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Proposing a "Work Smarter" Theory for Change That Leaves No "Mathematically Smart" Learners behind in South African Schools

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Abstract

Persistently high failure rates in the mathematical science keep dogging South Africa and teachers are always blamed for failing learners and punitive systems designed thereof. Progressive views suggest that, rather than designing punitive systems against teachers, education needs to be grounded in a "theory of change" for it to bring about positive results but the existing literature about South Africa has not so far been able to provide such a theory. This theoretical paper attempts to bridge this underlying gap. Its main argument is that the South African Mathematics Education System fails persistently because it is not working smarter. Grounded in Repenning & Sterman's systems dynamics theory, the paper provides evidence from both media and published literature to support this argument. The paper concludes with some recommendations on how the system could work smarter and not necessarily harder by identifying and nurturing its smart fraction or gifted learners in mathematics.

Keywords

Mathematics Education, Improvement Theory, Capability-Traps, Giftedness, Attribution-Error, Accountability, South Africa

1. Introduction

Poor learner performance in mathematics has received unprecedented media and public comment in almost three decades of post-apartheid South Africa. This follows many national and international assessments that the South African schooling system has been subjected to. Given that the majority of the scarce skills that are needed by the country require someone with mathematics, this perennial poor showing in the subject has prompted a number of studies to investigate the reasons for this problem as well as to propose what needs to be done to improve the situation.

On the part of government, several attempts have been made to address this problem. For example, the South African National Strategy for Mathematics, Science & Technology Education [NSMSTE] was introduced in 2001 with the aim of addressing a pernicious legacy of apartheid which was described by policy makers in part as follows:

> … If this cycle is wasteful from an educational point of view, it is catastrophic from the perspective of national developmental needs.

Despite this understanding of the catastrophic implication on national development, a disturbing practice is that stakeholders have always presented some "sugar quoted progess reports" in order to remain politically relevant even though things are not getting any better. Given that the pernicious legacy has remained a perennial concern, critics have described it as "a mess that just won't quit" and as if to fan the flames, they now point to yet another pernicious reality of the fourth industrial revolution (4IR) which comes with its inevitable demands for skills relevant for the 21st century knowledge based economy (KBE). Within these current KBE debates, the general consensus is that most of the sciences would be impoverished without mathematics; hence it should be the "gold standard" or *sine qua non* subject for assessing the real meaning of the senior certificate results in South Africa. For this reason, it is necessary that research informs policy and drives transformation towards a mathematically and scientifically literate society. So what is problematic in the way the country has been responding to the poor mathematics pass rate?

Statement of the Problem

Although several mitigatory strategies have been proposed to alleviate the pernicious legacy of poor performance in mathematics, the most common view is that teachers are to blame and the antidote suggested is that *teachers need to work harder* or *South Africa needs to up its game*. According to Loveless (2005), trying harder does not rely simply on the volition and goodwill of teachers and administrators; instead, it relies on an accountability system involving sanctions and incentives. In South Africa, it is assumed that if such accountability mechanisms are put in place, teachers and other educators will be forced to work harder and student achievement in mathematics will improve. Globally, many such accountability efforts (including South Africa) have however failed to yield the desired benefits, often exhibiting a pattern of short-lived improvement followed by a decline in performance to levels at or below those before the improvement initiative began (Kahn, 2019). Pritchett, Woolcock, & Andrews (2010) explain that for an accountability system to be effective in improvement, it needs to be grounded in a "theory of improvement". Yet in South Africa such a theory of change—an explication of what principals and teachers need to do to improve performance in mathematics is sorely lacking (Spaull, 2015). This theoretical paper attempts to fill this gap.

2. Review of Related Literature

2.1. Theoretical Framework

Given the background and statement of the problem, I needed a framework that would achieve the following two objectives simultaneously 1) explain why poor performance in mathematics has persisted as well as 2) propose what needs to be done to improve the situation. In order to understand the reasons why organizations succeed or fail to achieve their desired goals, the literature offers System Dynamics (SD) as one of the best threads from which theory can be woven. From this SD perspective, Repenning & Sterman (2002) formulated a capability trap theory which has since been expanded and applied by many researchers (Lyneis & Sterman, 2016) to understand why many systems persist in a state of constant and expensive reactivity and poor performance.

Although Repenning and Sterman [RS] have provided a series of diagrams depicting the process of the "physics of improvement" in various environments, **Figure 1** provides the most basic and generic causal loop diagram for the capability trap which I considered to be sufficient for this paper.

