenge gifted individuals. They should be able to teach the content of the general or specialized curriculum to individuals with gifts and talents across advanced performance levels.

Gifted education professionals should be able to design appropriate learning and performance modifications for individuals with gifts and talents in academic subject matter and specialized content domains that incorporate advanced, conceptually challenging, in-depth, distinctive, and/or complex content. Additionally, beginning gifted education professionals should be able to use a variety of specialized curricula to individualise meaningful and challenging learning for individuals with exceptionalities.

The adaptation of the curriculum is considered to be at the heart of gifted education, and the fundamental issue that policies and schools must confront when ensuring that gifted learners are able to have a differentiated and holistic learning experience (Eyre, 2012). In order to respond to diversity, gifted education programmes are most often based on a differential pedagogy, also merely called differentiation (Aneis, 2017; Eyre, 2012). **Table 3.4.1** below provides a general comparison between approaches based on traditional pedagogy and those based on differentiated pedagogy.

Table 3.4.1. A general comparison between approaches based on traditional pedagogy and those based on differentiated pedagogy [Source: Aneis, 2017, p. 4].

Traditional Pedagogy	Differential Pedagogy
Differences are not acknowledged, there is intervention when issues become significantly obvious;	Differences between students are studied and constitute the point of departure of the pedagogical project;
A general comprehension of students' intelligence is predominant;	The multiple forms of intelligence are recognised;
There is a simple definition of excellence in school;	Excellence is defined mostly from the individual evolution in relation with a previous stage;
Students' interests are sometimes taken into account;	Students are frequently solicited in order to base the teaching on their interests and motivations;
Teaching/learning follows the idea of respecting a manual and a curriculum;	Teaching/learning takes into account the availability, interests and profiles of the students;
Teaching/learning is focused on contents and activities not necessarily linked to context;	Teaching/learning is focused on the acquisition of essential skills, in order to value and understand the concepts and relevant knowledge;
In and out of class tasks provide with one option only;	Various options are available for in and out of class tasks;
Time management is relatively flexible;	Time is managed in a flexible way, in accordance with the students' needs;
The work is mostly based on written texts;	There are diversified teaching/learning material;
Facts and ideas tend to have one interpretation;	Facts and ideas tend to have various possible interpretations;

Traditional Pedagogy	Differential Pedagogy
The teacher guides the student's behaviour;	The teacher promotes the acquisition of an autonomous learning ability;
The teacher solves the problems;	Students help their classmates and the teacher to solve the problem;
Students assessment is done mostly at the end in order to verify what they understood ;	Students' assessment is continue and re-assessed in order to adapt the teaching to the students' needs;
Classification is standardised;	The teacher negotiates with the students, defining individual learning goals for the whole class;
One type of assessment is used.	The teacher negotiates with the students, defining individual learning goals for the whole class;

In the face of growing diversity, it is important that policy makers contend with how to make sure curriculums are mindful of, meet and promote the linguistic, academic, cultural, and economic diversity of gifted learners and all students more generally. A

quality curriculum is therefore one that is beneficial for all gifted learners, including from underrepresented groups, and which recognises that gifted students are not a homogenous group and do not necessarily display exceptionality, potential or talent in all subject domains (Callahan, Moon & Oh, 2017). According to OECD (2020) countries that give attention to gifted education emphasise the necessity of special educational provision adaptation of the pedagogy to respond to the specific needs of gifted students. In South Africa for example the guidelines on inclusivity emphasis differentiating the curriculum. Even in countries where a clear legal framework regarding this issue is lacking, gifted education tends to follow the same pattern, that is, a differentiated approach corresponding to adjustments of the curriculum and special educational provisions. This notion refers to educational strategies corresponding to a flexible education that adapts to the personal students' individual cognitive and psycho-social characteristics. Therefore, all school-level approaches to gifted programming involve differentiation. Such approaches expect teachers to recognise the different learning abilities of students and to respond appropriately according to students' individual needs (Lawrence-Brown, 2004). Moreover, differentiation is regarded as essential both to enhance the academic development of gifted students and to prevent the development of interpersonal challenges for gifted children (Beljan et al., 2006).

A 2015 study showed that less structured teaching methods coupled with enrichment models tend to raise performance among gifted children. The authors devised a randomised experiment with gifted pupils from more than 200 different American classrooms. The students would have access to instructional units in poetry and research skills for a full scholar year. The studies showed that a rich curriculum and responsive instruction driven by key components of three existing curricular and instructional models, is a viable option to enhance students' learning (Callahan et al., 2015[125]).

Differentiation can have significant benefits for different groups of students. In fact, though some academics argue that children perform better with more structured and rigid teaching methods, a growing body of research has shown that higher autonomy,

participation and individualised teaching methods can be highly beneficial for numerous students, and particularly for gifted individuals (Heller-Sahlgren, 2018[5]).

3.4.5. Assessment

Teachers for the gifted should have an understanding of measurement theory and practice for addressing issues of validity, reliability, norms, bias, and interpretation of assessment results. They should have an understanding of the policies and ethical principles of measurement and assessment related to gifted education referral, nomination, identification, program planning, differentiated instruction, learning progress, and services for individuals with gifts and talents, including individuals with culturally, linguistically, and economically diverse backgrounds. They should have an understanding of the appropriate use and limitations of various types of assessments and collaborate with families and other colleagues to ensure non-biased, meaningful assessments and decision-making. Teachers for the gifted should select and use quantitative and qualitative assessment information to support a wide variety of decisions within gifted education. They conduct formal and informal assessments of behaviour, learning, achievement, and environments to differentiate the learning experiences and document the growth of individuals with gifts and talents. Moreover, they differentiate assessments to identify above level performances and to accelerate and enrich the general curriculum. Teachers for the gifted should use available technologies routinely to support their assessments and employ a variety of assessments such as performance-based assessment, portfolios, and computer simulations. Using these data, beginning gifted education professionals make multiple types of assessment decisions including strategic adaptations and modifications in response to an individuals' constellation of social, linguistic, and learning factors in ways to minimise bias. They also use the results of assessments to identify above-level performance, develop long-range instructional plans anchored in both general and specialized curricula and translate these plans into carefully selected shorter-range goals and objectives to differentiate and accelerate instruction. Moreover, beginning gifted education professionals engage individuals with gifts and talents in assessing the quality of their own learning and performance and in providing feedback to guide them

in setting future goals. Like their general education colleagues, beginning gifted education professionals regularly monitor the learning progress of individuals with gifts and talents in both general and specialized content and make instructional adjustments based on these data.

CHAPTER 4: METHODOLOGY

4.1 Introduction

In order to answer the 3 research questions, this chapter elaborates some important points such as research paradigm, research design, material development in educational research, model development, type of data, data analysis technique, validity and research procedures.

