POWERING PAKISTAN FOR THE 21ST CENTURY

Volume I of III: How Maths and Science Power Nations

Alliance for Maths and Science Pakistan

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Pakistan Alliance for Maths and Science
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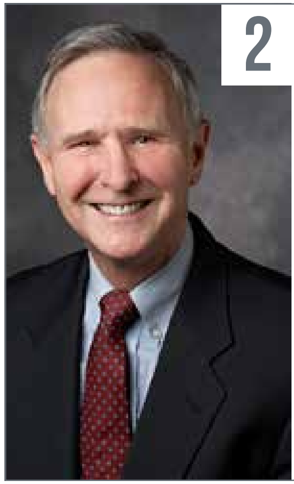
Contents



Acknowledgments

Bismillah hirr Rahmaan irr Raheem.

The Pakistan Alliance for Maths and Science is an informal collective of organisations which believe that the national discourse in Pakistan must begin to privilege maths and science education for the sake of our country's future generations. The alliance's informal stature allows for robust and meaningful internal debates, some of which have helped inform the preparation of this document.

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Executive Summary

In this volume, we attempt to establish the case for school-level maths and science as being instrumental in shaping a bright future for Pakistan.

In Section 1, we present the existing research from Pakistan that makes the link between education and economic well-being. There is a rich stock of research and literature that establishes how additional years of schooling contribute to future economic wellbeing for individuals. There is also clear evidence that the positive effects of education attainment are significantly higher for females compared to males. Finally, there is evidence that the quality of cognitive skills, built through better maths and science teaching and learning, helps dramatically improve returns on education in Pakistan.

In Section 2, we establish the case for quality maths and science education as being much better predictors of economic success for countries than merely enrolment, retention or school attainment rates. We do this based on the large body of work in support of this argument authored by Eric Hanushek, the leading authority on the evidence supporting the idea that maths and science are instrumental in shaping economic growth. The most salient takeaway from Hanushek's work is that a country's collective pool of cognitive abilities (endowed by quality maths and science learning) helps drive economic growth. The evidence presented covers maths and science test score data of students from a cross-section of countries that is collated against national economic growth rates. The results show that cognitive abilities measured through student performance in maths and science affect economic growth much more significantly than total years of schooling.

In Section 3, we explore the changing nature of the world economy, in the context of Pakistan, and examine the evidence from countries that have already identified maths and science as national priorities. The effect technological advancement has had politically, socially and economically is considered, as well as the changing nature of job opportunities and skills required nationally, as well as globally. This section also outlines how different countries the world over responded to these changes.

In Section 4, we argue that maths and science education has a unique significance for Pakistan owing to the unique nature of the country's security paradigm. Human security in Pakistan requires a dramatically improved maths and science education. Various dimensions of security are considered – food security, climate change, population and demographic factors.

In Section 5, we conclude by summarising the various arguments for maths and science, and try to present a coherent case for why this aspect of education deserves financial and political prioritisation. We explore what improved maths and science learning would mean for Pakistani citizens, families and communities as well as the country's overall progress.

About Powering Pakistan for the 21st Century

Powering Pakistan for the 21st Century is a three-volume document compiled by researchers and education activists mobilised by the Pakistan Alliance for Maths and Science, under the patronage of a range of government and non-government organisations.

The purpose of the Powering Pakistan for the 21st Century document is to highlight the importance of maths and science education in Pakistan's classrooms, especially those in government schools, (including publicly-funded schools), where the least privileged of this country's children study.

Volume I is titled "How Maths and Science Power Nations". In this volume, we present the case for maths and science as being essential informants of a nation's progress and prosperity.

Volume II is titled, "The State of Maths and Science in Schools". In this volume, we will present a summary of the effort being invested in maths and science, and the results being achieved with those investments. We will also explore why the state of maths and science education is what it is, and how the status quo has come about.

Finally, Volume III is titled, "A Roadmap for Maths and Science Education". In this volume, we will present a series of ideas and recommendations that can help Pakistan, as a state and as a society, re-orient public policy and private investment decisions, to serve a brighter, more prosperous and more secure future.

"POWERING PAKISTAN FOR THE 21ST CENTURY"

Volume I is titled "How Maths and Science Power Nations"

Volume II is titled, "The State of Maths and Science in Schools"

Volume III is titled, "A Roadmap for Maths and Science Education"

In this volume, we attempt to establish the case for school-level maths and science as being instrumental in shaping a bright future for Pakistan.

The basic driving motivation for the preparation and presentation of this document is to stir wide-scale public interest and engagement with maths and science education, and to ensure that the quality of learning—in government schools, (including publicly-funded schools) especially—becomes a critical informant of how decisions of funding, recruitment, measurement, rewards and punishment are made by the public sector.

Maths and science education is critical in developing the cognitive skills needed for citizens to begin to assert their rights, and take advantage of the privileges they are afforded. These skills are critical in enabling day to day activities. It is also important to remember that the focus of this document on maths and science does not in any way suggest that other subjects, especially language, are not critical informants of improved learning outcomes. Volume II, which will address the current state of affairs, and Volume III, which will map a path forward, will both deal more fully with the issue of language being an essential building block for maths and science.

Pakistan enjoys a confluence of a unique demographic profile, and a unique geo-strategic importance. These advantages can serve to transform the quality of life for the millions of Pakistanis that are disadvantaged and underprivileged. The quality of maths and science instruction in Pakistani classrooms, and the depth and breadth of improvements in maths and science learning will be instrumental in Pakistan's response to the epochal opportunities available to Pakistan. "Powering Pakistan for the 21st Century" is an effort to frame the challenge, and identify the path forward to ensure that Pakistan's response to its demographic and geopolitical opportunities generates the highest value for the largest number of Pakistanis possible.

1 Does education make a difference in Pakistan?

A reasonably diverse body of work on educational outcomes in Pakistan—that relies on a range of time-horizons, a variety of data sets, and varying methodologies—agrees that there is a positive link between education and individual economic well-being. In this section, we present the existing research from Pakistan that makes the link between education, and economic well-being.

1.1 The problem of parental agency and rational choice

One of the most common refrains employed in discussions about the very substantial number of out of school children in Pakistan is that many families, especially those that are poor and vulnerable, are making a rational choice to not send their children to school. The argument being that if the returns on getting an education were to really exceed the returns from not getting an education, parents would happily choose school over any other kind of activity that out of school children engage in (including under-age employment).

This argument has an instant appeal because it is simple. And yet it is exactly its simplicity that needs to be interrogated. It is hard to argue that individual actors, even the poorest and most vulnerable, are not rational. It is also hard to pretend (although it is commonly pretended), that anyone other than a child's parent(s) can know what is best for that child.

We must, however, recognise the complex problem posed by the argument of rationality being the basis for choosing not to educate. The pretence that parents face a binary choice between schooling, and not schooling is a weak one. All schools and classrooms are not equal.

We know this to be true even at the most macro-level of analysis possible, as Pakistan is home to at least five different mainstreams of education, namely high cost private schools, medium and low-cost private schools, government schools, and madrassahs.
In the case of an out-of-school child, are rational parents eschewing free of cost government schools, or are they eschewing high cost private schools? Of course, we know that there are millions of children whose parents are not choosing at all, as they are

This report argues that the quality of maths and science education is integral both to Pakistan's prospects as a nation, and to the prospects of its millions of children.

too poor, live too far away, and suffer too much information asymmetry to have any say in the matter at all. Millions more are choosing to eschew what they perceive to be a low-quality, and low-return education. Many more, eschewing one kind of low quality education for another. These are all rational choices, but they aren't being made on a level playing field. Pakistan's problem of out of school children is not because Pakistani parents don't want to educate their children. It is because Pakistani parents are probably wiser and more sagacious than we like to give them credit for being. Pakistani parents, especially those that are poor and vulnerable, probably know the difference between just being enrolled in school, and actually getting an education that will generate substantial future value. They probably know the difference between education for the sake of an education, and a quality education. It is time for Pakistan's federal government, and the governments of the four provinces, of Azad Jammu and Kashmir (AJK), of Gilgit-Baltistan (GB), of the Islamabad Capital Territories (ICT), and of the Federally Administered Tribal Areas (FATA) to match the wisdom and sagacity of the Pakistani people. It is time for our education discourse to recognise the integral role of quality in the decisions that parents and their children make every day all across the country about whether to enrol or not to enrol, to attend or not to attend, and whether to stay or to drop out. We believe that the starting point for this recognition is the importance of cognitive skills, especially as manifest in the learning of maths and science.

This report argues that cognitive skills, especially as developed through the quality of maths and science education, is integral both to Pakistan's prospects as a nation, and to the prospects of its millions of children. However, before we can make a persuasive argument for the importance of maths and science to the future of the country, we must first establish that there is any link at all between education, and the concept of future returns. Luckily, there is a reasonable body of work by academics and researchers that helps us make this case.

1.2 The research on returns to education in Pakistan

There is an extensive body of work exploring returns to education in Pakistan. The following are some prominent studies that have attempted to investigate the linkage between years of schooling and income levels. They consistently show that schooling improves the income of students later in life, especially for women.