The starting point for understanding this model is the Desired Performance of any organization—the thermostat setting or "trigger". The managers of any industrial or educational process, are responsible for its performance against a set

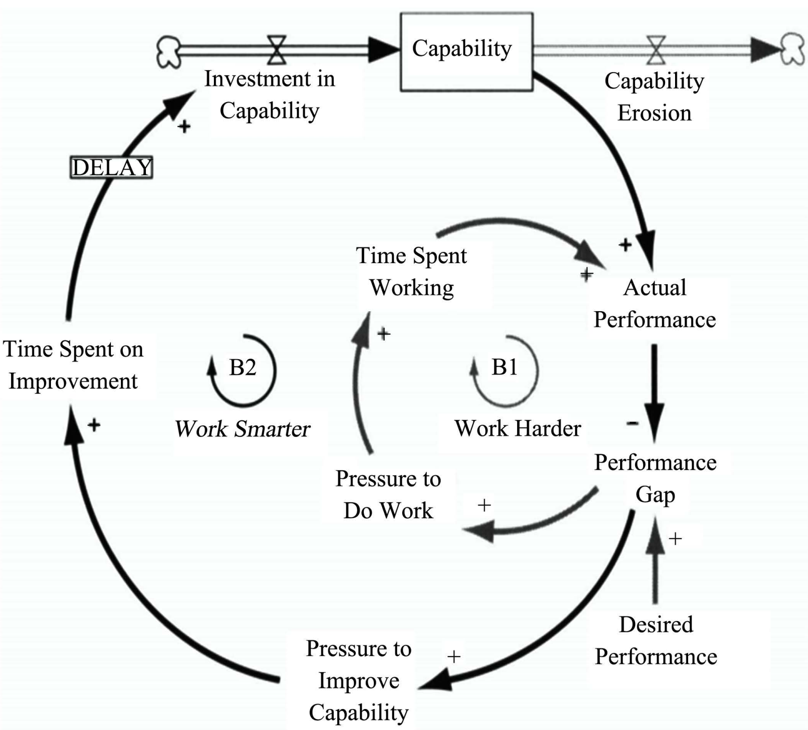


Figure 1. The capability trap: Generic structure [Source: Repenning & Sterman, 2002].

target or desired performance. This target setting triggers two basic loops in that if performance falls short of the set target, managers have two basic options to close the gap: 1) the working harder B1 loop which forms a first order improvement feedback, or 2) the working smarter B2 loop, which forms a second order improvement feedback. Although the capability trap theory was originally conceptualized in the context of process improvement in manufacturing, it is now more applicable and maps equally well to various social systems including educational systems (Landry & Sterman 2017; Robeyns, 2017). So what are the main features of the two loops?

2.1.1. Features of the First Order—Work Harder Loop B1

A capability trap [B1 loop] arises when pressure to work harder results in things getting worse leading to more pressure to work harder. Managers' tendency to attribute performance shortfalls to problems with the workforce is a typical example of a pervasive and robust phenomenon called fundamental attribution error (FAE), or dispositional bias (DB) (Berry, 2015) The fundamental attribution error describes perceivers' tendency to underestimate the impact of situational factors on human behaviour and to overestimate the impact of dispositional factors. For example perceivers often tend to believe that aggressive behaviour is caused by aggressive personality characteristics (dispositional factor) even though aggressive behaviour can also be provoked by situational circumstances (situational factor). Irrespective of these controversies, the fundamental attribution error is generally regarded as a very important phenomenon for social psychology, as it often leads to surprised reactions with research findings demonstrating a strong impact of situational factors on human behaviour. Due to this FAE, things get worse because whenever managers respond to a performance gap by increasing work pressure, several years of data have consistently found the "get back" response to be the most common way employees deal with accountability pressures. Employees can "get back" by engaging in counterproductive behaviours such as cutting corners, concealing defects, and fabricating throughput without increasing output in real terms (Berry, 2015). This again reinforces management's attribution that the workers really were lazy, hence this self-confirming behavior by management drives the organization into the vicious cycle of the capability trap. Consequently, once caught in the capability trap, people are unlikely to learn to escape from it.

2.1.2. Features of the Second Order—Work Smarter Loop B2

A second-order improvement option to close a performance gap is by improving capability—*The Work Smarter* loop B2. It is considered a work smarter loop because investment in capabilities will, with time, boost throughput, and close the performance gap. This work smarter loop yields more enduring gains than working harder even though after a substantial delay-hence B2 loop is longer than B1. For those organizations wishing to escape the capability trap, there is need to accept this reality that the first outcome to interventions designed to boost capabilities is a drop in system performance or a rise in costs known as the Worse-Before-Better (WBB) dynamic (Repenning & Sterman, 2002). This ability to discipline oneself to delay gratification in the short term in order to enjoy greater rewards in the long term, is an indispensable prerequisite for success and is the way organisations ought to go. Building on this conceptualization of system dynamics, I now use this RS model first to analyze the South African mathematics education system post 1994, and then to support my thesis that the system has evolved into the undesirable state of the work-harder loop B1. I then show how the system could escape the capability trap in which it has been ensnared for almost three decades now by investing in the innate potential of the mathematically gifted students—a capability that gets overlooked in our efforts to "educate all".