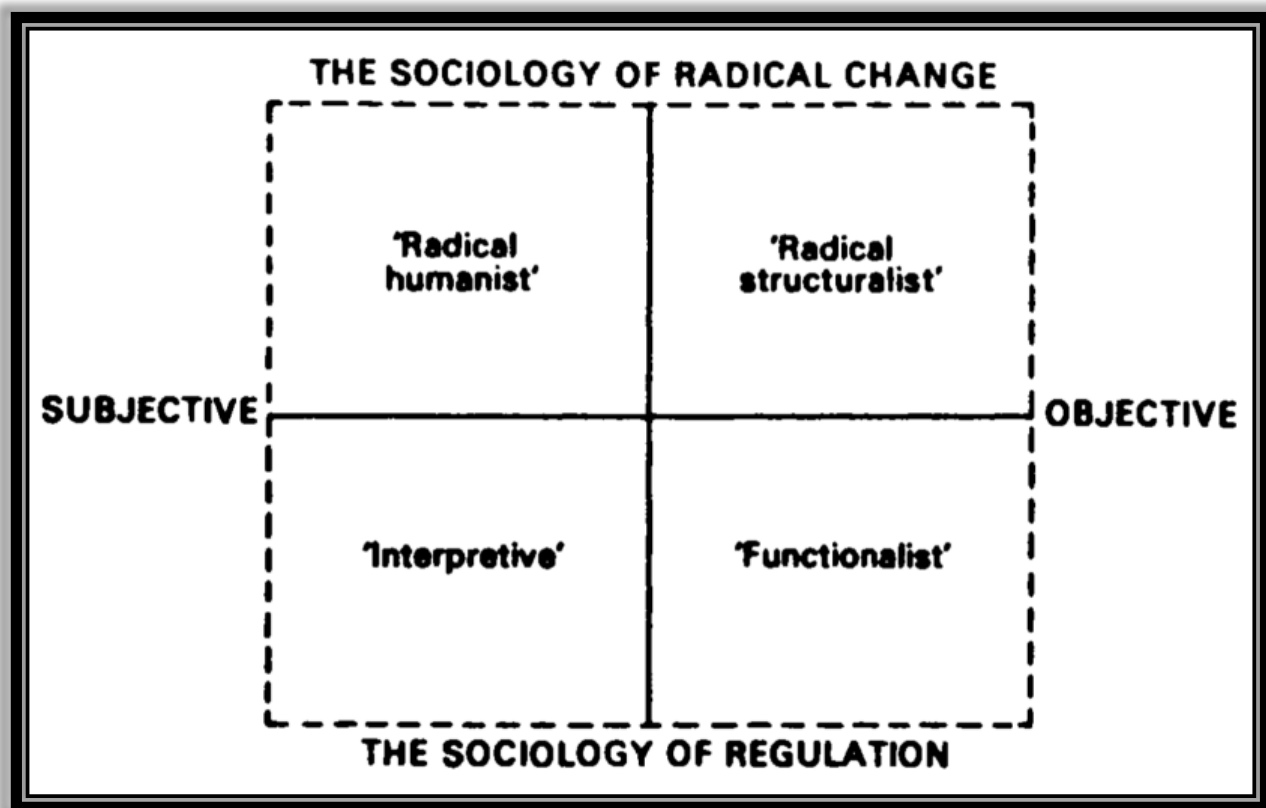
4.2 Research Paradigm

According to Burrell & Morgan (2021) all social scientists approach their subject via explicit or implicit assumptions about the nature of the social world and the way in which it may be investigated. These assumptions entail ideas, for example, about what forms of knowledge can be obtained, and how one can sort out what is to be regarded as 'true' from what is to be regarded as 'false' in a social world in which this dichotomy of 'true' and 'false' itself presupposes a certain epistemological stance. Research, especially in the social sciences, is therefore premised on the view that there are various ontological, epistemological, human and methodological standpoints which characterise approaches to social sciences and which in turn are likely to incline social scientists towards different methodologies. When a standpoint containing some basic assumptions, ways of thinking, and methodology is commonly accepted by certain members of a scientific community, it becomes a 'paradigm'. The term paradigm is intended to emphasise the commonality of perspective which binds the work of a group of theorists together in such a way that they can be usefully regarded as approaching social theory within the bounds of the same problematic (Burrell & Morgan, 1979).

Given the diverse standpoints about various phenomena in the social world, a principal concern in social science research is with an understanding of the way in which an individual researcher creates, modifies and interprets the world in which he/she finds him/herself. Burrell & Morgan (2019) proposed that social theory can usefully be

conceived in terms of four key paradigms as shown in **Figure 4.1** based upon different sets of assumptions about the nature of social science and the nature of society.

Figure 4.1 The Four Paradigms [Source: Burrell & Morgan, 2019]



According to Burrell & Morgan (2019), in identifying four paradigms in social theory we are in essence suggesting that it is meaningful to examine work in the subject area in terms of four sets of basic assumptions. Each set identifies a separate social-scientific reality and to be located in a particular paradigm is to view the world in a particular way. The plea for paradigm diversity is based on the idea that more than one theoretical construction can be placed upon a given collection of data. In other words, any single theory, research method, or particular empirical study is incapable of explaining the nature of reality in all its complexities. The view taken in this study is that there are many different ways of studying the same social phenomenon such as 'Giftedness'. Given that insights generated by any approach are at best partial and incomplete, Burrell & Morgan (2019) suggest that the social researcher can gain much by reflecting

on the nature and merits of different approaches before engaging in a particular mode of research practice. **Figure 4.2** provides a comprehensive summary of the four paradigms that were proposed.

Figure 4.2 Comparison of the four paradigms [Source: Burrell & Morgan, 2019]

		Functionalist	Interpretive	Radical Humanist	Radical Structuralist
Nature of Science	Ontology	Phenomena are objective and external to the individual	Phenomena are subjective and are the product of individual's mind	Phenomena are subjective and are the product of individual's mind	Phenomena are objective and external to the individual
	Epistemology	Knowledge has to be acquired and science is value-free	Knowledge has to be personally experienced and science is value-laden	Knowledge has to be personally experienced and science is historical	Knowledge has to be acquired and science is class-specific
	Human Nature	Humans are the product of their environment and are viewed as individuals	Humans are the creators of their environment and are viewed in their socially-determined relationships with other humans	Humans are the creators of their environment and are viewed as dominating other humans through society's ideological superstructure	Humans are the product of their environment and are viewed as members of antagonistic classes
	Methodology	The social world is real hard and external to the individual. One needs to find the universal relationships among elements of the phenomenon	The social world is soft, personal, and subjective. One needs to understand the way the individual creates, modifies, and interprets the situation experienced	The social world is soft, personal, and subjective. One needs to understand the way the individual creates, modifies, and interprets the situation experienced	The social world is real hard and external to the individual. One needs to find the universal relationships among elements of the phenomenon
Nature of Society		Society has unity and cohesiveness	Society has unity and cohesiveness	Society has deep-seated conflicts and modes of domination	Society has deep-seated structural contradictions

As can be seen from the table, each of these paradigms mean a different: (i) set of assumptions, (ii) framework of thought, (iii) and way of perceiving, thinking and doing associated with a particular vision of reality. The four paradigms thus define four views of the social world based upon different metatheoretical assumptions with regard to the nature of science and of society. It is Burrell & Morgan's (2019) contention that all social theorists can be located within the context of these four paradigms according to the metatheoretical assumptions reflected in their work. The four paradigms taken together provide a map for negotiating the subject area, which offers a convenient means of identifying the basic similarities and differences between the work of various theorists and, in particular, the underlying frame of reference which they adopt.

In this study the researcher argues that at attaining democracy in 1994, South Africa adopted a radical approach to gifted education, where the concept was associated with an elite group of citizens – the Whites – hence the then existing structures for gifted education were dismantled as part of the former apartheid system. It can be argued that such an approach runs contrary to the fundamental realities of giftedness which exists in all societies poor or rich and knows no race, gender nor colour. In fact, the reality on the ground today has proved stakeholders wrong in that by dismantling schools for the gifted on the premise that they were elitist, the country has created another form of 'covert elitism'. Evidence abounds which shows that the same learners from poor communities who were supposed to benefit from an inclusive education, find themselves with very little chances of gaining access to university education especially in STEM related degrees which matter most in the 21st century KBE. This study also argues that nationally, stakeholders are not being realistic if they continue to think that the much-needed skills for the 21st century will emerge from a one-size-fits-all approach to curriculum development and implementation. For example, Milne & Mhlolo (2021) provided comprehensive evidence to show that gifted education is what drives Singapore's success in education given that the country's vision was to build an inclusive society with many peaks of excellence. The country states the purpose of gifted education as seeking "to prepare talented youth for responsible leadership and service to country and society" (Ministry of Education [MoE], Singapore, 2013:1). What makes Singapore's inclusive education different from the South African version is that

Singapore's inclusive education is built on an ability-driven education system in which students are nurtured in different academic streams based on their strengths and talents. The aim of the MoE who oversees the development of the entire system is to help students "discover their own talents, to make the best of those talents, to realise their potential, and to develop a passion for learning" (MOE, Singapore, 2012:1). As a result, racial and ethnic segregation, affecting many countries like South Africa, was circumvented. Singaporeans do not associate gifted education with class differentiated access to the best schools. Instead, Singapore officially initiated "gifted education" in 1984 for two reasons, the first of which was educational. Singaporeans believed that intellectually gifted children need a high level of mental stimulation and challenge, which may be difficult to address in a regular classroom setting. The second reason for gifted education in Singapore was socio-political. As a small, vulnerable nation, Singapore has no natural resources and as such relies on its human resource for advancement and success. Hence, the country considered it advantageous to nurture the ability of talented children. The efficient driven phase from 1979 to 1996, witnessed Singapore's education transformation from its earlier one-size-fits-all approach to schooling that would create multiple pathways for students in order to reduce the drop-out rate, improve quality and produce the more technically skilled labour force needed to achieve the new economic goals (MoE, Singapore, 2014).

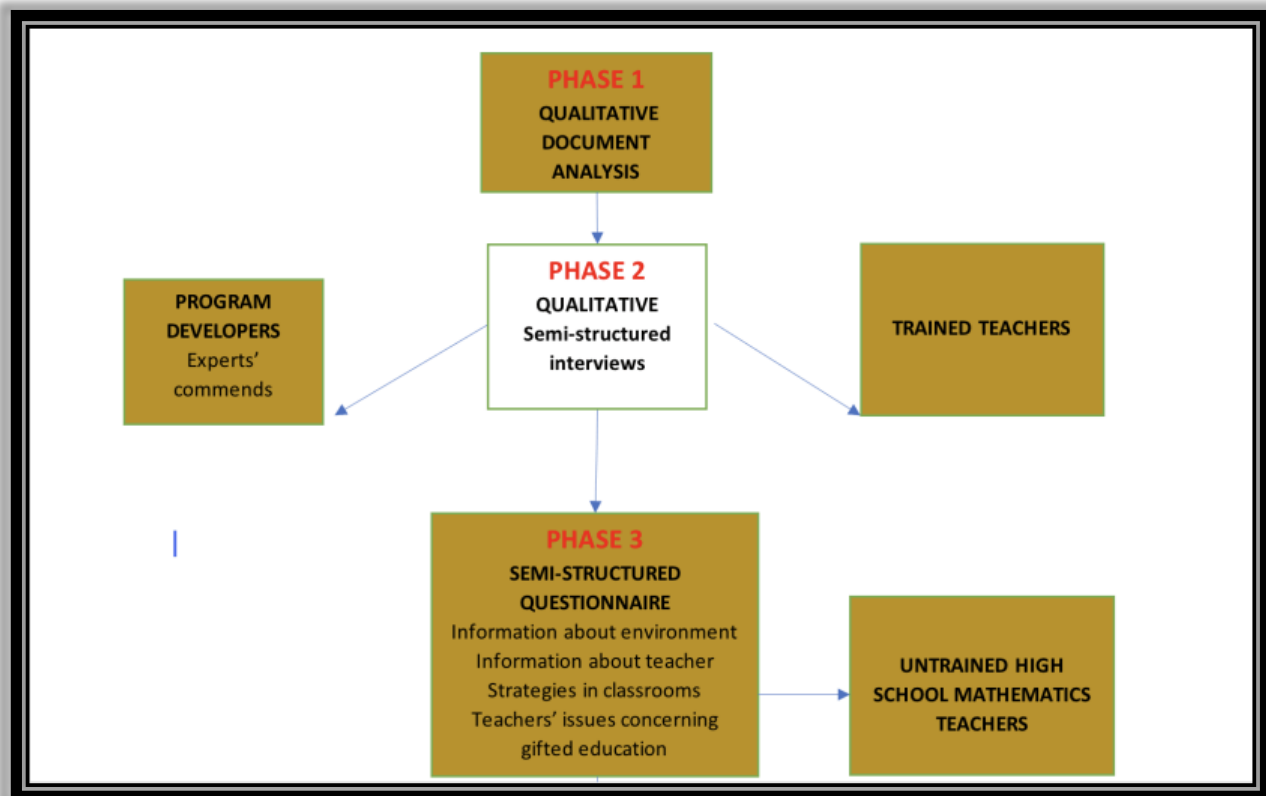
What we learn from this country comparison is that there is need for a paradigm shift in South Africa's approach to gifted education. In a document titled 'Outcomes-based Education [OBE] in South Africa: Background information for educators'; the Department of Education (1997:6) suggests strongly that in order for OBE to materialise there has to be a "move from one paradigm to another; from one way of looking at something to a new way. A move to a new mind set, a new attitude, a new way of thinking." This study was premised on the view that gifted education is another typical example of special education and as Naicker (2002:9-10) states: "special education theory is located within a functionalist paradigm and is concerned with learners who experience learning breakdown, as well as those who have gifted behavioursand that either enrichment or acceleration could be used to ensure that the gifted learner is not neglected". Consistent with that view, the study adopted a functionalist approach.