1.2.1 Gender in School Enrollment & Returns to Education, Qureshi (2012)[2]

This study uses data from Pakistan Social and Living Standards Measurement Survey (PSLM) 2005-06 to determine returns to education for males and females in Pakistan. The findings of the study show that returns to education increase with an increase in the level of education from primary to secondary, and from secondary to tertiary, for both males and females. The overall returns are incrementally higher for females than for males. Overall, each year of schooling improves income by 6 percent.[3]

The Gender Differences in School Enrolment and Returns to Education in Pakistan

Madeeha Gohar Qureshi
Pakistan Institute of Development Economics, Islamabad

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS ISLAMABAD

1.2.2 New Evidence on Rates of Returns to Education, Ashraf (2011)[4]

This study uses data from Pakistan Integrated Household Survey (PIHS) 2001-02 to compute returns from different levels of education. The findings of this study also confirm that returns to education are higher for females than for males at the lowest level of schooling. The returns for females are 13 percent which is considerably higher than 5 percent for men. Based on the results, the study recommends that policy makers should devote more resources to female education.[5]

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NEW EVIDENCE ON RATES OF RETURN TO EDUCATION IN PAKISTAN

Javed Ashraf, University of St. Thomas

ABSTRACT

Relatively few articles have examined the rates of return to education in Pakistan in recent years. This paper uses data from the 2001-02 Pakistan Integrated Household Survey to compute returns from different levels of education. Returns to education are found to be higher for females than for males at the lowest level of schooling. The results presented here support the findings of other researchers. In addition the result have significant policy implications for educators and policymakers.

JEL: J24; J31

1.2.3 Mincer Human Capital Model in Pakistan, Abbas & Foreman-Peck (2007)[6]

This study uses data from the Pakistan Social and Living Standards Measurement Survey (PSLM) 2004-05. The results are similar to other studies. It finds the rates of return consistently higher for females than males.[7]

The Mincer Human Capital Model in Pakistan: Implications for Education Policy

Qaisar Abbas
James Foreman-Peck

This article estimates and interprets returns to education for three sub-sectors of the labour market, by gender, in Pakistan, using the most recent data set of the Pakistan Social and Living Standards Measurement (PSLM) Survey, 2004–05. The results show two distinctive features of Pakistani education: the high apparent returns to female education outside agriculture and the remarkable increase of returns with successive levels of education, which are to be explained primarily by two departures from the basic Mincer model—generally poor quality primary schooling and family unwillingness to invest in female education because of a lack of earning opportunities. There is some signalling in Pakistani education investment, but the education is mainly a productivity-enhancing investment in human capital, according to a comparison of self-employed and paid employed earnings equations. Returns to the public spending of education are extremely high, suggesting considerable state underinvestment. The policy challenge is in the low wages and high education in the female paid employment sector, and the low participation rate.

1.2.4 Wage Differentials, Rate of Return to Education, Hyder (2007)[8]

This study uses data from the Labour Force Survey (LFS) 2001-02. It defines seven levels of education in order to compute the rate of return to each, relative to the preceding level. According to the findings, the gains range from 1.5 percent for primary education to 9.23 percent for professional education.[9]

1.2.5 Education Gender Gaps in Pakistan, Aslam (2007)[10]

Education Gender Gaps in Pakistan:
Is the Labor Market to Blame?

MONAZZA ASLAM
University of Oxford

This study uses four statistical methods to estimate the rates of return to education for males and females using the Pakistan Integrated Household Survey (PIHS) 2001-2002. It finds that the estimated return to additional years of education ranged between 7 percent to 11 percent for men, and between 13 percent to 18 percent for women.[11]

1.2.6 The Effect of Education, Experience and Occupation, Nazli (2004)[12]

Hina Nazli 1

The Effect of Education, Experience and Occupation on Earnings: Evidence from Pakistan

Hina Nazli*

This study uses data from the Pakistan Socio-Economic Survey (PSES) 1998-99. It employs a two-stage stratified random sampling design to select a sample of 3,564 households and then examines the effect of education, experience and occupation on individual earnings for wage earners and salaried individuals. It finds that the education-experience interaction had a positive and significant impact on earnings.[13]

1.2.7 Education and Earnings in Pakistan, Nasir and Nazli (2000)[14]

This study uses data from the Pakistan Integrated Household Survey (PIHS) 1995-96. It examines the effect of education and school quality on the earnings of wage earners and salaried individuals. The study concludes "the analysis confirms the positive role of education, as each year of education brings approximately 7 percent returns for wage earners".[15]

1.3 Evidence from rural Pakistan in the early 1990s

A group of researchers lead by Jere Behrmann and David Ross have published two studies to investigate the returns to education in rural Pakistan determined by the quality of education received in schools. These two studies provide significant insight into the relationship between education quality and economic returns, a theme that hasn't received enough attention owing to the relative unavailability of reliable data. These studies provide an alternate lens to view returns to education as linked to quality instead of the conventional variable of 'number of years in school'. This work highlights the significance of measuring quality as opposed to just the number of years of schooling. Cognitive achievement resulting from quality education is the desirable output while enrolment (number of years) is one of multiple inputs that go into making the educational experience more enabling.[16]

The first study was published in 1996 using data collected through a panel rural household survey from 1986 onward. The survey was conducted by International Food Policy Research Institute with support from the Ministry of Food and Agriculture. The human capital component of the survey that feeds into bulk of the analysis presented in the study was conducted from 1989 through the early and mid-nineties. The study used results of tests specifically designed to measure cognitive achievement among children over nine years of age with at least four years of schooling. The second study by Behrmann et al. published in 2006 uses the same data to follow up on earlier work exploring the link between cognitive achievement and economic returns in rural Pakistan. This study examines and compares the difference between rate of return for years of schooling and education quality. It explores the trade-off for governments between investing heavily in establishing new schools to drive up enrolment and improving the teaching quality in the existing ones to improve cognitive achievement among students.

The most significant conclusion from the work of Behrmann, Ross et al. is that cognitive achievement among students can deliver substantially better economic outcomes than years of schooling alone. "*The impact of cognitive achievement on wages is substantial with one standard deviation increase in cognitive achievement implying an increase of over 20 percent in wages.*"[17]

Both studies conclude the significant impact of education quality on an individual's earning potential in the future, "*Increasing the quantity and improving the quality of schooling are alternative potential means of increasing the productivity and earnings of the labour force".*

Additionally, they note that the actual returns on education may be even higher than they have calculated as their original data did not account for the significant expansion of private provision of education across the

THE RETURNS TO ENDOGENOUS HUMAN CAPITAL IN PAKISTAN'S RURAL WAGE LABOUR MARKET

Harold Alderman, Jere R. Behrman, David R. Ross and Richard Sabot

I. INTRODUCTION

Developing country governments spend over $100 billion a year on education, health, and other human capital investments. Thus it is important to determine the returns to these investments. Aggregate cross-country estimates and micro-studies suggest that the productivity effects of human capital investments in the developing world often are considerable.[1] Most of these studies focus on schooling, but some of them indicate that the returns to investment in health and nutrition also are large.[2]

In this paper, we focus on three problems in the literature on the

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Improving quality versus increasing the quantity of schooling: Estimates of rates of return from rural Pakistan

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This paper is dedicated to the memory of Richard Sabot, who contributed substantially to it in particular and more generally to the larger project of which it is a part before his untimely death on 6 July 2005

A reasonably diverse body of work on educational outcomes in Pakistan—that relies on a range of time-horizons, a variety of data sets, and varying methodologies—agrees that there is a positive link between educational attainment and individual economic wellbeing.

country, "*This means that estimates, based on the conditions of the late 1980s and early 1990s, probably underestimate the private and social returns to increased middle schooling by not anticipating the expansion of private schools based largely on publicly-schooled female labour force, nor the possible pressure on public school costs and efficiencies due to the expansion of the private school system.*"

On the whole, this evidence from Pakistan is reasonably compelling, though limited because of both the rural setting of the data it is based on, and the era in which it was collected. Still, the findings are consistent with international experience: there are substantial returns to a quality education, and the better quality education a child receives, the greater the likelihood that the child will grow up to be an adult with a substantially higher income than peers who did not receive a quality education. Similarly, Pakistan accrues aggregate economic and social benefits from better cognitive skills delivered through a quality education.

1.4 The consensus on returns to education in Pakistan

A reasonably diverse body of work on educational outcomes in Pakistan—that relies on a range of time-horizons, a variety of data sets, and varying methodologies—agrees that there is a positive link between the number of years of schooling and individual economic well-being. The collective evidence also generates two broad areas of consensus about the nature of this positive relationship. First, that on average each year of education increases income levels by at least 5 percent, and second that the returns to education are higher for females than males.

Furthermore, Pakistan is one of very few developing countries for which there is evidence of links between an education that develops cognitive skills, and the social returns on such an education. There is evidence that better quality education leads to as much as a 20 percent improvement in wages. More research is needed to help answer the critical questions that emerge in a resource-constrained environment like Pakistan, but under all circumstances, investing in quality leads to positive private and social returns.

This evidence-based consensus is a vital platform from which we must evolve a perspective on maths and science education that will power Pakistan for the twenty-first century.