3. Guiding Questions

Consistent with the RS model, the following questions were raised for this paper:

1) What are the desired goals of mathematics education in South Africa?

2) To what extent does the RS model help explain what is happening currently in South African Mathematics Education?

3) What practical suggestions does the model offer in terms of what should happen to mathematically gifted learners in the South African Education system?

4. Analysis and Discussion

4.1. What Are the Desired Goals of Mathematics Education in SA

Table 1 and Table 2 will help the reader to make sense of where South Africa is falling behind hence the goals it aims to achieve.

The two tables clearly show a declining trend in learner-participation at Grade 12 level in Mathematics from 301,897 learners in 2008 down to 259,143 learners in 2021. Yet during the same period learner participation in Mathematical Literacy

Table 1. Participation & performance in mathematics and mathematical literacy at grade 12 in South Africa 2008-2014.

Mathematics							
Year	2008	2009	2010	2011	2012	2013	2014
Wrote	301,987	304,159	263,341	224,635	225,954	241,509	225,522
>50%	21.1%	17.7%	19.1%	18.5%	22.7%	26.1%	22.3%
>80%	4.3%	2.9%	3.6%	2.5%	2.9%	3.4%	3.2%
Mathematical Literacy							
Wrote	268,022	281,623	280,877	275,385	291,468	324,097	312,103
>50%	37.5%	30.7%	40.6%	40.6%	35.8%	35.5%	34.3%
>80%	6.3%	3.2%	3.5%	2.7%	2.5%	1.8%	2.4%

Table 2. Grade 12 participation & performance in mathematics & mathematical literacy in South Africa 2017-2021.

Mathematics					
Year	2017	2018	2019	2020	2021
Total Wrote	245,103	233,858	222,034	233,315	259,143
N > 30%	127,197	135,638	121,179	125,526	149,177
>30% as a %	51.9%	58.0%	54.6%	53.8%	57.6%
Mathematical Literacy					
Total Wrote	313,030	294,204	298,607	341,363	441,067
N > 30%	231,230	213,225	240,816	275,684	328,362
>30% as a %	73.9%	72.5%	80.6%	80.8%	74.5%

increased from 268,022 to 441,067. The decline in learners registering for Mathematics is more worrisome when one considers that in 2008 there were only 595,216 learners in Grade 12 when compared to 750,478 learners in 2021. This suggests that gains made in improved enrolment and retention rates are being eroded by the declining participation rates especially in mathematics. In terms of performance, one might notice from Table 2 that at a 30% cut-off point, less than 60% of the learners pass mathematics. If we consider a 50% cut-off point, which is considered as a university entry or Bachelor pass, Table 1 shows that less than 30% of the learners pass mathematics and qualify for university degrees. If we further consider an 80% cut-off point Table 1 shows that less than 5% of the learners pass at that level. In fact the pass rate at the 80% cut-off point was at 2.6% in 2018, in 2019 it was 2%, in 2020 it was 3.2% and in 2021 it was 3%. Although the 50% cut-off point is the officially recognised entry point into university undergraduate programs, data collected in the 3 year period [2015-2017] of an entry level mathematics course in one of South Africa's selective universities shows a sobering reality: those who come in with a National Certificatate mathematics of 90% and above, pass the course with an average of 64%. Those who entered with a score below 90%, fail the course.

Given this background of lower participation and poor performance in mathematics, the revised [2019-2030] National Strategy for Mathematics, Science & Technology Education (DBE, 2018) set out two goals with a specific focus on participation and performance as follows [see Figure 2 and Figure 3]:

These goals emerged from a 2016 Mathematics Indaba where in her opening keynote the Minister of Basic Education was candid with the participants that government had begun to accept that there is a problem in the teaching and learning of Mathematics requiring urgent intervention. The extent and depth of the problem was often underestimated in favour of "progressive" reports. In her final comments she admitted that improving teaching quality alone may not be sufficient to redress the country's ills. She then posed a question: Where does one start in this regard?

In order to answer the minister's question let us start by understanding where managers are going wrong.

