Redefining Human Talents: Gifted Education in the Age of Smart Machines

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Abstract

Human beings vary in their endowments or talents. Diverse genetic and environmental factors give rise to unique strengths, interests, and preferences that are responsible for a broad spectrum of human variability. Consequently, humans have "jagged profiles" of abilities, skills, attitudes, social-emotional qualities, and even physical attributes (Rose, 2016). Although jagged profiles are immensely useful for fostering ingenuity and technological achievement, not all talents, attitudes, and qualities are equally valued in a society. Some talents are considered more desirable and thus worthy of investment, while others are considered undesirable, to be suppressed, corrected, or normalized.

Schools play a significant role in developing the desirable and correcting the undesirable according to socially accepted definitions of desirable and useful. When students differ from what is considered "normal", they are placed in systems to support the desirable. Both gifted and special education represent polar ends of the education system and are designed to cultivate desirable abilities and skills. Generally, gifted education is intent on accelerating or expanding, whereas special education is intent on remediating, correcting, and replacing deficient behaviors and skills. However, society has changed. What was previously deemed desirable may actually be less desirable or obsolete and what used to be undervalued has gained more value (e.g. see Florida, 2012; Pink, 2006; Zhao, 2012b, 2016a).

In this article, we discuss the need to change the education landscape to focus on individual talent, strengths, interests, and preferences. We provide examples of the

changes and further discuss how education leaders should consider how both gifted education and special education can share values and advance toward a talent-focused model.

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> Having gifts that differ according to the grace given to us, let us use them: if prophecy, in proportion to our faith; if service, in our serving; the one who teaches, in his teaching; the one who exhorts, in his exhortation; the one who contributes, in generosity; the one who leads, with zeal; the one who does acts of mercy, with cheerfulness. *Romans 12:6 The Holy Bible, English Standard Version. ESV® Permanent Text Edition® (2016). Copyright © 2001 by Crossway Bibles, a publishing ministry of Good News Publishers.*

Human Diversities and Individual Uniqueness

Human beings have enough commonalities to distinguish them from other species. But within the human species, each individual member is unique. The uniqueness comes from both nature and nurture. Human beings are not born a blank slate or exactly the same and their experiences after birth vary considerably. The interactions between innate variations and experiential differences (i.e., nature via nurture) result in unique individuals who are drastically different from each other on many dimensions (Ridley, 2003).

Human differences exist in a multitude of areas. The differences in some areas are much more obvious than others. Physical appearances, for example, are much more visible than intellectual abilities. We can directly see physical differences such as gender, hair color, height, weight, length of arms, and many other aspects of physicality. But intellectual abilities can only be "seen" indirectly. Psychometrics has been developed as a convenient way to "see" the invisible qualities of human beings (Kaplan, 2016). Decades

of efforts have produced a large body of theoretical frameworks and empirical evidence to show individual differences in a number of areas. Although there are a plenty of controversies over many technical details and specific theories, there is consensus that human beings indeed vary in aptitude, personality, motivation, knowledge and skills, values and beliefs, attitudes, mindset, and other psychological aspects.

Humans differ in their aptitude, a natural born capacity for learning. Although Howard Gardner's Multiple Intelligences Theory (Gardner, 1983) has met criticism for different reasons, the idea that human beings are born with different natural abilities and potentials is widely accepted and observed. According to Gardner, some are born to be more sensitive to languages, while others in math. Some are natural learners of visual arts while others are more talented in music.

Human beings also have different patterns of thinking, feeling, and behaving or "personalities" (John, Robins, & Pervin, 2008). Personality researchers have over the last 50 decades various models and theories about human personalities. One of the more accepted theories is the Big-Five Model (McCrae & Terracciano, 2005), which suggests human personalities differ along five dimensions: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. In other words, some people are more open to new experiences, while others may be more cautious with adventures. Similarly, some people have the tendency to be more organized and dependable. Likewise, some are more outgoing than others, while some are less friendlier than others.