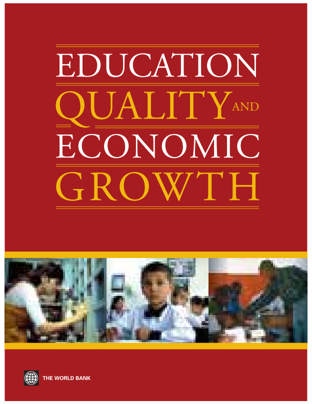
2 Unequal schools, classrooms & systems: The Hanushek Distinction

The research for Pakistan shows across several different methodologies, time horizons and data sets, that annual income for individuals increases by roughly 5%, for each additional year of schooling. The world average is 10% , which indicates that returns in Pakistan are significantly lower than elsewhere. There is not enough research that explores why Pakistani returns to additional years of schooling are lower than the world average. Our theory? The low quality of maths and science education in Pakistan limits the potential returns on education. We cannot state this to be the case conclusively without evidence. However we can support the theory with what we would term as the “Hanushek Distinction”.

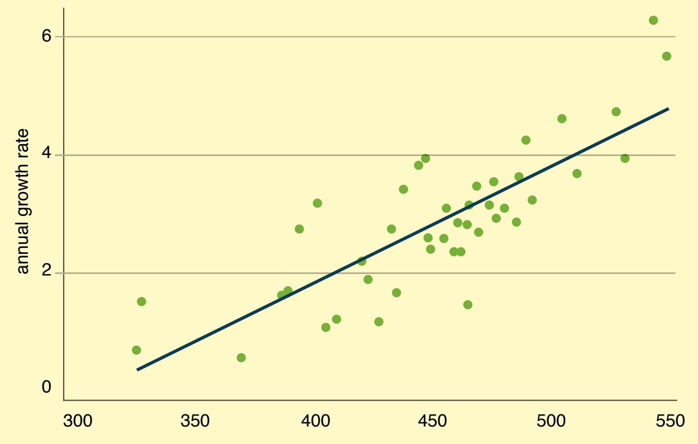
Eric Hanushek is the Paul and Jean Hanna Senior Fellow at the Hoover Institution of Stanford University. His academic work focuses on the economic analysis of educational issues. He has authored twenty-three books along with over 200 articles. He completed his Ph.D. in economics at the Massachusetts Institute of Technology. In recent years, Hanushek’s work has become the gold standard for analysing the impact of education on a national scale, especially in terms of economic growth. His most widely cited finding is that it is educational quality, and not just educational engagement (i.e. going to school, or staying in school) ,that is the big difference maker in any credible story of serious and sustained national economic growth. As a country that seeks to develop, deepen and sustain a narrative of national growth, Pakistan’s education discourse must be powered by a serious examination of Hanushek’s findings and how they may help the country chart a path forward for the twenty first century.

Among Hanushek’s many insightful findings, there are five broad conclusions of immense importance to Pakistan.

First, there is irrefutable evidence from across the world, and across various time horizons which proves that cognitive skills boost both individual incomes, and aggregate national economic growth



Growth and Mathematics Achievement, 1960-2000[20]



1. There is irrefutable evidence from across the word that cognitive skills boost individual incomes, and aggregate economic growth
2. Cognitive skills, as measured by learning achievements—especially in mathematics, science, and reading, are better at spurring national economic growth, than years of schooling alone
3. Quality of schools is integral in attempting to improve the quality of education being provided
4. The way in which quality is measured, especially in terms of inputs is inadequate to help produce better cognitive skills
5. Economic growth accruing from improved educational quality for middle income countries, is higher than for high-income countries

Second, that cognitive skills, as measured by learning achievements—especially in mathematics, science, and reading, are better at spurring national economic growth, than years of schooling alone.

Third, that the quality of schools is integral in attempting to improve the quality of education being provided—public policy that focuses on school quality tends to deliver better results.

Fourth, that the way in which quality is measured, especially in terms of inputs (such as teacher attendance, or money allocated) is inadequate to help produce better cognitive skills that would spur improvements in individual earnings, or in national economic growth.[19]

Five, the economic growth accruing from improved educational quality for middle income countries, countries is higher than for high-income countries.

2.1 Better quality education boosts individual & national income

The most consistent and forceful conclusion that Hanushek's work draws from evidence across time, space and various contexts is that no matter what country we examine, or what time-frame/era we examine, or what stage of development a country is at, we find that a country's stock of cognitive skills helps boost both the individual incomes of citizens, and the aggregate national income of that country. There are many qualifiers that Hanushek offers to temper over-zealous interpretations of this, including three in particular:

First, real and meaningful reform that reorients public policy towards delivering cognitive skills to the children of a country (through better maths, science and reading) is an incredibly challenging political proposition. Only countries capable of making difficult decisions are able to truly take advantage of the "Hanushek Distinction".

Second, reform takes a long-time, even if it has the right magnitude of political will behind it. Many of the projections Hanushek makes are framed in time-frames of 10, 20, and 30 years. In addition, improvements of one standard deviation are not trivial, they represent huge leaps—often not found outside very, very exceptional cases. Even small improvements in maths and science scores take many years, and they only deliver better economic outcomes over a long period of time.

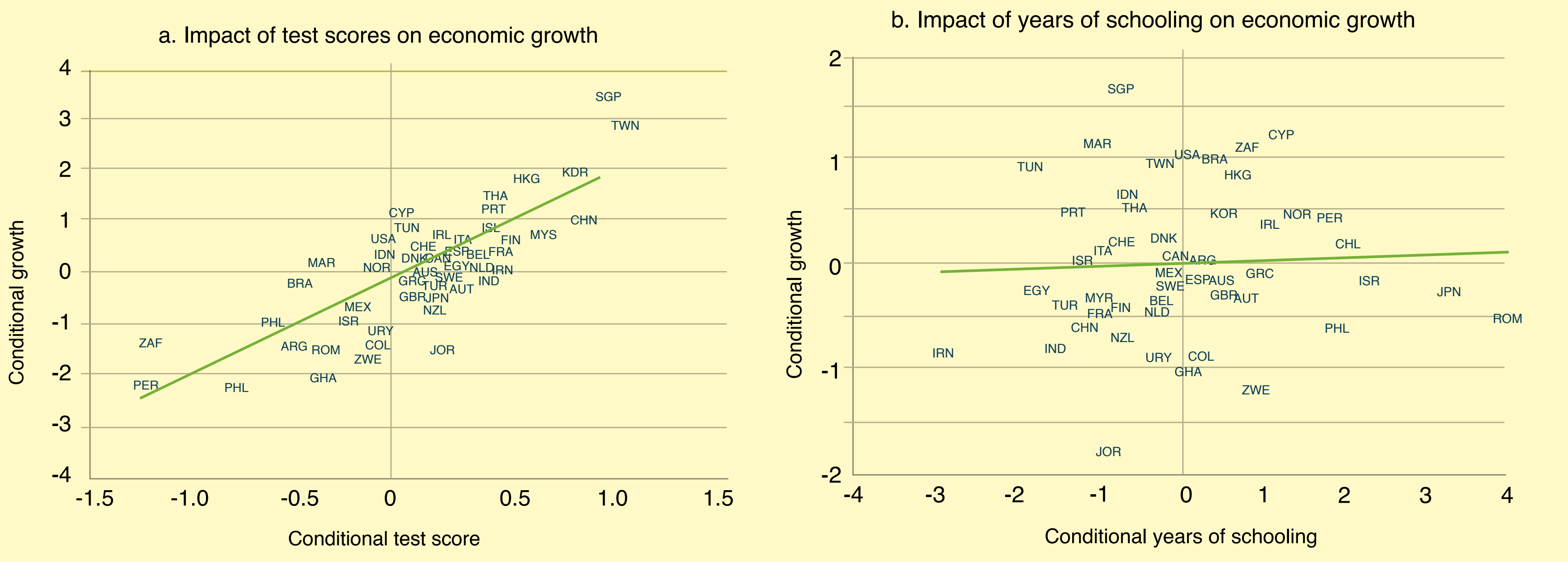
Third, there is often not enough data available to policy makers, especially those that work in countries that have the most to gain from better math and science scores, i.e. developing countries like Pakistan, that could be on the cusp of transformational economic change, but aren't quite there yet.

The plus side of course, is that for those countries able to improve their scores, for example in maths achievement tests, economic growth is an observed outcome across dozens of countries.

2.2 Cognitive skills are better at improving national growth than years of schooling alone

Hanushek's research shows that the quality of educaton is a better predictor of economic growth, compared to the number of years of schooling. The two graphs above show the contrast in the relationship between the quality of eduation (as measured by test scores) and the number of years of education, with economic growth. Data from a cross-section of countries shows that economic growth is more significantly correlated with

Test scores, as opposed to years of schooling have a powerful impact on growth [22]



test scores (measure of quality) than with number of years of schooling. "In the graphs above, first one has a much steeper slope than the second indicating that the quality of education (as measured by better maths and science test scores) is likely to be a stronger guarantor of national economic growth than the number of years of education.