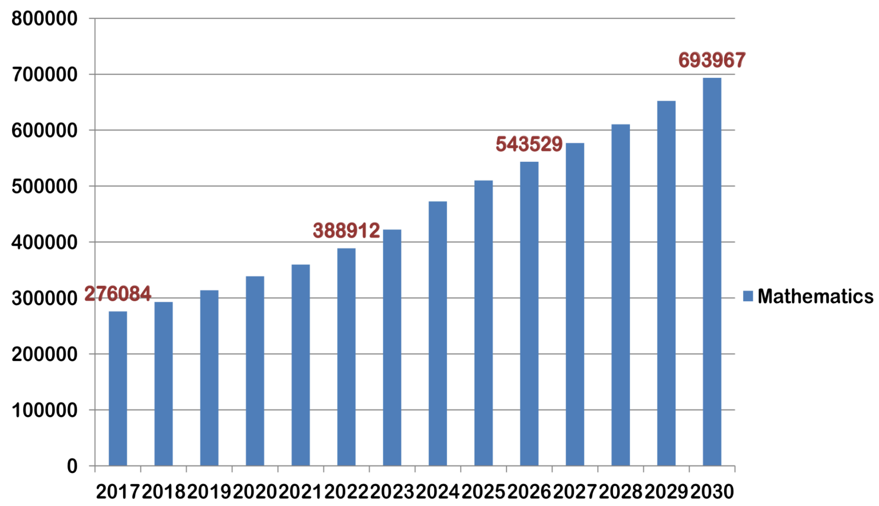


Figure 2. Participation rate: mathematics grade 12 targets [Source: DBE, 2018].

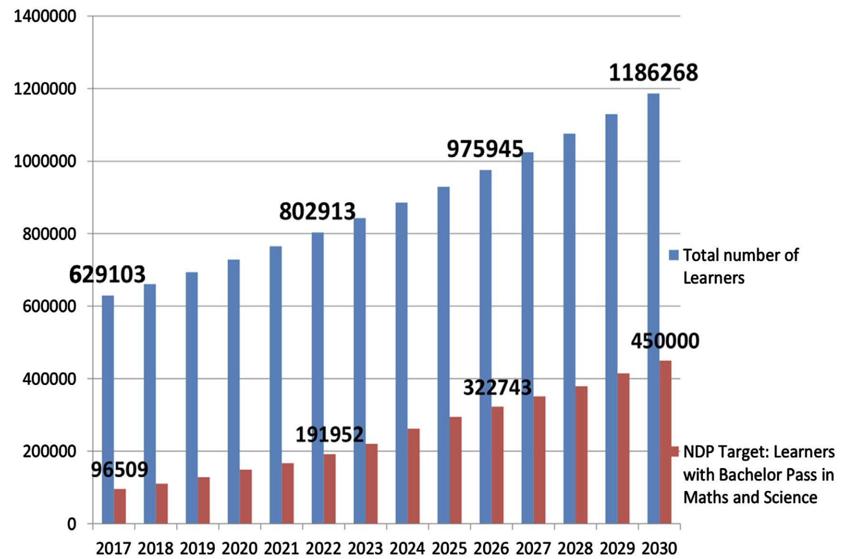


Figure 3. National development plan targets: learners with bachelor passes in mathematics & science [Source: DBE, 2018].

4.2. Managers' Fundamental Attribution Error [FAE]

It should be clear from Table 1 and Table 2 as well as Figure 2 and Figure 3 that set targets have not been achieved in South African mathematics education. As explained earlier, a work harder loop is ignited when there is this gap between set targets and actual performance. Reminiscent of this work harder loop, blame shifting statements are so ubiquitous in the South Africa media and literature to the extent that the practice has now become known as "the matric blame game" (Spaull, 2015). Media statements all point to one common attribution—mathematics teachers have been identified as the major human factor causing poor performance of students in the country and will not deliver if there is no machinery to hold them accountable. For example, in 2013 the Education Minister, Motshekga (2013) noted that "*South Africa is significantly under performing in education in general, particularly mathematics teaching and learning… Mathematics teaching is often poor quality, with teachers not able to answer questions in the curriculum they are teaching, one indicator of the challenge*." In 2014 it was widely accepted that the matric results could have been much better "*had teachers mastered the new curriculum*". With reference to the same 2014 results, in The Times newspaper article entitled "The matric blame game" of 5th January 2015, Spaull said that poor performance of learners in mathematics was a result of many teachers who do not have the required content knowledge and teaching skills; and that there is lack of accountability at all levels of the system and that there are no consequences for non-performance, both at school and in the bureaucracy (Spaull, 2015). Here we see again evidence of cracking the whip—teachers must be made accountable. So intense is the focus on mathematics performance, and the language of punitive accountability that it creates perverse and counterproductive behaviors.