People also differ in their desires or motivation, an aspect of personality. Psychologist Stephen Reiss proposes 16 basic human motivators but each person has a different motivational profile (Reiss, 2000, 2004). Reiss suggests an individual would have strong or weak desires in pursuing one of the 16 needs: acceptance, curiosity, eating, family, honor, idealism, independence, order, physical activity, power, romance, saving, social contact, social status, tranquility, and vengeance. In other words, some people may be extremely driven by achieving social status, while others may not even care about their social standings. Similarly, some people have a strong desire for orderliness while others can put up with a very messy closet.

There are other areas in which humans can vary. They can have more or less knowledge in certain domains or be more or less skilled with certain tasks. For example, some people may know more about U.S. history but know very little about dinosaurs. One can be very good at playing basketball while being a horrible piano player. By the same token, some people are extremely skilled at carpentry but are not very good dancers.

There is no doubt that we still lack knowledge about the complexity of human beings, but it is indisputable that every one of us is unique. Not only are we unique in one area, but also in the combination of all potential areas. In fact, when we combine the variations in all domains that human beings can vary, each member of the species differs even more from each other. Everyone has a "jagged profile" (Rose, 2016) or a unique combination of strengths and weaknesses: stronger in some areas and weaker in others. Learning variability is actually the norm rather than exception (Basham, Hall, Carter,

Stahl, 2016). Despite this, society and schools, in particular, continue to accentuate commonalities, elevating the value of similarity and discounting the differences that contribute to innovation and enrichment of the human experience.

Prescription of Valuable Human Qualities

The vast diversity of human beings is antithetical to the mission of traditional education, particularly formal education. The purpose of education, as has been conceived and practiced over the past century, is to equip all students with a uniform set of knowledge and ability deemed necessary for success in life after they leave school. A primary purpose is to produce adults with similar characteristics rather than individuals with unique features. As a result, the outcome of a successful education system is one that impedes human diversity.

Public education aims to prepare children to become productive members of a society. Deciding what to teach typically starts with describing and prescribing what productive members should know and be able to do. There are a number of ways to establish a prescription of knowledge and skills that productive citizens should be equipped with. The British philosopher Herbert Spencer, for example, used *a priori* reasoning in his 1859 essay *What Knowledge is of Most Worth* for the Industrial Age (Spencer, 1911). Harry Broudy (1982) followed the same tradition in an essay of the same title (Broudy, 1982) to redefine valuable knowledge in the modern era. Scholars, policymakers, and think tanks have relied on empirical evidence to identify worthy knowledge and skills (e.g, Brunello & Schlotter, 2010; Levin, 2012; Wagner, 2008; World Economic Forum, 2016a, 2016b). A more frequently used approach is a

combination of empirical evidence and reasoning weighted by expert panels. The Common Core State Standards Initiative (Common Core State Standards Initiative, 2011) and the Partnership for 21st Century Skills framework for 21st Century learning (Partnership for 21st Century Skills, 2007) are two examples.

Irrespective of how they are arrived at, most prescriptions share some common characteristics. First, they are educated guesses of what might be needed for successful living in a society at a given time. The guess is often based on past evidence and reasonable forecast of future trends. The prescribed knowledge and skills may be based on very solid evidence and meticulous reasoning, but are attempts to predict the future nonetheless. Second, the prescribed knowledge is expected to apply to all children (i.e., the standards-based model). That is, all children are expected to be equipped with the same set of knowledge and skills, and have mastered them at the same points in time. Consequently, educators are responsible for teaching the skills and knowledge that will (allegedly) make children into productive members of society.