According to Burrell & Morgan (2019), functionalist theorists have been at the forefront of the order—conflict debate, and approach general sociological concerns from a standpoint which tends to be realist, positivist, determinist and nomothetic. In its overall approach the functionalist standpoint seeks to provide essentially rational explanations of social affairs. It is a perspective which is highly pragmatic in orientation, concerned to understand society in a way which generates knowledge which can be put to use. It is often problem-orientated in approach, concerned to provide practical solutions to practical problems. It is usually firmly committed to a philosophy of social engineering as a basis of social change and emphasises the importance of understanding order, equilibrium and stability in society and the way in which these can be maintained. It is concerned with the effective ‘regulation’ and control of social affairs.

4.3 Research Design

This study adopted a sequential mixed methods approach where a Quasi-experimental non-equivalent groups design (NEGD) was employed and both primary and secondary data were collected. In order to answer the first research question, the researcher used document analysis [secondary data] where both international and local documents on Teacher Professional Learning Programs [TPLP] in gifted education were analysed. The outcome of the document analysis then enabled the researcher to develop a template for creating a semi-structured interview schedule [hence sequential] as well as a semi-structured questionnaire to gain some insights from trained and untrained teachers respectively - resulting in the 3 phases shown in **Figure 4.3**.

Figure 4.3 The three study phases illustrated.



Here the terms ‘trained’ and ‘untrained’ are being used with specific reference to training on gifted education. The last phase 3 involved a semi-structured survey questionnaire [primary data] also develop from the template in phase 1 where participants indicated their perceptions about gifted education and gifted students.

Quasi-experimental designs identify a comparison group that is as similar as possible to the treatment group in terms of baseline (pre-intervention) characteristics. The comparison group captures what would have been the outcomes if the programme/policy had not been implemented (i.e., the counterfactual). Hence, the TPLP can be said to have caused any difference in outcomes between the treatment and comparison groups. In this case the researcher chose experimental group 1 comprising teachers from South Africa who are not trained on gifted education. The researcher then chose experimental group 2 comprising teachers from the USA who have received training on gifted education. In quasi-experimental designs, the TPLP is viewed as an ‘intervention’ in which a treatment comprising the elements of the

programme/policy being evaluated, is tested for how well it achieves its objectives, as measured by a pre-specified set of indicators. In this case the TPLP on gifted education in South Africa (treatment group) is viewed as an intervention which should change their perceptions and support for gifted learners in their schools. The three data sets were then used to guide the development of the proposed Teacher Professional Learning Program [TPLP] for South Africa.

4.4 The Population and Sample

4.4.1. The Population

Since the study aimed to develop a TPLP for teachers of the mathematically gifted learners [MGLs] in South Africa, the population of the study were mathematics teachers in both primary and high schools. The Association for Mathematics Education of South Africa [AMESA] is the national organisation for all mathematics teachers in South Africa which holds an Annual Congress where teachers present papers on a diversity of issues related to mathematics education. The Annual Congress was therefore considered an ideal event to target the participants as it conveniently brings together teachers from all the nine provinces of the country. The university where the TPLP will be developed is a new university situated in Bloemfontein and has future plans to take care of mathematically gifted learners and to develop creativity in general. To the researcher's knowledge, no previous studies have been conducted in South Africa for developing TPLPs to facilitate instruction of mathematically gifted learners [MGLs].

4.4.2. Sampling

To answer the first research question, 7 documents were purposively sampled as follows:

- 10 Global Principles for Professional Learning in Gifted Education from the World Council for Gifted & Talented Children [WCGTC]
- The National Association for Gifted Children [NAGC] Standards Professional Learning

- 20 Principles for Professional Learning from the American Psychological Association, Centre for Psychology in Schools & Education [APACPSE]
- Western Kentucky University [WKU] – Centre for Gifted Studies – modules for Professional Learning in Gifted Education
- Singapore National Institute of Education [NIE] Teacher Education Model of the 21st century
- Singapore Gifted Education Unit – Gifted Education Program [GEP].
- South Africa- International Gifted Education Teacher Development Network, IGET- Network Professional Learning Program

The justification for why each one was chosen is given in the Literature Review Chapter. To answer research question 2, a group of 21 participants was conveniently sampled from the USA trained teachers who attended the 3-week VAMPY event. The group comprised 1 VAMPY teacher, 3 VAMPY assistant teachers, 2 practicing teachers for the gifted, 1 Camp Innovate teacher, 1 district coordinator for gifted education, 1 educational psychologist, 1 educational counsellor, 1 assessment specialist on gifted education, 1 advocate for gifted education, 1 former elementary school principal with a gifted education endorsement, 1 current pre-service student on the gifted education programme and 7 VAMPY students. The USA does not use similar biographical categories like South Africa but suffice to say that there were 2 male and 19 female participants. This group provided the study with some insights on how gifted education is viewed after one receives training on gifted education.

To answer research question 3 and in accordance with the non-equivalent group design, a second group comprising 121 teachers was conveniently and purposively sampled at the Association for Mathematics Educators of South Africa [AMESA] Conference as shown in [Table 4.1](#)

Table 4.1 Group 1 Participants information

Biographical information about participants	
Gender	
Male	71
Female	50
Race	
Black	121
White	0
Coloured	0
Indian	0
Years of Experience	
0 - 5	29
6 - 10	20
>10	72
Age group in years	
21 - 30	14
31 - 40	14
41 - 50	41
51- 60	52

4.5 The Research Instruments

Data collection instruments are linked with each research question where the first one was: ***Which content is common among some selected Teacher Professional Learning Programs [TPLP] in gifted education globally?*** Document analysis was used to gain some insights from the 7 documents listed under sampling. The second

research question was: ***What insights can we gain from some trained teachers for gifted learners?*** Trained teachers were interviewed following a structured interview schedule. The third research question was: ***What are the needs of South African teachers that should be included in the Teacher Professional Learning Programs [TPLP] for the mathematically gifted?*** A structured questionnaire was used to capture the untrained teachers' needs. The term 'untrained teachers' is used in this study with special reference to teachers who might have been trained as general practitioners but did not receive training on gifted education.

4.6 Technique of Data Analysis

4.6.1. Qualitative data

In qualitative research, data analysis entails the process of arranging the collected data into categories to identify relationships among them (White, 2005). In this study the 10 Global Principles for Professional Learning in gifted education provided the basis for analysing the other six documents from USA, Singapore, Australia and South Africa. The outcome of this document analysis then provided a template for structuring interview schedules and questionnaires as well as analysing the responses thereof.

4.6.2. Quantitative data

For the quantitative data, the questionnaires were coded numerically to facilitate analysis using Statistical Package for Social Scientists (SPSS) software. Responses were analysed to discover frequencies with which mathematics teachers identified supports and needs. To easily access the data for analysis, the voice recorder was used with the consent of the participants to record the interviews. Recording the meeting with a voice recorder allowed the interviews to be transcribed verbatim (Silverman, 2002). Mouton (2005) describes analyses as breaking up the data into themes and categories with the purpose of understanding all aspects of the collected information. After transcribing, the researcher arranged the responses of the participants into groups to make a common pattern. Afterwards, the patterns were organised into categories that

were then condensed into themes. Similar themes were then grouped together to obtain the overall picture of the cases (Creswell, 1998).

4.7 Technique of Data Validity

In this study credibility was addressed through the triangulation of data collection methods. In the social sciences triangulation would be described as the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena (Patton, 1999; Flick, 2018). This method is essential to improve the authenticity and credibility of the data or results (Setiyadi, 2006). Denzin (1978) and Patton (1999) identified four types of triangulations: (a) method triangulation, (b) investigator triangulation, (c) theory triangulation, and (d) data source triangulation. Both types (a) and (d) were employed given that in terms of methods triangulation, document analysis, questionnaires, and interviews were done. In terms of data source triangulation, the researcher sourced data on TPLPs from 7 documents, 121 untrained teachers in South Africa and 21 educators trained on gifted education in the USA.