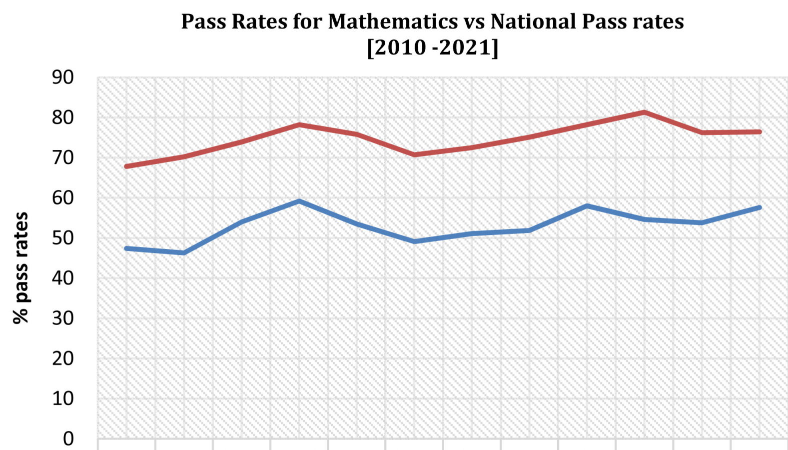
4.3. Teachers Getting Back at the System

Whilst stringent incentives and sometimes ruthless sanctions jolt able teachers and other stakeholders into actively raising the quality of education they provide, research has shown that for those not motivated by the incentives and sanctions outlined in accountability programmes, such a system is "likely to induce behaviour distortions along other dimensions as agents seek to game the rules" (Jacob & Levitt, 2003: p. 843). In South Africa there is ample evidence justifying behaviour distortions. For example in their rejection of the Annual National Assessments [ANA] the spokesperson for the teachers' union said teachers spend considerable amounts of time "programming" students because they are scared of being labelled poor teachers and schools are worried of being called dysfunctional. Even where a policy was meant to be supportive and developmental rather than punitive and judgmental, Letseka, Bantwini, & McKenzie (2012) have shown how the South African Democratic Teachers' Union (SADTU) for example waged a bitter battle against the Whole School Evaluation [WSE] Policy, as well as against the Integrated Quality Management System (IQMS) by protecting its teachers from being evaluated as well as fabricating evaluation scores, even though some of the teachers have in fact been described as "scoundrels". Following what has been described by SADTU as an exposure of teachers' weaknesses, there are a number of ways in which teachers have been able to game the system, and a few of these methods will be discussed here. They include lowering the pass mark, "statisticulation", excluding academically poor students from the assessments and outright cheating in the examinations.

4.3.1. Lowering the Pass Mark

For example, in South Africa teachers are heavily unionised under SADTU and because of their strength they have fought vehemently to lower the bars where learners need a mere 30% to pass mathematics at matric level (Spaull, 2015). If we compare the pass rates as shown in **Figure 4** there is prima facie evidence that learners are passing mathematics given the rise from 47% in 2010 to about 58% in 2021.

However, the 30% pass mark has been described in many corners as a failure of the high school education system in the country which is used as a strategy by the government to remain politically relevant to the people. Lowering of pass marks has gone so contagious to the extent that this game has permeated even the international arena. For example, South Africa has set its targets for TIMSS as follows: 2011 [target 300] (achieved 352); for 2015 [target 340] (achieved 372); for 2019 [target 380] (achieved 389); for 2023 [target 420]. In the TIMSS 2019 report, South African mathematics and science set targets for 2011-2019 are described as having been achieved. The averages have been described as having "improved" from "very low" (1995, 1999 and 2003) to "low" (2011, 2015 and 2019). This is despite the fact that the years of "improvement" coincide with the years when the country fielded Grade 9 learners for Grade 8 tests. According to the South African TIMSS 2019 report, the 2011 level of performance is still low, but there is a trend in the right direction, and the trend is roughly as fast as one might expect (Reddy et al., 2020). The report goes on to say, whilst South Africa has performed poorly in the TIMSS tests, countries participating in TIMSS tend to be countries which take education rather seriously. So does it mean that South Africa does not take education seriously—one might ask? This is the kind of reporting that is prevalent in the South African education system which conceals the real deficits of poor performance in STEM but keeps the country ensnared in the capability trap. Responding to what they view as a sense of complacency about



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Math P>29	47.4	46.3	54	59.2	53.5	49.1	51.1	51.9	58	54.6	53.8	57.6
National	67.8	70.2	73.9	78.2	75.8	70.7	72.5	75.1	78.2	81.3	76.2	76.4

Figure 4. Mathematics pass rates at $p > 29\%$.

investment in future innovations, both the National Planning Commission [NPC] (2012) and the Department of Science & Technology task team recommended that many of the new graduates between now and 2030 must be in the critical skills categories, such as engineering, actuarial science, medicine, financial management, and chartered accountancy and so the downward trend in the number of learners who pass matric with mathematics must be reversed.