2.3 School (and teacher) quality is integral to developing cognitive skills

Hanushek's research reinforces the importance of good schools as being at the heart of any meaningful reform that seeks to enable cognitive skills being drivers of economic growth. Whilst good schools and by definition therefore, good teachers, being central to improved education outcomes seems obvious, the implications of this theme in Hanushek's work goes far beyond the superficial. Good schools have qualities that make them unique and distinct. For example, a good school is much better at retaining students year to year, than a bad school. This means that retention and school attainment (the number of years of schooling) figures often understate the importance of quality – without a relatively better quality of education, better retention and attainment numbers are harder to achieve. Additionally, the project of establishing and sustaining good schools tends to be one in which local ownership and engagement in management and administration of schools is high. Central policy and standard setting are common in many successful countries, but schools that are run via remote control, from great distances, tend to have a lower chance at being high quality schools.

2.4 Existing policy tools for quality education are inadequate

Hanushek has a wealth of experience in assessing the state of education in developed and developing countries and has thus been able to identify some of the analytical challenges embedded in the very structures of developing countries like Pakistan. A focus on enrolment and years of

A good school is much better at retaining students year to year, than a bad school.

The quality of education reflected by test scores in maths and science has a much stronger effect on lower income economies.

Improving individual and national incomes through better cognitive skills requires the pursuit, development and adoption of much better ways of measuring both what goes into a system and what comes out.

schooling (attainment) is partially informed by the plethora of "easy" metrics that lend themselves to measuring things like enrolment and attainment. Among such metrics are budgetary allocations—which may tell us how much money is being allocated, but not how much was spent, or more importantly what it was spent on, and how it informed cognitive skills. He identifies teacher attendance as a particularly vexing policy metric that, whilst useful in determining whether a teacher is in school or not, during working hours, tells us nothing about her or his ability to impart maths or science concepts or the aligned cognitive skills. With poorly constructed metrics like teacher attendance often being used as proxies for teaching quality, the attendant output and outcome metrics also suffer and policymakers are forced to make decisions based on data that often does not tell us what we actually need to know. Improving individual and national incomes through better cognitive skills requires the pursuit, development and adoption of much better ways of measuring both what goes into a system and what comes out. One important potential pitfall in formulating metrics that really work is the allure of using data as a punitive measure, to punish low performance, either by students or by teachers. System-wide improvements must be focused on generating improved learning outcomes, rather than extracting vengeance for poor performance.

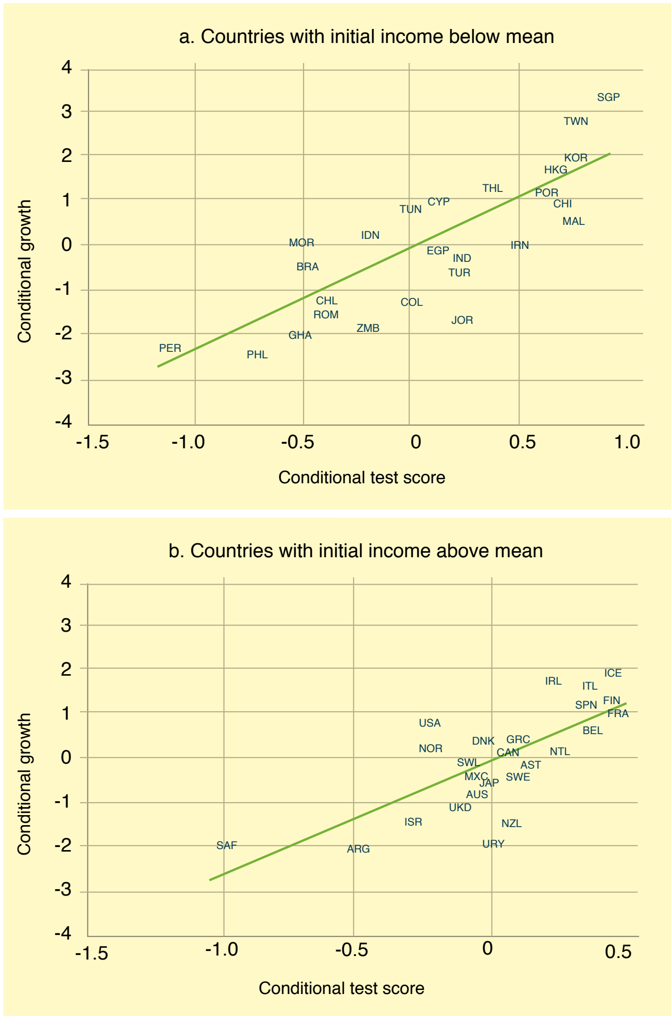
2.5 Quality education has a greater impact for developing economies

The quality of education reflected by test scores in maths and science has a much stronger effect on lower income economies. The data used by Hanushek and Wossman considers countries whose national income is lower than the total mean, as well as countries whose national income is higher than the total mean. The quality of education is shown to have a stronger positive effect on the economic growth of countries whose national income is lower than the mean. This means that lower income countries have a greater absorptive capacity for an improved focus on maths and science education than high income nations. The slope of the first graph given is steeper than the second indicating the national economic returns to quality maths and science education for developing countries is higher than developed countries.

2.6 Defining The Hanushek Distinction

Hanushek's research essentially demands a substantial revisiting of traditional thinking around education policy on the basis of the potential contribution education can make to the national economic growth. The traditional approach to education privileges access, and this is where the centre of gravity for the Education For All (EFA) agenda, and subsequent efforts to ensure universal enrolment are located. Hanushek's research suggests that whilst enrolment, retention and the number of years of schooling (attainment) do contribute to economic growth, the returns to education only truly begin to pay for themselves when there is a systemic privileging of learning outcomes in reading, maths and science. In other words, without improving the stock of a population's cognitive skills, countries may essentially be wasting the opportunity to engage in transformational economic growth. The Hanushek Distinction therefore would be the ability of a country's policymakers to distinguish themselves by choosing to commit to the politically challenging, long-term process of improving education quality

Test scores influence growth in both low and high income countries



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Whilst enrolment, retention and the number of years of schooling (attainment) do contribute to economic growth, the returns to education only truly begin to pay for themselves when there is a systemic privileging of learning outcomes in reading, maths and science.

– especially by engaging in improved maths and science education. Only by adopting the Hanushek Distinction can a country, especially a developing or middle-income country like Pakistan, truly take advantage of the tremendous economic potential of education. Since most countries already have fully functioning, suboptimal systems of education, the Hanushek Distinction demands neither overnight reforms, nor the building up of brand new stocks of infrastructure or people. It simply demands a consistent and unrelenting focus on improved maths and science learning for all children. We believe that the adoption and adherence to the Hanushek Distinction can serve as a distinguishing policy measure for Pakistan—helping to truly put into action, the vast and untapped potential of the country and its two hundred million people.

3 Learning from others for maths and science

3.1 A brave new world

A steady barrage of profound advancements in technology in the last decade and a half have begun to alter the economic, political and social landscape across the entire world, and especially in Pakistan. These changes are relatively easy to acknowledge in rhetoric, and even in pronouncements of policy intent, such as in political party manifestoes and speeches. They are dramatically harder to quantify, and they are extremely difficult to prepare for. A number of efforts at the international level however are helping countries around the world to get a perspective on what technology advancements are doing to economies and societies. The conversations that have helped countries prepare for the future, however, all began in the past.

3.1.1 Changing skills for changing times

The changing landscape of the global economy has been on the radar of the highest levels of economic policy-making for several years. In testimony before the Committee on Education and the Workforce of the U.S. House of Representatives, former Federal Reserve Bank Chairperson, Alan Greenspan spoke at length about the economic importance of improving math-science education on September 21, 2000. He said:

"The proportion of our (American) workforce that created value through intellectual endeavours, rather than predominantly through manual labour, began a century-long climb. In 1900, only one out of every ten workers was in a professional, technical, or managerial occupation. By 1970, that

"The proportion of our (American) workforce that created value through intellectual endeavours, rather than predominantly through manual labour, began a century-long climb. In 1900, only one out of every ten workers was in a professional, technical, or managerial occupation. By 1970, that proportion had doubled, and today those types of jobs account for nearly one-third of our workforce"

- Alan Greenspan

Sector of GDP	1960	2010
Agriculture	43%	21.5%
Industry	15.6%	25.2%
Services	39%	53.3%

Annual Growth Rates of Pakistan's Sectors, 1975-76 to 2009-10

Sector	Growth Rate
Agriculture	3.63
Mining and Quarrying	5.99
Manufacture	6.31
Construction	3.86
Electricity and Gas Distribution	5.46
Industry	5.72
Goods	**4.96**
Transport, Storage and Communication	5.07
Whole Sale and Retail trade	4.95
Finance and Insurance	6.80
Ownership of Dwellings	5.19
Public Admn and Defense	4.84
Social and Community Services	6.52
Total Services	**5.46**

Source: Economic Survey of Pakistan (Various Issues).

proportion had doubled, and today those types of jobs account for nearly one-third of our workforce".[26]

These represent relatively dramatic changes to the economy of the United States, but because most technologies do not require passports to cross national boundaries, these changes have influenced and affected every country on the planet. Though the depth and breadth of economic and household data is not as rich in Pakistan as it could be, there is compelling evidence that these changes have affected the country profoundly.[27]

There is a robust debate about the source of these profound changes, but economists agree that higher domestic consumption has helped drive the much larger share of services in the economy than previously. What kinds of skills are required to cater to this growth? The data suggests that cognitive skills are vital, with finance and insurance being the highest growth sector in Pakistan over the last three decades.