4.8 Ethical considerations

In any research involving humans, the assurance of dignity, rights, safety, and welfare of participants must be the principal concern. According to Opie and Sikes (2004), any research that involves people has the potential to cause “unintentional” damage. Therefore, the fundamental ethical concern in any research involving humans is avoiding harming them and treating participants fairly and respectfully. The researchers recommend an ‘acid test’ for evaluating the suitability of any research methods: “Ask yourself how you would personally feel if you and your children or your friends were ‘researched’ by means of them” (p. 25). Throughout the data-collection process, the researcher reflected on this ethical issue. The participants in this study were informed about the risks and benefits involved, and research interviews were conducted in environments that were conducive for all participants.

Additionally, the participants used in this study are all educators, thus protocol dictates that the researcher must have a permission letter to use them (Appendix A and Appendix B).

4.9 Implications of the study

It is hoped that the standardized Teacher Professional Learning Program [TPLP] developed by the researcher can be recommended for use by the Higher Education Institutions [HEIs] to train teachers on how to cater for the mathematically gifted learners in their classrooms. Various instructional strategies that will be proposed in the standardized TPLP will also assist the mathematics teachers to enrich their instructional skills, teaching approaches and professional development. It is expected that this will result in improving mathematically gifted learners' development and academic achievement as well. Although this study has focused on gifted education in mathematics because of the urgency brought about by the demands of the 4IR, it is hoped that the TPLP developed thereof will also provide a basis for other TPLPs for gifted education in other fields. Singapore is a typical example where TPLPs for gifted education have spread beyond STEM into other academic and non-academic fields.

CHAPTER 5: RESULTS

5.1. Results for the first research question

The first research question for this study had to do with what appears to be common content among some selected Teacher Professional Learning Programs [TPLP] in gifted education globally. Through documentation analysis, the study gained some insights from the World Council for Gifted & Talented Children's [WCGTC] 10 Global Principles for Professional Learning, Professional Learning Standards compiled by National Associations for Gifted Education [NAGC] from USA, Singapore, Australia & South Africa as well as standards from the leading universities on gifted education within the same countries.

The **Figure 5.1** compiled by the researcher shows that the characteristics of gifted students are central to the development of any TPLP for gifted students because those characteristics can be linked to researchers' interest in understanding their origins, the effects they have on students' learning – hence the foundations and theories of gifted education. The diversity of those characteristics also justifies why teachers need to change their attitudes and create a learning environment that is favourable for the full development of those children's gifts. Similarly, each of the other eight boxes around the characteristics can be justified from the extant literature.

Figure 5.1 Common content in Teacher Professional Learning Programs [TPLP] globally



Figure 5.1 shows that the characteristics of gifted students are central to the development of any TPLP for gifted students. It can be argued that due to the uniqueness and diversity in those characteristics both psychologists and genealogists have for example been mused on their origins, and how they influence students' learning – leading to the foundations and theories of gifted education. The uniqueness and diversity of those characteristics also justify why teachers need to change their attitudes and create a learning environment that is favourable for the full development of those children's gifts. Within each box, other connections can also be discerned, for example the diversity in gifted students' emotional characteristics point to the need for

counselling strategies. Given this interconnectedness, it is important to acknowledge that while **Figure 5.1** depicts a basic linear connection between the characteristics of gifted students and each of the other eight boxes, there is also a connection between the boxes themselves e.g., assessment vs instructional strategies or teacher characteristics vs differentiated curriculum. This connection between and among each of the other eight boxes around the characteristics can be justified from the extant literature suggesting that in reality there is a complex connection between these issues which can be depicted in a complex spider's web. Suffice it to say the simplified depiction in **Figure 5.1** was meant to highlight the basics within the complexities in the relationships.

5.2. Results for the second research question

The second research question for this study was: What insights can we gain from some trained teachers for gifted learners?

In an attempt to provide answers to this question, the researcher visited the Western Kentucky University [WKU] as part of a study visit arranged by Central University of Technology [CUT] Free State. The researcher held some interviews with some 21 trained educators on gifted education. Here is the interview with the coordinator of the VAMPY week who also happened to be the current president for the WCGTC as well as legislative chair for NAGC in the USA.

RESEARCHER:

In the gifted education literature, policy is considered the foundation and framework of our gifted education system. It is the foundation because all goals and aspirations of our schools are built upon policies, and it is the framework because all aspects of school organization and operations are created and implemented within the rules and guidelines created by policy. What has been your experience and what advice can you give to us regarding policy and legislative mandates on gifted education?

COORDINATOR:

Legislative advocacy is something that's very close to my heart because that's where we get things to happen for gifted children; whether we're talking about advocacy at the school level, the district, state, or the national level. Policy matters! Policy makes best practice for identifying and providing services something educators, parents, and students can read about and anticipate having in place. Educators can count on policy to make decisions rather than needing to make decisions one by one or case by case. Educators know that policy details opportunities they can implement and/or suggest to students as a good match for their interests or their stage in the talent development trajectory. Policy lets parents know the steps in the identification process as well as services that are available at each stage of schooling in the district. At this particular time, I happen to be legislative chairman for the National Association for Gifted Children, and I appreciate the fact that it requires numbers of advocates and people who know what they're talking about. Gifted children have needs that require advocates working in homes, schools, universities, industry and communities to ensure their needs are met. In addition to advocating for day to day programming, it is important to advocate for laws and policies that create a supportive learning environment for gifted children.

As a visiting researcher, the coordinator drew my attention to the fact that the United States is currently experiencing a wave of educational policy at Federal (National), State (Provincial) & Local (District) levels that support gifted education. For example, I checked and noticed that in 1993 the U.S. Department of Education published National Excellence: A Case for Developing America's Talent which recommended the following steps to better support gifted students:

- set challenging curriculum standards,
- provide more challenging opportunities to learn,
- increase access to early childhood education,
- increase learning opportunities for disadvantaged and minority children with outstanding talents,

- broaden the definition of gifted, emphasize teacher development and match world performance (i.e., learn from other nations and work to match high achieving counterparts around the world).

COORDINATOR (continues):

At a lower level, most states have a state-wide gifted education association that advocates on behalf of gifted students. Many of these groups focus on legislative advocacy in their state capitals; most also offer a range of education opportunities, including statewide and regional conferences for teachers and parents.

RESEARCHER

Besides the legal framework what else would you consider to be a must in preparing TPLP for gifted children?

COORDINATOR

The coordinator emphasized the need for parental involvements.

NAGC has a unique national vantage point, one grounded by the insights and anecdotes shared by the incredible network of gifted education leaders, educators, and, yes, parents like you. From this bird's-eye view, one common thread has emerged: When parent groups are involved in advocacy and support for their gifted children, change happens—maybe not all at once, maybe not as comprehensively as we might like — but parents make a difference. For example the National Association for Gifted Children (NAGC) maintains that the identification process includes three phases: (a) nomination, (b) screening, and (c) placement. In the nomination phase, anyone (e.g., parent, teacher, friend, administrator) may recommend a child for screening. There is a general consensus that parents are extremely important especially in the nomination phase of their gifted children. Parents are the ones who usually recognize the special gifts and talents of their child and want to support them both socially, emotionally, and academically. In the placement phase, parents collaboratively discuss with educators and other stakeholders about available services and

those that can help meet the needs of the G/T learner. In terms of support, parents must know how important it is for their children to be with others who think like they do and share some of their interests and if that means driving several miles with regularity to get the children to a youth orchestra or to a chess club or or whatever it is; no child needs to be isolated from others who share their interests.

The coordinator further emphasized the need for Teacher Professional Learning Programs:

In my capacity as the president of WCGTC, I would like to emphasize that the council is concerned that educators world-wide receive little information about how to educate gifted and talented children. In order close that pervasive gap, a request from the World Council members has been to develop a position paper on standards for teachers of gifted and talented children and young people. Research shows that, in the absence of professional preparation, educators lack the knowledge needed to accurately identify gifted students for acceleration or specialized gifted programs; and they do not learn how to use differentiation strategies that increase the depth and complexity of their instruction. Therefore the WCGTC is of a strong view that at the most basic level of developing programs for gifted children, providing universal educator preparation in gifted education provides an infrastructure for preparing all educators to support gifted children in their classrooms across the world, regardless of their educational setting. These principles can provide guidance for educators, policymakers, and professional learning specialists, as well as for those making decisions for teacher preparation programs in various localities and countries across the globe. We will be soliciting members interested in working on this project. We will want them to represent World Council members from across the globe.

After the interview with the coordinator, the first question that was raised with the trained teachers was with reference to teacher characteristics that are favourable for nurturing gifted children:

Researcher:

What motivated you to train as a teacher for the gifted?

Teacher 4:

I am a gifted student myself.

Teacher 5:

My brother is gifted and so I felt the need to help him.

Researcher to teacher 4:

How did you know that you are gifted yourself?

Teacher 4:

I wrote the Scholastic Aptitude Test (SAT) used in the talent searches in the USA.

Results from similar studies have confirmed that a person's self-perception as gifted significantly predicted attitudes toward gifted education in one of the reviewed studies (Michener, 1980), suggesting that those who perceive themselves as academically gifted or who have gifted friends and family tend to harbor more positive attitudes toward the gifted. In addition, contact with gifted children, past participation in a gifted program, the presence of a gifted program in the participant's school, and perceived knowledge of giftedness were statistically significant predictors of attitudes toward the gifted in the majority of studies that included these variables (Bégin & Gagné, 1994).