4.3.2. Statisticulation

In his book entitled: "How to lie with statistics", Huff (1991) coined the term *statisticulation* with reference to statistical manipulation or the art of misinforming people by the use of statistical material. Although the title might suggest that Huff is advising the reader on how to lie with number, on the contrary the book suggests that without writers who use numbers with honesty and understanding and readers who know what they mean, the results can only be semantic nonsense. The book is full of examples where readers have been made to believe certain claims by the *statisticulator* which appear true at first glance yet when one gives them a careful squint the claims would be false.

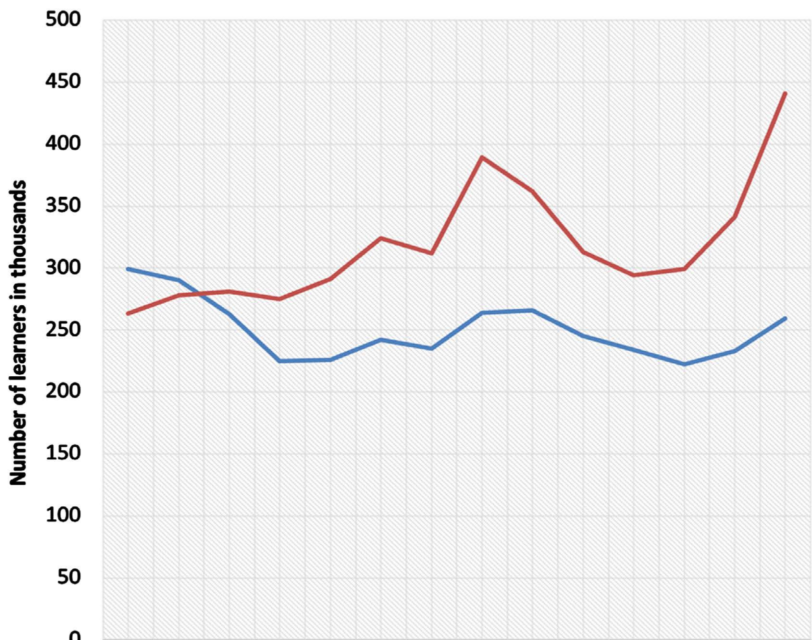
In South Africa there is evidence of doctoring the figures one of which was during the implementation of the Intergated Quality Management System (IQMS) where records revealed that educators inflated their scores. With specific reference to mathematics education, in their paper entitled the DNA that belies the claim…, Mhlolo & Ntoatsabone (2022) articulate meticulously how numbers have been used for two decades in performance reports to conceal a number of deficits which are inherent in the system. Huff (1991) warns us that in fairness to the *statisticulators*, they may be presumed innocent of a desire to deceive, however he opines that as long as the errors remain one-sided, then it becomes difficult to attribute them to bungling or accident. In this case of the Dinaledi Schools the "errors" have remained one-sided for more than two decades now. These findings are supported by earlier findings by Deacon et al. (2009) who carried out a commissioned study for the National Research Foundation (NRF). From a comprehensive analysis of over ten thousand South African research papers Deacon et al. (2009) expressed concern about the prevalence of what they termed the "politics of knowledge", where data had been misrepresented or distorted for political ends.

4.3.3. Reshaping the Test Pool

In South Africa a number of studies have shown that schools can 1) hold learners back in earlier grades and 2) they can downgrade pupils into easier subjects, such as Mathematical Literacy over Pure Mathematics. The Department of Basic Education revealed this during a briefing to the Portfolio Committee on Basic Education about their plans to improve performance and participation in mathematics, science and technology (MST) subjects. Its spokesperson David Hlabane said: "It seems the secret in producing the best matric results in mathematics of highly celebrated provinces like the Western Cape, Gauteng and Free State, was to encourage very few pupils to take the subject. These last three provinces are always celebrated as producing the best but their secret is to get as little as possible number of pupils taking mathematics and to encourage many to take mathematical literacy. As we celebrate them we must understand this. Then we get provinces like the Eastern Cape and KwaZulu-Natal where more than half the learners do mathematics however they are now also copying these three celebrated provinces having fewer learners to take maths so that their pass can also be good."

In his response the African National Congress [ANC] spokesperson Mr. Sayed said: "This is a very incorrect practice and exposes shortsightedness and backward mentality. We will be taking this further in the legislature, we need to get to the bottom of the rot and bring up urgent intervention to save the learners' careers from being jeopardised any further…"

Over the years other studies have also explained the decline in numbers of learners taking mathematics in a similar way where teachers discouraged such participation tactfully. For example Jansen (2019) has always been vocal about a practice he referred to as "culling"—a strategy where weak pupils are systematically prevented from taking certain subjects or from going into the next grade so as to boost pass rates. Considering the steady trend away from Mathematics and towards Mathematics Literacy shown in **Figure 5**, poor performance and the subsequent devaluation of a passing grade in mathematics, this development runs contrary to the needs of the fourth industrial revolution, which requires



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Math	299	290	263	225	226	242	235	264	266	245	234	222	233	259
Math Lit	263	278	281	275	291	324	312	389	362	313	294	299	341	441

Math Math Lit

Figure 5. Learners enrolling for mathematics and mathematical literarcy [2008-2021].

highly competent graduates in the science, technology, engineering and maths areas. Strong performance in mathematics is essential for careers in computing, programming, finance and machine learning.