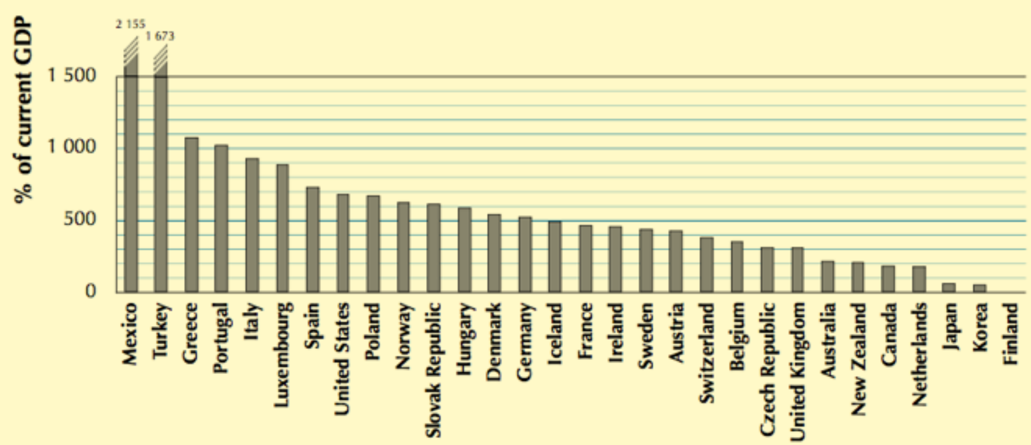
The data thus shows that the direction of travel for the Pakistani economy is largely the same as the rest of the world's: a greater emphasis on individuals that can deploy cognitive ability in the service of economic activity. Indeed, policymakers in Pakistan are broadly conscious of this trend, and a host of policy efforts, from proactive infrastructure development like the China-Pakistan Economic Corridor (CPEC) to more passive policy articulation, like the Vision 2025.

3.2 The analytical platform

3.2.1 OECD's The High Cost of Low Performance

The Organisation for Economic Cooperation and Development (OECD), which was originally conceived as the implementing multilateral agency for the post WWII Marshall

Plan, has a substantial practise for education and education cooperation among member states. In addition to the Programme for International Student Assessment (PISA), the triennial international survey evaluating education systems worldwide by testing the skills and knowledge of 15-year-old students, the OECD also conducts regular analytical work to help frame lessons and define ways forward. In 2010, the OECD published a seminal study called, "The High Cost of Low Educational Performance: The Long-Run Economic Impact of Improving PISA Outcomes" (whose principal author, unsurprisingly, was Eric Hanushek). This study helped establish the importance of quality education as a norm for public policy in OECD countries—using Finland's sustained success in education reforms and PISA outcomes, as a barometer. The study establishes a variety of metrics to assess potential returns to improved cognitive skills including estimating that a 50 point higher



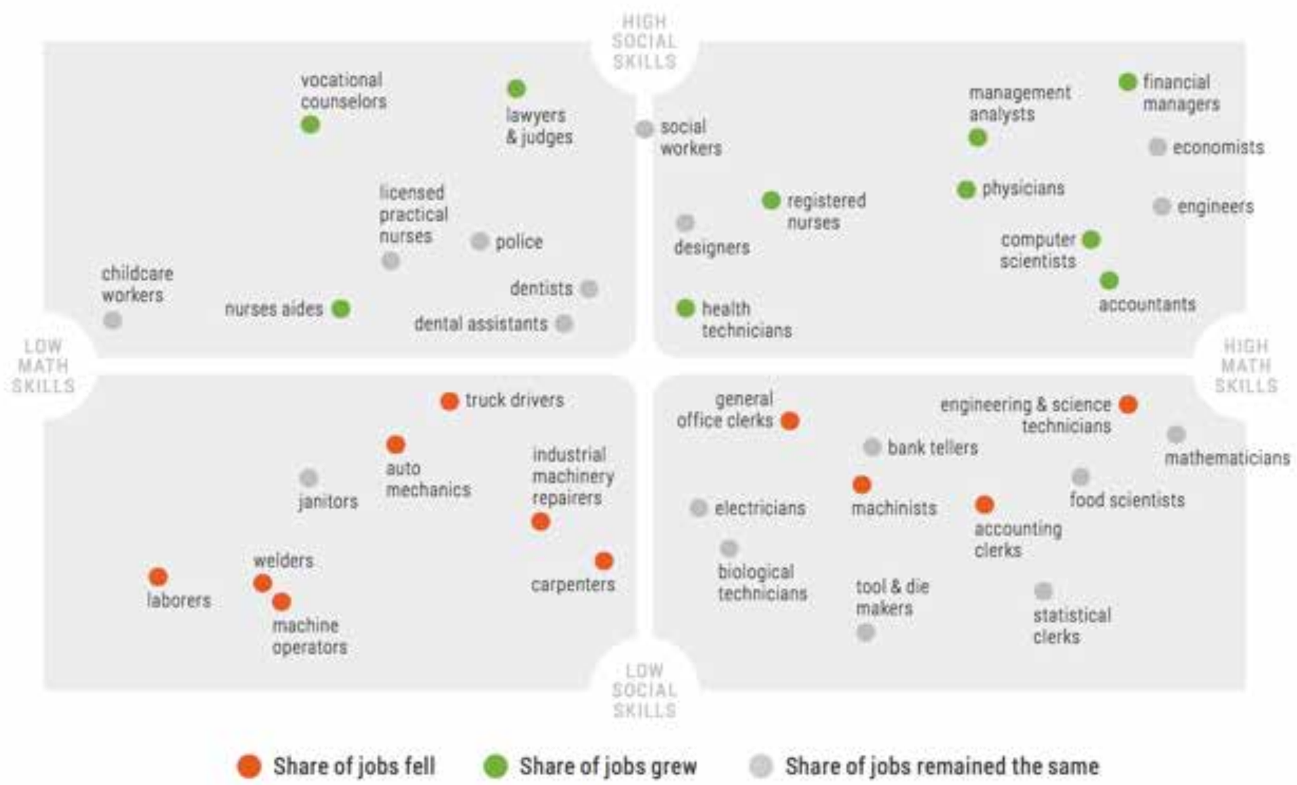
Note: Discounted value of future increases in GDP until 2090 due to a reform that improves student performance in each country to reach the level achieved by Finland, at 546 points on the PISA 2000 scale (average of mathematics and science in 2000, 2003 and 2006), expressed as percentage of current GDP

average PISA score (i.e., one-half standard deviation) would be generate a 0.87% higher annual growth. Among the many compelling arguments made in the document, the one that has the greater relevance for Pakistan is the net GDP growth impact on countries accruing from PISA improvements that help take countries to the same level as Finland.

The graph above was presented in the document to show improvements in percentage of GDP terms of OECD countries if student performance in each by country was to reach the level achieved by Finland.

3.2.2 ICFGEO's The Learning Generation

The International Commission on Financing Global Education Opportunity (ICFGEO) was set up under the stewardship of former UK Prime Minister and global education advocate, Gordon Brown. Its purpose is to advocate for higher allocations for education, both by developing countries themselves, and by the international assistance structures of developed countries. In 2016, the Commission issued a new report titled, "The Learning Generation: Investing in Education for a Changing World". This report is focused on the quantum of funding that is needed to improve current education practices, yet it also projects for future needs and articulates a reasonably comprehensive set of parameters for what



Source: World Economic Forum (2016). US Department of Labor data; changes in the share of jobs from 1980 to 2012.[v14] Note: The position of an occupation on the x and y axes reflects the intensity of math and social skills required.

is needed to prepare tomorrow's generation for the challenges of the future. One the most important representations made in this report is the changing nature of what the marketplace demands in terms of skills, and the evolution of those needs.

The message is clear: jobs that require high levels of maths skills, and high levels of social skills are growing. Jobs that require lower levels of maths and social skills are shrinking. Without creating schools, and supporting teachers that contribute to the growth of a country's stock of cognitive skills, countries will find themselves incapable, both of taking advantage of the opportunities afforded to them, and of keeping up with the basic needs of their people.

3.2.3 WEF's The Future of Jobs

The changing nature of jobs theme in the Learning Generation report is adapted from the World Economic Forum's 2016 report titled, "The Future of Jobs". It projects dramatic growth for highly developed cognitive skills, and a corresponding shrinking of the window of opportunity for those that can only offer brute strength or manual labour to the marketplace. The report states:

"*The overall scale of demand for various skills in 2020, more than one third (36%) of all jobs across all industries are expected by our respondents to require complex problem-solving as one of their core skills, compared to less than 1 in 20 jobs (4%) that will have a core requirement for physical abilities such as physical strength or dexterity"*.[28]

The collective implication of these seminal reports points in the same direction as the Hanushek Distinction: any country with serious designs on transformational economic growth MUST invest in enabling its people to have ever-improving cognitive skills through a school system that consistently succeeds in imparting proficiency in maths and science

Jobs that require high levels of maths skills, and high levels of social skills are growing. Jobs that require lower levels of maths and social skills are shrinking.