The researcher was also interested to capture trained teachers' perceptions on whether or not gifted students should be of concern to them and why and here is what one of the teachers had to say:

Teacher 4

So, I would say that a lot of my reason for choosing to study gifted education, is just the lack of representation that gifted populations have, I think a lot of times, I'm not sure if this would be true in your culture as well. But I think a lot of times

people see it as a luxury. Like, we've got to get these kids that aren't getting it. And then those that already have it, they'll be having fun. And so that, for me, I was one of those. So, for me, that is not fulfilling. And that did not keep me challenged throughout my own education. And I would say you probably have a similar experience.

The researcher also asked trained teachers in the USA what was challenging when working with these students and here is what they had to say:

Teacher 1:

They grasp things so quickly and they ask too many why questions. They want to move on these challenging problems that I put up. These are problems that I think will take them a long time to do, but quickly they're done. Yeah, 10 minutes, I expected it to take them a couple hours, 10 minutes, they've got the answer.

Teacher 2:

I think the most challenging part of working with gifted children is they can grasp things so quickly, I have a student who has already finished one book and is about a third of the way through his second book. And he's still doing all these challenging problems. He can often see the answers really quickly.

Researcher

You must be way ahead of them.

Teacher 2

Yes. And there are times that he asked me questions where I just have to say, I don't know. Can I look at this and get back to you later? Yes.

Researcher

So, what do you do in that case?

Teacher 1:

In terms of why questions, I can acknowledge the question and defer answering it until later. In terms of finishing work too quickly I give them more. We have to over prepare so much for this, because they can just move through them very quickly. And so, with this group, they have their book work that they can do. And that is all individual, whatever they're working on. So, they have different textbooks. And then even those who have the same textbooks, they're often at different places in those books. And then on the challenging problems they work together. But, they just can move so quickly. So, this is the beginning of the third week. I have a student who has already finished one book and is about a third of the way through his second book. And he's still doing all these challenging problems. He can often see the answers really quickly.

Teacher 2:

You need to make use of that information without making them feel bored with the very basic stuff.....Gifted children know themselves a lot better than we give them credit for. So I asked her: Do you want some more? and she said give me. So, she is busy working on that for one more hour.

In the extant literature on gifted education lack of sufficient subject matter is identified as one of the major teacher-related barriers to the education of gifted learners. Subject matter knowledge becomes a critical characteristic for educators working with gifted learners. Lack of content knowledge also affects the use of important pedagogy. So the researcher asked a similar question to the trained teachers for gifted learners in the USA and here is what they had to say:

Teacher 1:

I have a PhD in math. So, bachelor's degree in math education, Masters and PhD in math.

Teachers 2 & 3:

We are two practicing teachers (and friends) who have recently completed our Masters in Gifted and Talented Studies.

Program co-ordinator commented about Teacher 1, 2 & 3:

I had them as brilliant undergraduates in mathematics.

One other question that was asked to untrained teachers was about grouping strategies which they preferred. The extant literature shows that untrained teachers prefer mixed ability grouping given its reciprocity. On one hand it is believed to help gifted learners as they learn from others and share ideas, while others can also learn from them while exchanging ideas as they help fellow learners with barriers. There is however evidence to show that untrained teachers abuse this reciprocity and use gifted students as assistant teachers. So, instead of just asking teachers who trained on gifted education to give their view on grouping strategies, the researcher decided to capture the gifted learners' views about the matter since they were available as part of the VAMPY camp.

Figure 5.2 Gifted Students' voices about grouping strategies.

Learner	Comments
CSw	I love coming to VAMPY because I can ask all my questions and I get answers. It is really interesting to see how everything around us works and how we can manipulate it to our advantage.
AH	I love math. I have spent three weeks doing math because I love it and I want to be exposed to this community that wants to learn and love math as much as I do.
LH	The best part is working on projects because I meet new people and I am also contributing something.
DJ	In this camp, you can pick anything, and you will get many different viewpoints, but everyone will listen.
LK	We are one big happy family, we belong. That is what I love so much about VAMPY.
CS	We are not just doing a curriculum because we must, we discuss work that is aligning with our interests.
BL	Our home away from home. It is so cool to be part of this group that is thinking and reasoning about things like I do. It is ok to ask many questions.

Clearly learners find it cool to be part of a group that is thinking and reasoning about things in the same way as them. This is an instructional strategy that teachers for the gifted need to consider in their classrooms practice.

RESEARCHER

Quite interesting. Any challenge we can expect with them? What are their challenges?

COUNSELLOR 1

I think the challenges for me personally, is emotional investment. Maybe, because you hear a lot that some of these kids have very rough home lives. And they come from difficult backgrounds. And it's hard, I think to see when they leave, especially knowing that they have to return to a harmful environment. It's difficult to watch because a lot of the kids are so distraught on the last few days, because they know that what they're returning back to.

COUNSELLOR 2

That is not what they're experiencing here.

COUNSELLOR 1

Yeah. So, for me, that's probably the hardest part. It's also sometimes difficult to, on a more mundane note, difficult to punish them. Because they're older, like they're 13 to 16. Generally, some of them are 12, but generally, like 13 to 16. And a lot of the counsellors are 18 and 19. So sometimes, I mean, the counsellors are great, they do an incredible job. And I could not have hand-picked a better group of counsellors, but still, sometimes the 16-year-old is going to say what you're two years older. You can't tell me what to do like my dad. That's where we step in. Yeah. Because we are older. And we have the experience. And yeah, so we are on our counsellor sides at all times. But sometimes that can be a bit of a challenge is because they're like, oh, you're not even that much older than me.

RESEARCHER

Are you allowed to talk to or reprimand the boys when they are making mistakes?

COUNSELLOR 2

So, we, whenever so usually in our position as head counsellor, there is a female head counsellor and a male head counsellor. This year, there were not any appropriate male head counsellor's applicants who could fill the role so that we're qualified Yeah. So, I stepped in as male head counsellor, kind of. So that just means that what we've been doing this year is Tori and I work more as a team. So, we will take female camper discipline meetings together. And we will take male camper discipline meetings together, usually with the male counsellor that is above them directly, you know.

COUNSELLOR 1

We don't even want to be, since we don't have a male counsellor now, it's against protocol for either of us to be alone with the male camper. Yeah, because that's just, you know, me or so can be alone female camper, we can't be alone with male campers, okay, so that's not all. So, we travel in a pack. We handle most of the disciplinarian problems together. Or even if we just need to talk to a camper, it's not always bad. But if we just need to discuss something, we always go together and have their counsellor present. So that's how we've kind of handled the not having a male of this year.

RESEARCHER

I just want to follow up on the issue of the harmful environment that they go back to after the camp. Is there a way that you can refer them to an appropriate facility or authority depending on the case?

COUNSELLOR 2

We never, so we not by harmful we don't necessarily mean like, like abusive, or it's more like, maybe they don't fit in at school and they fit in here, maybe they

don't really get along with their parents, but nothing is actually happening. They just don't feel accepted.

COUNSELLOR 1

We have a few campers that maybe go by a different name, or they prefer different pronouns. And they're able to use them here, but they are not able to use them at home. So we have that sometimes be an issue that we have to kind of watch how we speak around their parents, because how they are comfortable here is not how they are accepted. So that's kind of difficult to watch them to transition kind of revert back from all the progress that they feel like they've made here.

COUNSELLOR 2

So no, I mean, if there's any if we ever hear of any kind of abuse or anything we have, like we contact authorities, right? But that has happened rarely. Yeah, that's ever.

RESEARCHER

What do you enjoy?

COUNSELLOR 1

I love all of it. I'm tired, and I'm stressed, and I'm cranky all the time. But I love all of it. And I love this job. I went to this program for five years. This is my fourth year as a counsellor. And it's just, it's very inspiring to see changes that we've implemented make a difference in campers' lives. And if even if I say you know, it's hard to watch them leave and revert back, but even if we can give them three weeks of peace and happiness a year, then I feel good about that. And if we can make their lives a little bit better while they're here and make them feel comfortable in their own skin and let them learn what they want to learn. Then I feel good about the work I've done here.

COUNSELLOR 2

During that time, I would say that when Counsellors have the most interaction with them is during community time, you know, we make ourselves present, we make sure that we are everywhere that they could be. So as to supervisor activities, we interact with them a lot on Hall time, that's when they come to us in a smaller group. And just talk about their day and talk about their lives and what they liked and disliked and then we do room checks every night before they go to sleep. So, the Counsellor goes and meets with them one on one or two in one in their rooms because they have a roommate. And then I mean when I was a counsellor, I always said it like roses and thorns, like what are good things about your day and bad things about your day. And that was just kind of a way to talk through their experience and make sure they're having a good time here.

5.3. Results for the third research question

The third research question for this study was: What are the needs of South African teachers that should be included in the Teacher Professional Learning Programs [TPLP] for the mathematically gifted? Let us recall that following a sequential approach, the document analysis resulted in a template **Figure 5.1** with boxes comprising potential content for teacher training modules. Those 9 boxes then shaped both the interview schedule as well as the structured questionnaire. The results will be discussed also in accordance with that template although in no specific order.

For example, in terms of teacher characteristics, the study was interested to capture teachers' perceptions on whether or not gifted students should be of concern to them and why. Literature abounds of the myths that prevent teachers from appropriately educating millions of advanced students. The National Association for Gifted Children [NAGC] compiled a list of the most prevalent myths in gifted education with evidence rebutting each of them. This study borrowed 6 of them and developed some statements and asked the participants specifically to tick all of those statements that they agreed with.