4.3.4. Cheating

Experience has also shown that teachers can even engage in outright cheating to appear better on the accountability examinations (Mhlanga, 2015). South Africa is not immune to these issues with examples too numerous to list. In some of the schools under investigation parents openly admitted that group copying was "standard practice" and had been going on since 2008 hence "we are not surprised nor flabbergasted because we have always been experiencing this problem". While cheating by students is of global concern what makes the South African variant even more disturbing is that it is teacher assisted. Teacher assisted cheating has become an epidemic with many newspaper articles carrying numerous recounts where teachers were acting as a "united front" in helping pupils to cheat. Despite the introduction of the National Senior Certificate Examination Pledge to curb examination irregularities in 2019, the following year in 2020 the cheating scandal rocked the country and nearly led to a rewrite of certain National Senior Certificate (NSC) examination papers. In the 2021 National Senior Certificate (NSC) exams 57 educators were implicated in the incidents (Department of Basic Education, 2022). In fact a spokesperson from the Independent Institute of Education eloquently stated that: "Every year, without fail, we hear about scores of matriculants whose results are held back, who face criminal charges, who are banned from writing NSC exams for years, and who spend ages in court as a result of cheating." Teacher cheating encompasses a broad range of illicit activities such as changing student responses on answer sheets, announcing the correct answers in the test venue, and teaching students based on knowledge of the questions in the test (Jacob & Levitt, 2003). That teachers work as a united front with students is not only worrisome given that such practices then become more difficult to detect but it also confirms that teachers have interest in the matter. In the 2021 final matric exams, an investigation revealed that some of the educators confessed to helping the learners during exams. That the prevalence of cheating during examinations is considered "standard practice" suggests that the practice is no longer an exception to the rule but the norm.

4.4. The Working Smarter Loop B2 as an Alternative

Consistent with the RS model, the work smarter loop would suggest that in order for South African education to close the persistent performance gap there is need to invest in the improvement of its capability. What constitutes capability in an educational organisation follows Hanushek's (2020) fundamental idea of an educational production function (EPF) where the output of the educational process i.e. the achievement of individual students, is directly related to inputs that are manipulated by teachers and other policymakers as well as those that are not so controlled (Hanushek, 2020). Researchers who have applied the capability approach to educational settings refer to these inputs as conversion factors (Sen, 1993) some of which are internal to the student while other are external. Williams & Williams (2011) place students internal conversion factors as the number one ingredient suggesting that capability should be viewed in terms of what students are able to do. The conversion argument says that these internal converting capabilities are highly diverse among people, which weakens the supporting argument for a resource-based equality" (Bonvin & Farvaque, 2006). Their view was that all the other factors (leadership, material resources, teacher subject matter knowledge) only have an impact on the student outcomes when the student has the potential and is motivated to exploit them. With respect to education this perspective may implicate that total value of resources made available in the course of educational processes should be related to actors different abilities to transform them into baskets of assets which they are then potentially free to make use of (Otto & Ziegler, 2006). Such stocks of (educational) assets are in turn to be related to the conditionality of what Sen (1993) calls "functions of utilization". Therefore from a capability perspective the focus should be on "who can do what, rather than who has what bundle of commodities, or who gets how much utilities" (Sen, 1993)—hence the conversion argument says that the importance of primary goods or resources [external conversion factors] is derivative on the individual capability [internal conversion factors] to convert them into valued functionings. Gustafsson & Taylor (2012) cite a number of previous studies and concluded that resource-based interventions (such as teachers, textbooks, laptops, tablets, PCs, calculators) render better results for more capable learners and that weaker learners are far less likely to enjoy these benefits.