Quality of maths and science education

How would you assess the quality of maths and science education in your countries' schools (1 – Poor; 7 – Excellent) 2011-12 weighted average

1	Singapore	6.31
2	Finland	6.213
3	Belgium	6.18
4	Switzerland	5.83
5	Korea Rep	5.55
6	Hong Kong	5.37
7	Netherlands	5.37
8	Canada	5.32
9	United Arab Emirates	5.17
10	Malaysia	4.98
11	Australia	4.86
12	France	4.86
13	Japan	4.75
14	Jordan	4.69
15	Germany	4.66
16	India	4.66
17	Ireland	4.66
18	China	4.61
19	Ukraine	4.59
20	Sweden	4.57
21	Saudi Arabia	4.52
22	Denmark	4.49
23	Hungary	4.48
24	United Kingdom	4.45
25	Austria	4.42
26	Indonesia	4.39
27	United States	4.32
28	Russian Federation	4.29
29	Morocco	4.26
30	Greece	4.23
31	Romania	4.19
32	Bahrain	4.18
33	Norway	4.18
34	Vietnam	4.15
35	Poland	4.18
36	Thailand	4.11
37	Italy	4.08
38	Kenya	3.88
39	Czech Republic	3.84
40	Kazakhstan	3.80
41	Slovak Republic	3.80
42	Pakistan	3.68
43	Israel	3.67
44	Nigeria	3.64
45	Ghana	3.63
46	Portugal	3.59
47	Spain	3.55
48	Philippines	3.55
49	Turkey	3.52
50	Kuwait	3.44
51	Colombia	3.41
52	Bangladesh	3.18
53	Argentina	3.11
54	Chile	3.03
55	Venezuela	2.80
56	Tanzania	2.79
57	Mexico	2.76
58	Panama	2.76
59	Brazil	2.56
60	Egypt	2.25
61	Peru	2.15
62	South Africa	1.99

Source: World Economic Forum

at the primary, middle and secondary school levels.

3.2.4 How Pakistan is perceived in this changing world

In 2012, the World Economic Forum published a study titled, "The Financial Development Report" which examined the financial sectors of 62 countries and explored how well prepared those countries were to take advantage of new opportunities in global and regional economic contexts, especially as they relate to the financial sector.

One of the inputs for the Financial Development Report 2012 was a global survey of senior executives from around the world. Their opinions on a range of issues were elicited to establish a clear picture of the hierarchy within the international economic system. One of the survey questions was executive opinion about the quality of maths and science being taught in the respondent's country.

Pakistan ranked 42nd out of 62 countries, with a total score well below the world mean.

Economic decision-makers and policymakers in Pakistan need to consider the long-term impact of such perceptions on the marketability of Pakistan's narrative of economic growth and transformation.

3.3 How other countries are improving maths and science

For over a decade now, countries across the world are taking note of the changing landscape described above. The clear indications from the best analysts and forecasters in the world are that without the attention that is due to maths and science education, countries will be left ill-prepared for the economic challenges that are being generated by a rapid and sustained technological transformation of the economy and society at large. The "Science-

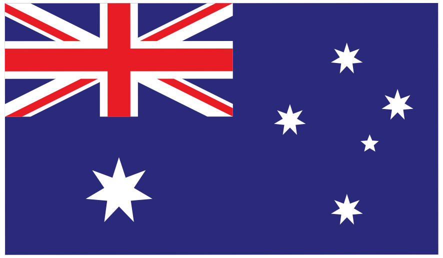
Technology-Engineering-Mathematics" or "STEM" narrative is one manifestation of the global recognition of both the challenges and opportunities in better education quality. Another variant of the STEM narrative is "Maths-Science-Technology" or "MST". A host of both developed and developing countries have invested a significant effort in both understanding the challenge, and establishing a path to deal with them, in service of creating better opportunities for both individuals and countries at large. The emphasis on maths, and especially, on science has important ramifications for many developed economies, as evident in recent studies by Deloitte. In November 2012, Deloitte published a study of the impact of mathematical science research in the United Kingdom (UK). It quantified its contribution to the UK economy in 2010 to be approximately 2.8 million jobs, and £208 billion (US $252 billion) in GVA (or GDP) terms.[29] . This was substantially higher than the total GDP of Pakistan in 2010.

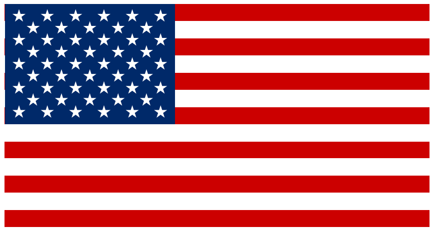
In January 2014, Deloitte published a study of the impact of mathematical science research in the Netherlands. It quantified its contribution to the Dutch economy to be approximately 2.5 million jobs and almost € 160 billion (US $169 billion) to its GVA (GDP)[30]. This is roughly half of the total annual GDP of Pakistan.

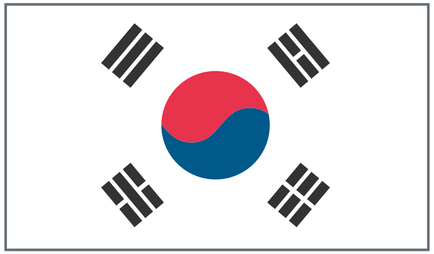
Below are examples of what some countries have done to address the education quality issue, with respect to improved learning outcomes in maths and science.

3.3.1 Australia

In March 2015, Australia's Chief Scientist released a study by the Centre for International Economics which found that advances in physical sciences and mathematics directly contribute approximately $145 billion (US $108 billion) per year to the Australian economy.[31] This is more than a third of Pakistan's annual GDP.







Australia has a series of initiatives, driven largely by the Office of the Chief Scientist, that are helping prepare Australia for better maths and science outcomes, based largely on the argument that aggregate national economic growth cannot be achieved without sustained investments in maths and science education.

3.3.2 The United States of America

America's sustained education policy discourse is often seen to be deeply ideological between free market advocates, and adherents to a more Keynsian view of the role of the state in service provision. However, the US also tends to set the ball rolling in terms of critical debates about education.

In 1983, the "A Nation At Risk" report commissioned by the Reagan administration first identified a growing crisis in maths and science learning. Subsequent efforts have reinforced that original fear, and the urgent need to address it. In April 2012 the US Congress Joint Economic Committee published a report titled, "STEM Education: Preparing for the Jobs of the Future". Almost exactly a year later, in May 2013, the White House published a plan for the US to pursue improved maths and science learning outcomes, in the "Federal Science, Technology, Engineering, and Mathematics (STEM) Education - 5-year Strategic Plan - A Report from the Committee on STEM Education National Science and Technology Council".

3.3.3 Republic of Korea

In 2008, the Korean government set an education policy roadmap called the "Zero plan for 2 below-basic students" to move all students toward basic academic achievement. Basic academic achievement means that students reach the minimum objective levels presented in the curriculum for each subject (language arts, mathematics, English, social studies, science) and each grade. In 2009, this was followed up with the launch of the School for Improvement programme that was designed to raise the standards across schools where the proportion of below-basic students was higher than the average.[32]

3.3.4 Singapore

Singapore is an undisputed world leader in quality education, having topped the PISA rankings for 2016. The effort to put Singaporean children at a distinct advantage in comparison to their global peers is deep rooted, and its seeds were planted decades ago. The most recent major policy initiative that has triggered the dominance of the country is the 1997 "*Thinking Schools, Learning Nation" policy. The core of this policy was a commitment from Singapore's most powerful leaders, including its legendary leader Lee Kuan Yew, who said in 1977 that his view of an educated man was one who "never stops learning and wants to learn*"[33] to challenge the existing system, and generate an entirely new narrative for education.