Figure 5.3 Perceptions of teachers before receiving training on gifted education (n=121)

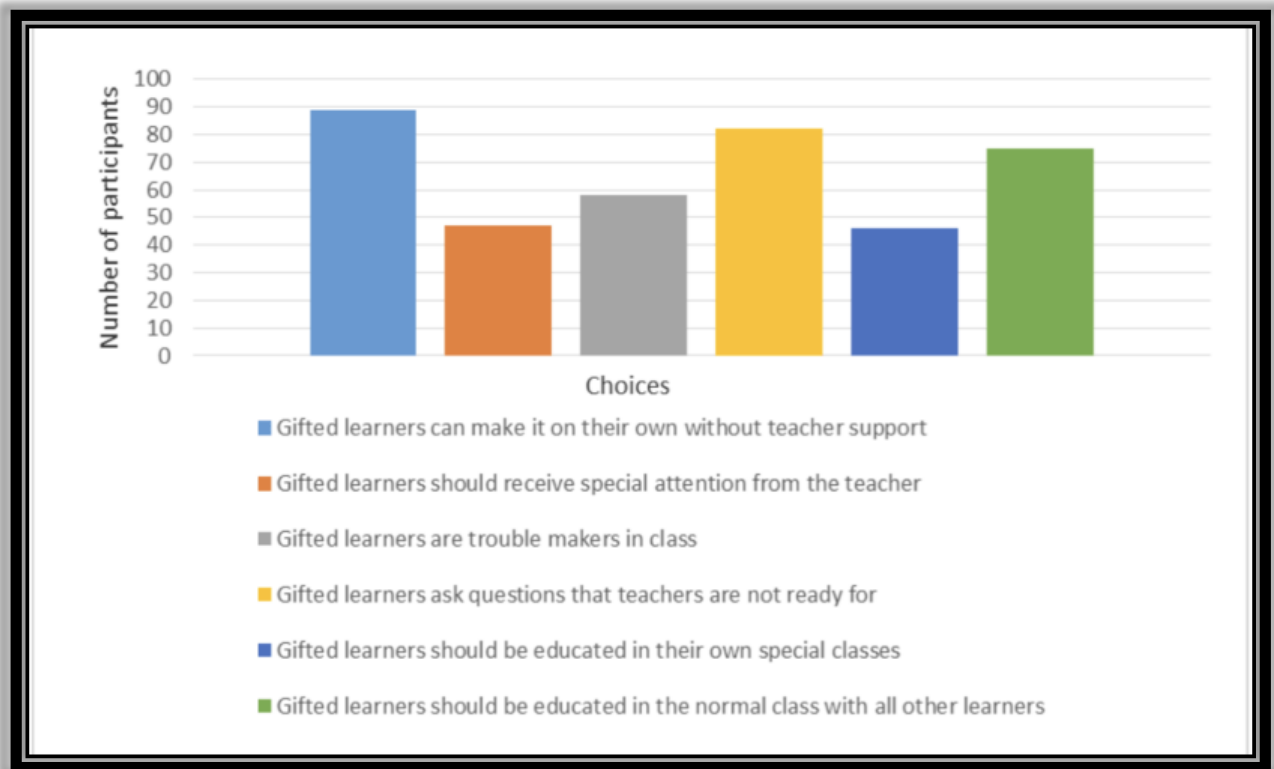


Figure 5.4 Teacher attitudes towards gifted learners (n=121)

	Agree	Neutral	Disagree
	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)
I have gifted learners in my class	78.3	12.8	4.3
Gifted learners ask questions that teachers are not ready for	68.1	-	31.9
Gifted learners should be educated in the normal class with all other learners	55.3	-	44.7
Gifted learners can make it on their own without teacher support	61.7	-	38.3

In terms of policy documents the study was interested in understanding teacher awareness of current policy pronouncements on gifted education in South Africa. This

was further subdivided into four sub questions where the study wanted to establish whether or not teachers had read the different documents in which gifted education is being recommended. The results are presented in **Figure 5.5**.

Figure 5.5 Teacher knowledge about policy pronouncements on gifted learners

	Agree	Neutral	Disagree
	<i>f</i> (%)	<i>f</i> (%)	<i>f</i> (%)
I am aware of the National Planning commission's recommendation regarding gifted learners.	14.9	31.9	51.1
I am aware of the MST Task Force's recommendation regarding gifted learners	10.6	40.4	46.8
The new CAPS documents come with guidelines for responding to learner diversity in the classroom	63.8	21.3	34.0
The document makes sufficient provision for teachers to attend to the needs of gifted learners	23.4	68.1	8.5

Figure 5.6 What untrained teachers see as barriers to gifted education.

Teacher	Response
1020	The teacher who is not preparing well everyday
1021	Teacher development. Teachers must be well trained to deal with such learners. They must be trained concerning their behavior and activities that can be used to keep them meaningfully busy. Lack of information from the teacher or parents to deal with such learners. Teachers consider them as restless learners in the classroom and just need punishment.
1024	Little or no special training is given to educators as to how to deal with such learners.
1028	Well-trained educators
1054	Lack of experience in teaching gifted learners
1074	Lack of quality education can be a barrier to such learners.
1075	Lack of sufficient subject matter. Subject matter knowledge becomes critical for educators working with gifted learners. Lack of content knowledge also affect the use of important pedagogy.
1089	Lack of teacher training for such learners.

These results are similar to the findings of The International Gifted Education Teacher Development Network [Iget-Network] study where there was an overwhelming response and interest among student teachers to “bring back” gifted education to South African classrooms [Scott, Davis & Osman, 2009]]. IGET was likewise a result of data collected from practicing teachers and numerous conversations with enlightened and knowledge-able educators within the Johannesburg area community (Scott, 2008). This led the co-founders to organize a network of individuals willing to make a difference in the lives of children not being recognized as gifted by their classroom teachers or school districts. Hence, when the American co-founder and visiting scholar returned to the United States of America, she vowed to investigate programs and services in the USA that have a history of success with populations of culturally diverse gifted learners. Once such programs and services met certain criteria the question became could they be duplicated within a South African educational context.

CHAPTER 6: DISCUSSION

In terms of training results from the analysis highlight the teachers' perceptions about their readiness to teach gifted learners in the identified competencies. The tables show that almost three quarters (74.4%) of the participating teachers claimed they had not received training on how to teach gifted learners. The majority of the teachers (72.3%) indicated that Higher Education Institution should include content on gifted education. These results are similar to some findings elsewhere which have shown that training and professional development in gifted education is insufficient and weak (Rowley, 2012; Van Tassel-Baska, 2006). In South Africa, the research done by Oswald & de Villiers (2013) made similar observations that while the quality of gifted education is dependent on the quality of training the teachers receive; teachers who took part in their study said that they had not been trained to deal with gifted students. Yet research by Hudson et al. (2010) suggests that teacher training, especially when addressed at pre-service level, can have a positive impact on an educator's ability and confidence to provide quality learning experiences for gifted and talented students. It is also suggested that teacher training reinforces positive beliefs, attitudes toward and perceptions of gifted and talented education, while ensuring the ability to identify these students and differentiate their learning appropriately across a diverse range of domains (Taylor & Milton, 2006; Tomlinson, 2005). The second finding in this study was about teachers' knowledge about current policy pronouncements. In the questionnaire certain specific documents – the NPC report, the MST task team report as well as the CAPS documents - were targeted. These reports make explicit reference to gifted students and suggest that the education system should now pay special attention towards meeting their needs. The results highlight the teachers' perceptions about their awareness of current developments in gifted education. This shows that most of the teachers (83.0%) are not aware about the National Planning commission's recommendation regarding gifted learners. Similarly, only 11% of the participants were aware of the MST task team report and its recommendations on gifted students. Although a reasonable number 63.8% of the participants reported that the CAPS documents come with guidelines for responding learner diversity in the classroom only 23.4% of the participants reported that the CAPS documents make sufficient provision

for teachers to attend to the needs of gifted learners. In response to the open-ended questions participants asserted that the National Education Department made no direct reference to giftedness or provided guidelines with regard to the education of the gifted learner. Similar findings of the policy-implementation gap were observed in the study by Oswald & de Villiers (2013). Furthermore, their data suggested that a particular drive for the inclusion of gifted learners was absent in the department of education's agenda. Their recommendations were that before learners who are gifted (and others) will be able to receive appropriate education and support, this gap between policy ideals and classroom realities regarding the implementation of gifted or inclusive education needs to be addressed. Elsewhere Gross (2004), suggested that teachers should be trained in research and exposed to research findings that contradict many of the misconceptions held regarding gifted education. This may assist in dispelling the myths and misconceptions about giftedness and gifted children. Enhanced knowledge, understanding and skills, and a related increase in confidence, may reduce unfavourable attitudes. Some of the participants in this current study suggested that provision for gifted children should be enforced. In the third objective, the study was more interested in understanding teachers' attitudes towards gifted learners and the kind of strategies they used to identify gifted learners. Results show that a high percentage of 78.3% confirmed they had gifted students in their classes, 68.1% confirmed that gifted students ask questions that teachers are not ready for. Most teachers 61.7% were also of the view that gifted students can make it on their own without teacher support. Teachers were asked to explain some of their responses, and it became apparent that gifted students are considered troublesome as they sometimes ask questions which derail the teacher's focus. From such responses one can infer the negative practices that follow given that teachers' perceptions about gifted students and strategies for identification of such learners impact the way they teach (Adams & Pierce, 2004; Hativa, Barack & Simhi, 2001; Plunkett & Kronborg, 2011). Research has shown that a negative attitude and prejudice can cause discriminatory behaviour, particularly when it exists within a group of teachers (Bohner & Wänke, 2002). Teacher training programs are justified because professional training has been shown to change these negative attitudes. If teachers develop positive attitudes towards giftedness, they are more likely to be supportive of gifted education, and effective in identifying and catering

for gifted students. Empirical evidence shows that many regular classroom teachers find themselves feeling caught between the push to promote students' creative thinking skills and the pull to meet external curricular mandates, increased performance monitoring, and various other curricular constraints (Beghetto 2013). Teachers prefer learners who have characteristics that are in sharp contrast with creative personality traits, such as "conforming" and "considerate" (Mhlolo, 2017). The more creative a class becomes, the less desirable their behaviour appears to teachers given that a creative teacher loses an aura of authority.