Following such findings, Kennedy (2010) suggested that we have veered too far toward attribution of quality education to other external factors, yet we are overlooking students' fundamental characteristics that may have a strong bearing on the quality of the teaching practice that we see. In fact theories of teaching and learning remind us that, ultimately, teaching is an attempt to change other human beings (students), and that such enterprises cannot succeed unless the students cooperate. This suggests that it is time to look beyond the teacher to the teaching situation itself and especially the student characteristics. Similarly this paper argues that our capability to improve the South African education system does not only reside in the school teachers. Admittedly, teachers matter but there is a critical component of our capability which the system has neglected for decades—the gifted learners. Studies done by Lubinski & Benbow (2021) have confirmed that there is an intellectual elite whose abilities are a crucial ingredient for technological, economic, political, and cultural development. A recommendation coming from such observations is that our future depends crucially on how we educate the next generation of gifted people (intellectual class or smart fraction) especially in the mathematical sciences. So, the view taken in this paper is that gifted children represent a nation's intellectual capability, with the potential to bring creative, innovative solutions to scientific, medical, economic, political, and social challenges (Tanenbaum et al., 2016). Yet in South Africa one school principal interviewed by Oswald & de Villiers (2013) lamented on their neglect:

> I do feel that the gifted learners should come into their right. They are the future of South Africa. We can all try to do something for the child that struggles, but when we think about our future, the gifted child is the one that needs the attention and it does not happen. This is really sad. We all try to throw our rescue buoys for the child who does not want to work, but the child who can really make a difference for the country, this child is ignored. It is a crying shame (principal 8).

The principal's concern about "…*throwing buoys for the child who does not want to work*…" suggests that South Africa, like many other developing countries, seems to be working towards the goal of universal access to education (working harder) at the expense of those who have the potential—the gifted—who are neglected. Today, as innovation and development in the field of economy, technology and industry are rapidly gaining importance, the country needs qualified people with appropriate education to increase and support their knowledge base in this race. These skills cannot be achieved in a haphazard manner and South Africa acknowledges this fact. For example, in its national strategy for mathematics & science the Department of Education (2001) described as a vicious cycle the resultant effect of few learners graduating in mathematics and science. The department suggested this could be better alleviated by focusing on mathematics and science learners with potential in dedicated schools, rather than through a dilution of effort across the whole schooling system (Department of Education, 2001). Lessons from other successful countries are that targeted 21st century skills to be acquired by the students can only come from a deliberate and well structured focus. Therefore South Africa cannot afford to continue throwing mud aimlessly at the wall with the hope that some of it will stick. In the 21st century economy the potential contribution of the gifted and talented to the global economy is becoming increasingly important, which is why policy makers and the leaders of business and finance express a growing interest in gifted education in its various formats. In Europe as well as the United States of America policy makers are urged to meet the needs of their intellectually precocious youth because they represent "extra-ordinary human capital for society at large" (Bleske-Rechek, Lubinski, & Benbow, 2004: p. 223). From this perspective, the gifted have been described as "the world's ultimate capital asset" (Lubinski et al., 2014), and also that they guarantee a constant reservoir of individuals who will lead, both research and development, thus continuing to propel recruitment of the community, the State, and humanity at large toward a knowledge-based economy (Sever, 2011). In many African countries, economic and scientific stagnation is the order of the day because we have never bothered to invest in our intellectually precious youth. This paper argues that the blame shifting game in South Africa with its calls for sanctions and incentives, may be hindering the educational progress of the students with the best potential in mathematics. A Work Smarter Loop would require us to invest in these individuals who will yield high returns for all humanity through their exceptional skills thereby closing this persistent gap between desired performance and actual performance.

5. Conclusion

This theoretical paper was driven by an observation that in South Africa there are not enough youths leaving the schooling system with good results in mathematics and science. This perennial problem puts the country in jeopardy of failing to produce skills relevant for a 21st century knowledge economy. Persistent implementation failure in development, as and when it occurs, is often a product of the deployment of theories of change that inadequately map onto the types of problems they are increasingly being asked to address. This paper was premised on the view that South Africa lacks a theory of change that explicates what principals and teachers need to close the performance gaps in mathematics.

I then proposed Repenning & Sterman's Capability Trap as a simple model that allows one to examine the failure of many process improvement programs.

The paper's main contribution is in its proposal of a theory of change that explains the fundamental attribution error in South Africa's interventions to the persistent problem of poor performance in Mathematics as well as suggesting what needs to be done. Current views on the economics of gifted education suggest that our future depends crucially on how we educate the next generation of people gifted in the mathematical sciences. A work smarter loop suggests the need to put in place well-structured programs for the development of our future human capital—the gifted students.

6. Recommendations

In this paper, I have shown how the work smarter loop suggests that South Africa should take advantage of the potential that resides in the gifted students who are currently neglected by the system. The Singapore education system is a typical example that has been the envy of many nations by going the work-smarter route. After its survival phase post-independence, Singapore's education system abandoned the one-size-fits-all system and progressed into an ability-based phase where the underlying belief was that gifted education must help students to discover their own talents and make the best of those talents for the benefit of society. Further research should be done to understand how successful countries have managed to achieve their goals.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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