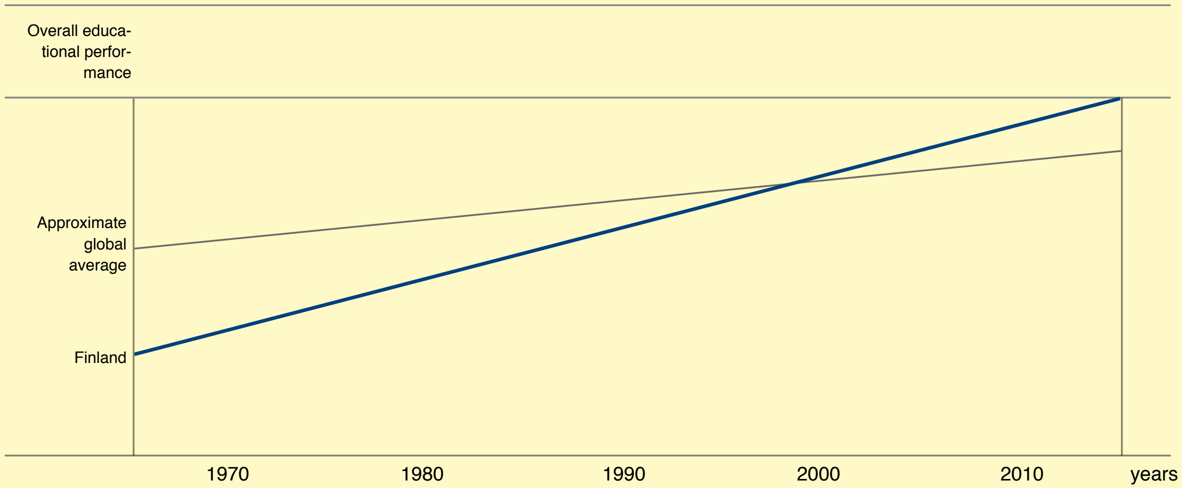
In announcing the Thinking Schools, Learning Nations policy, Prime Minister Goh Chok Tong said, "*What is critical however is that we fire in our students a passion for learning, instead of studying for the sake of getting good grades in their examinations… Thinking Schools must be the crucibles for questioning and searching, within and outside the classroom, to forge this passion for learning among our young*".[34] ". In less than twenty years, Singapore has delivered schools where children are capable of demonstrating better maths and science skills on aggregate than any other country in the world: an unqualified success story.

3.3.5 Finland

Finland has been a global superstar in generating consistently high scores in PISA assessments since the turn of the century. This sustained excellence in maths and science education has helped generate Finland's impressive social and economic success—with equality being a widely cited feature of the country's high education outcomes.

The roots of this success are generally seen to be rooted in a number of reforms over the years, beginning with the establishment of

Finnish educational improvements compared to the approximate global average



Source: Sahlberg, 2011

the nine-year basic schooling system known as peruskoulu in Finnish.

This standard system was an effort to consolidate previously disparate systems. Among its key features was the vesting of the authority to run the school to local and municipal bodies.[35] Not surprisingly, another key facet of the Finnish system is high degrees of autonomy for teachers. Excellence in maths in particular is generally attributed to an emphasis on equity, and on ensuring that low achievement is minimised. This counter-intuitive approach has helped create a scenario in which Finland's students exhibit the lowest standard deviation in maths scores, and consequently, superior overall results in PISA assessments, cycle after cycle.

4 A unique significance for Pakistan

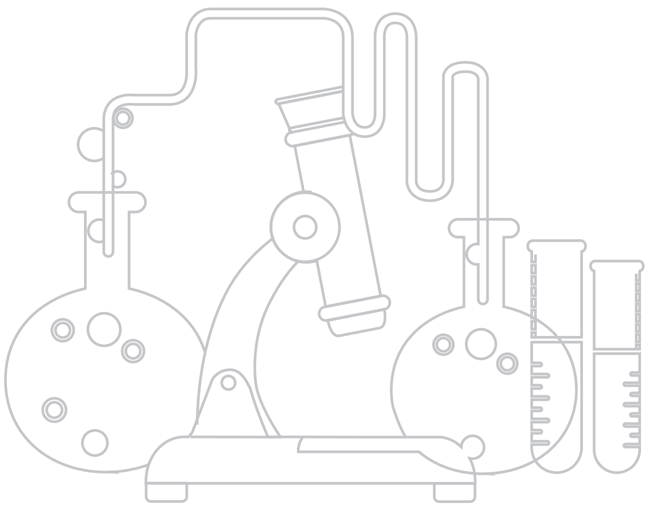
Pakistan is a unique country, situated in a region that has seen violence and war repeatedly, since its founding as an independent nation in 1947. There is a growing body of work, internationally, that assigns a linkage between both human security and overall national security, and the state of maths and science education. We believe maths and science therefore is not only integral to Pakistan's prospects for economic growth, but also, to its ability to enhance the security of its people to protect them from all threats.

There are several dimensions to the case for maths and science for improved security. Some of the most obvious do not need to be repeated here. Improved maths and science education produces higher individual and aggregate national income, and nothing succeeds in securing a country from threats like success with growing its economy. There are a range of other arguments too that merit consideration within the spectrum of Pakistani public policy. Among the dimensions of security that are informed by maths and science are:

- Food security: a country's ability to feed its people is more dependent than ever on a robust research and development culture that privileges higher and better yields, through the most advanced agricultural practices, as well as the best strategies for optimising existing capacity

- Water security: a country's ability to provide an adequate supply of water to its people is dependent on the ability to draw on the most advanced engineering and planning

We believe maths and science therefore is not only integral to Pakistan's prospects for economic growth, but also, to its ability to enhance the security of its people to protect them from all threats.



- Climate change: Pakistan is part of a region that is among the most vulnerable to climate change, and its impact – and advances mathematics, and applied sciences are critical in enabling countries like Pakistan to be equipped to deal with the challenges posed by climate change

- Population and demographics: Pakistan is one of the only large countries on the planet whose demographic dividend will continue well into the 2040s. This surplus working age population is often framed as an opportunity, however without adequate preparation, it risks posing a challenge, rather than an opportunity, in terms of the dangers to social cohesion and national harmony, through social exclusion, unequal growth, and uncontrolled urbanisation.

4.1 Maths and science, and national security

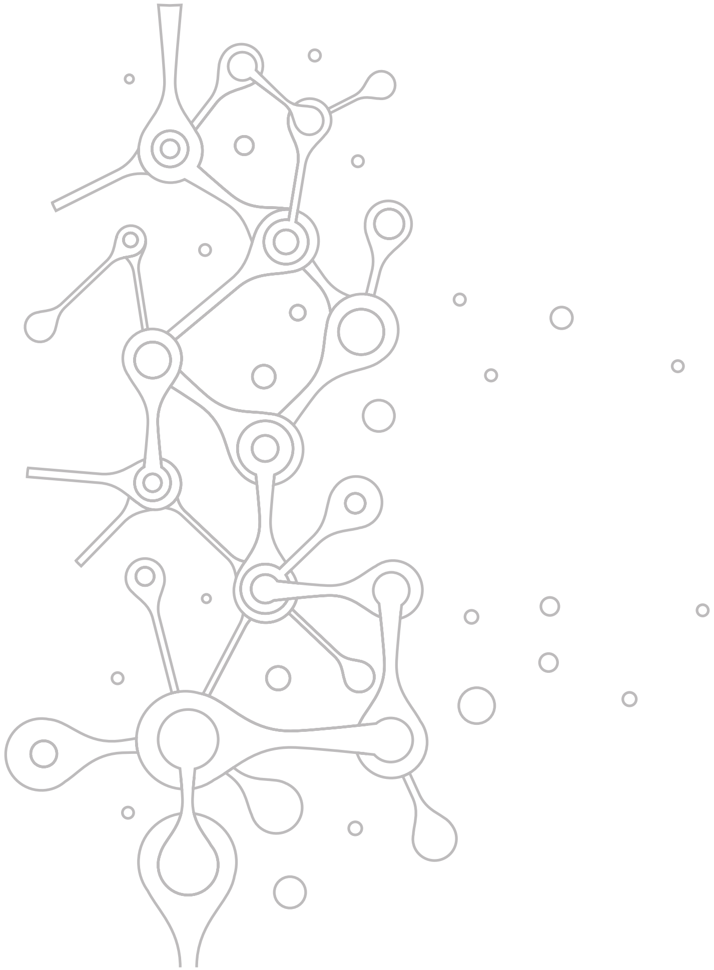
In a 1997 article for the Issues in Science and Technology publication, Sapolsky and Gholz present an interesting argument for thinking of maths and science, and specifically high technology research and development (R&D) as a substitute for current existing spending on military hardware and software.[36] It is a complex, but compelling argument that considers the future gains from cutting-edge, and pioneering technology to be higher than the benefits of continued spending on traditional items (like tanks or second generation fighter jet programmes). For a resource constrained country like Pakistan, the implication is clear: there are different kinds of defence spending, and a reorientation in favour of spending more on R&D today will yield better bang for the buck in the future.

The American debate on the relevance of education to national security is rich, and deeper than that for most other countries. In part, this is explained by US military pre-eminence. However, as a regional power, Pakistani decision-makers can benefit from the various arguments.

Even before September 11, 2001, American policymakers were debating the criticality of US national security being at risk due to the below OECD average performance of American children in maths and science. A report released on February 15, 2001 by the U.S. Commission on National Security characterised deficiencies in math and science education in the US as “threats to national security,” which needed to be tackled in order to mitigate the against “distinctly new dangers” . The Hart-Rudman Commission, as this group was called, was critical of the absence of public policy attention on maths and science education, and the urgent need to reforms to help the American student benefit from the latest and best knowledge in maths and science.

In 2012, the Council on Foreign Relations convened an American task force on US Education Reform and National Security, chaired by Condoleezza Rice and Joel Klein. They claim that, “*Educational failure puts the United States’ future economic prosperity, global position, and physical safety at risk*,” . Their report identified low achievement in maths, reading and science as being the source of five specific kinds of national security threats:

- compromised economic growth and competitiveness,
- lower physical safety,



- higher threat to both establishing and protecting intellectual property,
- limited U.S. global awareness, and
- lesser unity and cohesion within the US national discourse.