In all the three categories of teacher competencies, the teachers seemed not to be ready to teach gifted learners, and they were not aware of current developments in gifted education. Teachers' perceptions revealed by participants in this study confirm previous research reported on the quality of teacher preparation (Kagan, 1992). Teachers' awareness of latest developments in gifted education, is important given previous findings suggesting that being aware of latest developments or policies may improve educational practices (Fullan, 1993, 2001; Goodlad & Klein, 1970; Gross, Giacquinta, & Bernstein, 1971; Sarason, 1971, Sultana, 2008). Furthermore, in identifying effective teaching practices for gifted learners, teacher competencies are not the only factor to consider but the attitudes and strategies for identification of gifted learners are equally important (Feldhusen & Hansen, 1988; Eyre, Coates, Fizpatrick, Higgins, McClure, Wilson & Chamberlin, 2002). Yet participants in this current study seemed to have negative attitudes towards gifted students, hence the National Planning Commission recommended that the provision of opportunities for excellence for the most talented students must be at the centre of all our educational efforts. Similarly, in the more recent South African curriculum documents inclusivity is now foregrounded and the gifted learner is mentioned as one category of exceptionality that should become the central part of the organisation, planning and teaching at school (Department of Basic Education, 2011).

CHAPTER 7: CONCLUSION

7.1. Introduction

The main purpose of this study was to develop a teacher training program that higher education institutions might use for training teachers for the gifted in South Africa, by borrowing best practices as identified in exemplary institutions, international experts on gifted education, the literature and on local teachers' inputs. Data collection was done through document analysis of programs from the USA, Australia, Singapore, and South Africa, as well as interviews with experts on gifted education in the USA and a questionnaire for South African mathematics teachers. A total of 21 trained experts on gifted education were interviewed in the USA and 121 untrained South African mathematics teachers responded to a questionnaire. There were three main research questions within this study:

1. Which content is common among some selected Teacher Professional Learning Programs [TPLP] in gifted education globally?
2. What insights can we gain from some trained teachers for gifted learners?
3. What are the needs of South African teachers that should be included in the Teacher Professional Learning Programs [TPLP] for the mathematically gifted?

Throughout this chapter, the key findings, contributions, recommendations, and implications of this study will be presented. The conclusion of this study was reached through careful consideration of the data analysis and discussion of the findings.

7.2. Key findings of this study

The three essential key findings for developing Teacher Training Programs for teachers of mathematically gifted learners in South are as follows:

1. Teacher Training and Readiness: The study highlighted that a significant portion of participating teachers claimed they had not received training on how to teach gifted learners. The majority of teachers also indicated a need for content on gifted education

in Higher Education Institutions. These findings align with previous research, suggesting that training and professional development in gifted education are insufficient and weak in South Africa. Additionally, the study suggests that teacher training, especially at the pre-service level, can positively impact educators' ability and confidence in providing quality learning experiences for gifted and talented students.

2. Awareness of Policy Pronouncements: The research revealed that a large percentage of teachers were not aware of specific policy recommendations regarding gifted learners, such as those outlined in the National Planning Commission's report and the MST task team report. Furthermore, while some teachers recognized that the Curriculum and Assessment Policy Statements (CAPS) include guidelines for responding to learner diversity in the classroom, a smaller portion felt that these documents adequately address the needs of gifted learners. The study also noted a gap between policy ideals and classroom realities regarding the implementation of gifted education, echoing findings from previous research.

3. Teachers' Attitudes and Strategies: The study found that a high percentage of teachers confirmed having gifted students in their classes, but also expressed challenges in addressing their needs. Some teachers believed that gifted students could succeed without teacher support and expressed that these students could be troublesome. These findings suggest negative attitudes and strategies for identifying and supporting gifted learners, which can impact the way they are taught. The study emphasizes the importance of addressing negative attitudes and prejudices through teacher training programs, as positive attitudes towards giftedness can lead to better support for gifted education.

Overall, the study concludes that teachers in South Africa may not be adequately prepared to teach gifted learners, have limited awareness of current developments in gifted education, and may hold negative attitudes towards gifted students. This highlights the need for improved teacher training, increased awareness of policy pronouncements, and the promotion of positive attitudes and strategies for identifying and supporting gifted learners in the education system.

7.3. Original contribution to the knowledge

This study contributed to the knowledge on the subject of gifted education by identifying the topics that emerged from the various sources of data that the study collected, which could form the basis of a teacher training program in South Africa. Having done so, this will guide South Africa, and other African countries where there is limited gifted provision to make it available. This study also attempted to provide essential literature on gifted education and considered the history of this field to guide the interested researcher in developing programs for teachers of gifted learners, and therefore this thesis can be considered one of the first studies to have the topics which could form the basis of a teacher training program in South Africa.

In terms of the methodology, this study was original in the way in which it was designed, as the researcher visited an actual gifted education practice in the USA, to examine the feasibility of transferring the educational components to a completely different context in order to develop teacher training programs in South Africa . This approach ensured a clear understanding of the situation, as developing a Teacher Training Program for mathematically gifted learners has not been considered in South Africa before. Moreover, it is important to add that the examination of some of the frameworks used in this study was done for the first time in the South African context. The principles and components related to this subject and examined in this study can guide the interested researcher who aims to find out more about similar phenomena. In addition, this study interviewed the vast majority of experts in gifted education in USA, with their opinions contributing to the findings of Stage Two of this research.

CHAPTER 8: RECOMMENDATIONS

Based on the findings from the document analysis, the experts on gifted education as well as the untrained teachers who responded to this study, as a researcher I would strongly recommend the following (1) that if a teacher programme for gifted education is to be developed, questions such as what motivates applicants to want to embark on gifted education training should be considered (2) that further studies be carried out with Foundation Phase mathematics teachers. My view is that Gifted Education should start much earlier than what the National Strategy for Mathematics, Science & Technology Education currently suggest. Gifted Education at FET level is too little too late. All the same, here are the topics that emerged from the various sources of data that the study collected, which could form the basis of a teacher training program in South Africa.

Topic Number	Area	Content
1	International & National Legal Frameworks & Policy Documents	➤ Universal Declaration of Human Rights in 1948 ➤ The 1989 United Nations Convention on the Rights of the Child, ➤ The 1990 Jomtien World Conference on Education for All (EFA). ➤ The 1994 Salamanca Statement on Inclusive Education ➤ The Incheon Education 2030 Declaration and Framework for Action (UNESCO, 2015) ➤ Department of Education White Paper 6 (WP6, 2001), ➤ SIAS, (2014)

		➤ National Strategy for Mathematics, Science & Technology Education [NSMSTE] ➤ National Guidelines on Inclusive Education
2	Foundations	Historical foundations of gifted and talented education including contributions of certain individuals from diverse backgrounds e.g. ➤ Galton's (1865) general laws of distribution ➤ Spearman's (1927) general intellectual ability ➤ Catell's (1963) fluid and crystal intelligence ➤ Guilford's (1967) information processing model ➤ Sternberg's (1985) triarchic model of intelligence ➤ Gardner's (1993/1994) multiple intelligence ➤ Key philosophies, theories, models and research supporting gifted and talented education.
3	Psychology of the Gifted children	Development and characteristics of learners: ➤ Definitions of giftedness ➤ Cognitive characteristics ➤ Physical characteristics ➤ Emotional characteristics ➤ Social characteristics
4	Psychology of the Teacher for the Gifted children	Teacher Characteristics Personally: ➤ have an affinity for the gifted children.

- understanding gifted students and what makes them tick.
- must have a positive attitude toward gifted students, excellence, productivity and leadership.
- enjoy working with students who require constant challenge and innovation.
- be willing to adapt themselves to the social and emotional needs, of their students.

Professionally:

- good teachers are authorities in their field, capable of stimulating their students and developing their intellectual abilities
- A good teacher for the gifted should have a willingness to think and work in new and different ways, when working with gifted children.
- A good teacher knows that it is important to have insight when working with gifted children. In this case, **insight** refers to deep knowledge or understanding of someone. Each gifted child is different, so make sure to take the time to get to know gifted students as whole people and consider their particular strengths and learning styles and make note of aspects of school or life that might be especially challenging.

Pedagogically:

- to properly identify what the child knows or does not know at this point.
- to explain concepts in a way that interests, challenges and fascinates the student.