The report emphasises that too many young people are not employable in an increasingly high-skilled and global economy, and too many are not qualified to join the military because they are physically unfit, have criminal records, or have an inadequate level of education.

The added complexity that all countries face today is the ideological contempt for the state and its institutions, cultivated among young discontents by violent extremist groups that often are capable of leveraging for new technology and mass media, better than states themselves.

As the US educational policy community has adopted the "STEM" agenda, academics and practitioners have also begun to make the explicit link between STEM and national security. This narrative is best captured in a 2015 article by Harold Levy and Jonathan Plucker in the US News which ends with this appeal:

"*During the height of the Cold War, when Americans worried that the Soviet Union was pulling ahead in advanced technology, we created NASA and invested heavily in educational excellence through the National Defense Education Act and National Defense Student Loan program. Those programs helped ensure the nation's security for decades. We need to respond to current and future cyberthreats with that same sense of urgency and with the same basic approach: Excellence in education matters*".[39]

Maths and science has been cited regularly in statements and speeches by leaders across the world, as being critical to their pursuit of national security. From China, to India, to the United States, improved learning outcomes at the school level in maths and science are increasingly being linked to the national capacity to provide security to all citizens.

4.2 Maths and science and Pakistani national security

Strategic thinkers and government in Pakistan have also attempted to draw public attention, and policy momentum in favour of maths and science as instrumental in shaping national security. The Institute of Strategic Studies, Islamabad (ISSI), conducted a seminar on the ‘Role of Education, Science & Technology in National Security” in collaboration with the University of Management and Technology, Lahore in July 2016. An impressive list of speakers attended and spoke at the seminar, including Rana Tanveer Hussain, Federal Minister for Science & Technology, and the current President of Azad Jammu & Kashmir, Masood Khan, who was hosting the discussion. In his speech, the minister echoed for Pakistan, the sentiments many before him had expressed for countries like the United States and India:

“We need strong education, science and technology for the protection of national security. In the military and in intelligence, we must be on the cutting edge of science and technology… Our national security requires talented biologists, physicists, and computer specialists just as much as soldiers and politicians” .

Pakistan’s preparation for the security of its people hinges more than ever on a robust, and rich maths and science culture. Public policy must account for this important facet of maths and science education in assigning it the priority it deserves.

“We need strong education, science and technology for the protection of national security. In the military and in intelligence, we must be on the cutting edge of science and technology… Our national security requires talented biologists, physicists, and computer specialists just as much as soldiers and politicians”


الف اعلان
Alif Ailaan
PAKISTAN

5 The promise of maths and science to Pakistan

Nations have used maths and science to empower their citizens with higher incomes, and to help grow their economies. The confluence of new technologies, a changing economic landscape, and a unique set of opportunities and challenges specific to Pakistan make this an ideal time for the country to embark on a serious, sustained and unrelenting path to provide high quality maths and science education to every Pakistani child. This journey, once taken, will deliver a range of advantages to Pakistan at each level of national life, from the individual, to the family and community, to the nation at large.

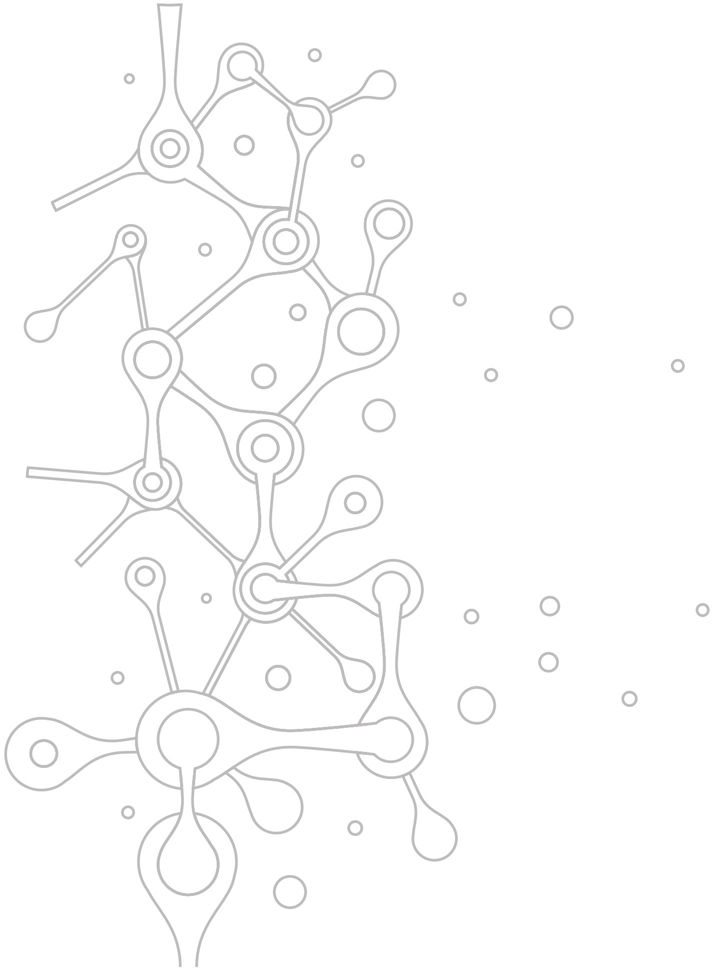
5.1 Promise for the individual citizen: Economic Security

Research from Pakistan, and from around the world shows that the returns to the individual (or private returns) to education are substantial and that these returns multiply several times over when the quality education of education enhances cognitive skills, as opposed to assessing simply whether children are being enrolled in, or attending school. The returns to a standard deviation of improvement in maths and/or science scores are roughly four times higher than returns to an additional year of schooling. For individual citizens, and especially for girls, these returns make the provision of a quality education an absolute necessity. The net impact of a quality education on individuals is uncontested and irrefutable. Pakistani children deserve to be provided with such a certain instrument to bolster their economic potential.

5.2 Promise for families and communities: Transformation

Aggregating the economic impact of improved maths and science education on

For individual citizens, and especially for girls, these returns make the provision of a quality education should be a matter of citizens' rights.



individuals in both rural and urban Pakistan has profound implications for families and communities. Research proves that education in general, and education that builds cognitive skills in particular, deliver higher returns for girls and women, than they do for boys and men. These returns are economic only. Their calculation tends not to include the quantification of the impact of young mothers having better cognitive skills on their immediate environment, on their newborn children, or on the extended families with whom they reside. Cognitive skill-empowered young mothers will contribute to families and homes in which the acquisition and deepening of cognitive skills will be privileged, leading to a multiplier effect that has long been the basis for arguments about investing in girls' education. The maths and science dimension to this debate, and the large evidentiary basis for the impact that quality education has, makes the accumulation of individual impact at the family and community level, a key policy consideration in the social and economic context of Pakistan.

5.3 Promise for the nation: Enduring Security & Prosperity

National economic growth is buoyed in countries with high school attainment, but such growth receives a dramatic boost when school attainment is combined with the acquisition of measurable cognitive skills, particularly through maths and science. Those same skills, as they become more specialised, are central to the national security infrastructure of countries that have challenging security contexts to contend with. Pakistan has both the need for large-scale economic growth and the need for a robust capacity to serve the security needs of its people. Both objectives demand a substantially greater emphasis in public policy on maths and science education – beginning at the primary level.

5.4 Conclusion

Pakistan's neighbours and other countries of Pakistan's stature and size have already begun the journey. As a country of creative, enterprising and innovative people, Pakistan can easily catch up with the rest of the world – but to do so, it must take the first step. We must acknowledge the need for a dramatic improvement in the national stock of cognitive skills, and prioritise taking up the opportunity maths and science education offers. To do so, Pakistan must develop a plan to tackle weaknesses in the system and build long-lasting, enduring strength that will produce internationally recognised success in maths and science education.

In Volume II of the "Powering Pakistan for the 21st Century: The State of Maths and Science in Schools" document, we will present a summary of the effort currently being invested in maths and science, and the results being achieved with those investments. We will also explore why the state of maths and science education is what it is, and how the status quo has come about.

Then, in Volume III, "A Roadmap for Maths and Science Education" we will present a series of ideas and recommendations that can help Pakistan, as a state and as a society, re-orient public policy and private investment decisions, to serve a brighter, more prosperous and more secure future.

To acknowledge the opportunity maths and science education offers, and develop a plan to tackle weaknesses in the system and build long-lasting, enduring strength that will produce internationally recognized success.

Endnotes & References

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آرٹستان

CGPA
CENTRE FOR GOVERNANCE AND PUBLIC ACCOUNTABILITY

Children's Literature Festival

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GHAZALI EDUCATION TRUST

HEC

IBT

IRC
Indus Resource Centre

INTERNATIONAL RESCUE COMMITTEE

I-SAPS
Institute of Social and Policy Sciences
Informing Policies, Reforming Practices

KHWARIZMI SCIENCE SOCIETY

MCB
Bank for Life

IDARA-E-TALEEM-O-AAGAHI

MOAWIN
FOUNDATION

NAYAtel

NUTSHELL FORUM

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Pakistan Innovation Foundation

PAK INSTITUTE FOR PEACE STUDIES
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