		➤ to give constructive feedback, allowing the student the opportunity to adjust his learning methods to allow full control of the material. ➤ to cultivate motivation and self-esteem in the student.
4	Learning Environments & Social Interactions	➤ The classroom needs to be a place where gifted students can learn about and respect different social and cultural norms and language diversity. ➤ Promote self-esteem of students. ➤ Guard against unrealistic expectations from both the teacher and parents ➤ Identify and be receptive to different copying styles of students. ➤ Support the self-efficacy of the students.
5	Instructional Strategies	Curriculum strategies for gifted students include: ➤ Pre-assessment in order to adjust instruction that is consistent with the individual student's progress. ➤ Acceleration ➤ Enrichment ➤ Grouping ➤ Problem based learning. ➤ Curriculum compacting ➤ Extra-curricular activities
6	Assessments	Assessments are vital for decision making when working with gifted students e.g.

		➤ For identification – use of multiple measures and alternative assessment ➤ For monitoring academic progress ➤ For adjusting instruction
7	Identification tools	Below is a list of of some tools that could be modified for local contexts that could then be used in the process of identifying gifted children.

Nomination by parent or caregiver

Student's name: _____ Year: _____

Person completing the form: _____ Relationship to student: _____

Characteristic	Most of the time	Some of the time	Rarely
Recalls facts easily	☐	☐	☐
Expresses himself/herself fluently	☐	☐	☐
Is always asking questions	☐	☐	☐
Has a sense of humour	☐	☐	☐
Finds unusual uses for things	☐	☐	☐
Tends to lead/initiate activities	☐	☐	☐
Is curious	☐	☐	☐
Has long attention span	☐	☐	☐
Is easily bored	☐	☐	☐
Is an avid reader	☐	☐	☐
Thinks logically	☐	☐	☐
Mixes with older children and adults	☐	☐	☐
Is impulsive	☐	☐	☐
Is an independent learner	☐	☐	☐
Is concerned about world issues	☐	☐	☐

When did your child first begin to read? Is he/she self-taught? _____

At what age did your child show an understanding of numbers, puzzles and patterns? _____

How many books and magazines would your child voluntarily read in a month? _____

Does your child have any unusual interests? If so, what are they? _____

What types of television programs does your child like to watch? _____

Does your child have an interest in music? If so, what is he or she learning and what level has been attained? _____

In what activities does your child participate outside school hours? _____

What hobbies and interests does your child have? _____

Would you consider that your child has a particular problem or need that may affect his or her learning? _____

Please add any other information you may feel relevant to your child's education. _____

Nomination by teacher

[illegible]

Nomination by peer

Name: _____ Year: _____

If astronauts were being selected on the basis that they could tell someone on another planet all about Earth, who would you nominate to go? _____

Who is the funniest person in your class? _____

If you needed help with a particular subject, who would you ask? _____

Who in your class would you ask for help if you had a personal problem? _____

Who is the best in your class at solving problems? _____

Imagine that the class was given the project of building a model of an invention. Who would you expect to build the best and most original model? _____

Which students in class can complete their work and still have time for other activities? _____

Who says the most original things in class, things that you would never have thought of? _____

If children did not have to go to school, who could talk you into going? _____

Who can structure the best argument in the class? _____

Who should have the lead role in the school play? _____

If your teacher could not be in the classroom, who could take over? _____

Imagine that the school has been asked to provide a work of art for the youth centre. Who in your class should be asked to do it? _____

Who is always reading? _____

Who has a wide range of knowledge? _____

Self-nomination form

Name: _____ Year: _____

If you were given the chance to meet anyone in the past or present, whom would you like most to meet and why? _____

What is your favourite subject? _____

What do you enjoy about this subject? _____

What do you like to read? e.g. books, magazines, fiction, and non-fiction. _____

About how many books or magazines would you read each week? _____

When you are not at school, what do you do? _____

What sorts of things interest you? Do you know a lot about certain things? What are they? _____

Observational guide

Students' strengths and weaknesses

Date:	Topic:	
Students' names	Specific strengths	Areas for development

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Appendix A: Permission to conduct the study with the USA participants

Central University of
Technology, Free State

MEMORANDUM OF UNDERSTANDING BETWEEN



CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE AND WESTERN KENTUCKY UNIVERSITY, KENTUCKY, USA ("MOU")

CENTRAL UNIVERSITY OF TECHNOLOGY, FREE STATE, a university duly established under the Higher Education Act No 101 of 1997 with its registered address at 20 President Brand Street, Bloemfontein, 9300 herein represented by the Vice-Chancellor and Principal (Prof. H de Jager), duly authorised thereto and acting by virtue of delegated authority (hereinafter referred to as "CUT") and Western Kentucky University with its registered address at Bowling Green, Kentucky, USA herein represented by Provost and Vice President for Academic Affairs (Prof. Cheryl Stevens), duly authorized and acting by virtue of delegated authority (hereinafter referred to as "WKU"), hereby enter into an understanding of mutual cooperation with the purpose of developing academic and cultural exchanges, scientific research projects, and other activities or programs within, but not limited to, the field of gifted studies education. Such programs may include, but are not restricted to:

1. Exchange of faculty members and research scholars;
2. Exchange of students at both undergraduate and graduate levels;
3. Collaborative degree programs and curricular articulations;
4. Exchange of academic materials and information;
5. Joint research activities and publications;
6. Participation in seminars and academic meetings.

CUT and WKU shall also include any programs offered at either university that are deemed mutually desirable and reasonable for the development of cooperative activities between the two institutions. However, any specific programs shall be subject to the adherence the universities supply chain management and/or procurement policies, processes and procedures, mutual consent, availability of funds, and approval of each university and this MOU does not purport to create any expectations between the Parties to carry out any of the programs set out in this MOU. In the development of such programs, the universities will attempt to establish financial and other arrangements that are reciprocal and mutually beneficial. Both institutions are committed to cooperate at the institutional level, and they may also pursue collaborations at a departmental/college level.

The institutions will appoint primary contacts for communication and execution of this agreement. The contact for WKU shall be the Associate Provost for Global Learning & International Affairs and for CUT shall be Deputy Vice Chancellor: Research Innovation and Engagement, Prof A.Ngowi. Any changes to the contact person shall be presented to the partner institution within a reasonable amount of time so as not to hinder the exchange of communications or progress of activities between the two universities.



To assess the results of this MOU, representatives from the two institutions will review and evaluate this MOU once every five (5) years. Any amendment to the MOU shall be discussed and agreed upon in writing by both parties prior to the initiation of any particular modification.

This MOU shall go into effect following the date of signing of the last signature, and will remain valid for a period of five (5) years. This MOU shall be renewed only with the written consent of both parties. Either party may terminate this ag by providing a six (6) month written notification to the other party. In the event that the present agreement is not renewed or terminated, both parties agree to meet the commitments undertaken during the period in which the agreement remained active, or to make the necessary arrangements with mutual consent. The termination of this MOU shall not affect the validity of any agreements concluded between the parties under this MOU and any such agreements will be be valid for the duration as stipulated in such agreements.

On behalf of our respective universities and with the authority entrusted to us by virtue of our offices, we hereby execute this MOU.

**For Central University of Technology,
Free State:**

 20/10/2020
Prof. A de Jager (date)
Vice-Chancellor and Principal

For Western Kentucky University:


Dr. Cheryl Stevens (date)
Provost and Vice President for Academic
Affairs

Digitally signed by Cheryl Stevens, known as
Cheryl Stevens for the purpose of making
this document a legal record.
Public Key Infrastructure - Certificate
Revoked by Certificate Authority
2020.10.20 11:15:00 +0200

Appendix B: Permission to collect data from AMESA Conference



AMESA Office
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Tel: 011 484 8917
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Cell: 082 341 6060
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NPO registration no: 134-443 NPO
PBO registration no: 930 008 391

Prof M Mhlolo
Central University of Technology
Bloemfontein
9300

Dear Prof Mhlolo

Permission to collect data from AMESA delegates: 2017 National Congress

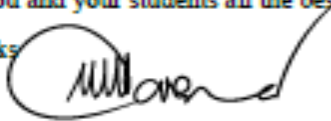
Your email today (21 June 2017) refers. According to your email, you would like Masters' students to collect data from AMESA delegates at our 23rd Annual National Congress. Permission is hereby for your students (under your supervision) to collect data from AMESA participants provided the following issues are taken into account:

- The identity of the participants should not be revealed in your research reports.
- Participation is on a voluntary basis
- The collection of data will not have a disrupting effect on Congress 2017

AMESA is very thankful to you and your team in its members and know that this important research on gifted learners will provide useful input to the Department of Education and other important stakeholders in education on how to advance the cause of gifted learners in South Africa. AMESA welcomes this important research and would appreciate having access to the reports/theses generated from the data collected.

On behalf of the AMESA National Council and Executive let me take this opportunity of wishing you and your students all the best in this important research activity.

With thanks



Dr VG Govender (AMESA President)

21 June 2017

Appendix C: Language editor's Letter



Dr Jabulani Sibanda
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School of Education
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19 July 2023

RE: CERTIFICATE OF LANGUAGE EDITING

To whom it may concern

I hereby confirm that I have proofread and edited the following Dissertation using Windows 'Tracking' System to reflect my comments and suggested corrections for the author(s) to action:

Developing a Teacher Training Program for High School Teachers of Mathematically Gifted Learners in South Africa

REFERENCE

- Author(s): Jack Mathoga Marumo
- Student No: 213025965
- Affiliation: Central University of Technology

Although the greatest care was taken in the editing of this document, the final responsibility for the product rests with the author(s).

Sincerely



19.07.2023

SIGNATURE

This certificate confirms the language editing I have done in my personal capacity and not on behalf of SPU