Third, the prescribed set of knowledge and skills is necessarily narrow. While it is of course ideal for everyone to know and be able to do everything possible, it is not possible due to practical constraints such as school resources and time limitations. A school cannot possibly teach everything worth knowing nor can students spend all their life learning everything. Some individuals spend their entire lifetime focused on learning, but they cannot possibly learn everything there is to learn; neither can they learn to do everything worth doing. As a result, educational institutions must make choices. Thus, the prescribed set of knowledge and skills to be taught in schools typically is very

narrow. Currently, the prized knowledge and skills are primarily cognitive abilities in math, language, science, and social studies.

Finally, the prescription often expects all children to progress at a similar pace. When translated into practice, the prescribed knowledge and skills are put into a sequence that runs through the duration of schooling, with periodical checkpoints to ensure every child is making similar progress. The sequence is typically aligned with children's biological age or grade-level. In other words, not only are all children expected to acquire the same total amount of the prescribed knowledge and skills at the end of schooling, they are also expected to do so at a similar speed along the way. This is clearly exemplified by uniform curriculum standards such as the Common Core State Standards (Common Core State Standards Initiative, 2011), which not only spells out what all students should learn, but also by what time in their life they should master the required content and skills. Furthermore, international assessment programs such as the globally influential Programme for International Student Assessment, better known as PISA, expects all 15-year-olds around the globe to be able to do the same in reading, math, and science. Those 15-year-olds who do not perform the tasks on these tests are deemed inadequately prepared for living in the 21st Century (OECD, 2010).

In the process of identifying and prescribing skills and knowledge for productive participation in a society, individual uniqueness and human diversity plays virtually no role. The process for prescribing standards for knowledge and skills is entirely predicated on what society needs, not about what individual already possess upon entering school.

This tradition continues even in recent efforts to redefine valuable knowledge and skills in the wake of recent technological transformations.

Reducing Human Diversity through Education

The most effective way to ensure that every student is equipped with the prescribed skills and knowledge at the same pace would be having every aspect of education to be identical: identical curriculum, identical schools, identical teachers, identical textbooks, identical assessment, and most importantly, identical students. Over the years, educational institutions have indeed worked very hard to make education identical by developing common standards, homogenizing curriculum and teaching, standardizing teacher preparation and evaluation, and requiring common assessment. The only inconvenience is the vast variations that exist among students. Their uniqueness is a stubborn obstacle to be removed. Students are not empty computer hard drives, all similarly formatted and ready to be programmed to perform any desirable function. To succeed in the modern era, education must try to minimize the influence of individual variations, which has been viewed as the singly most persistent liability that hinders the progress of equipping all students with the same knowledge and skills so they can be ready for life. To lighten the burden of human variations, education has developed a host of elaborate and sophisticated strategies in policy and practice.

Selective admissions. When possible, educational institutions often will use admissions requirements to increase the homogeneity of their student body. While requirements differ across institutions, students seeking to study in a particular school or college are often admitted based on their performance on a narrow set of indicators that

align with the prescribed knowledge and skills. Typically, students strong with qualities that align with the school's missions are more likely to be admitted, while individuals with strong qualities in areas less aligned are less likely to gain admission. As a result, the student body has much less variation than the general population.

Ability Grouping and Tracking. Teachers and schools have long used practices to create homogenous student bodies within classes or within schools. Teachers use *ability grouping* to put students into different groups based on their academic performance and schools use *tracking* to put students into different classes or different tracks (Loveless, 2013). Moreover in some educational systems, students are put into different tracks of schools based on their academic performances (Bokhorst, Heng, & Pereira, 2008; Young, 1958; Zhao, 2014). The decisions about how to group students are based on how well the students have mastered the prescribed skills and knowledge at a given point of their school career. This results in the creation of student bodies with more similarity than what naturally exist. Such practices have for decades been embroiled in controversies (Boaler, Wiliam, & Brown, 2000; Brunello & Checchi, 2007; Duflo, Dupas, & Kremer, 2009; Gamoran, 1992; Hanushek, 2006; Ireson & Hallam, 2001, 2009; Slavin, 1990), yet they continue to be practiced widely.

Grade Retention. Another common practice to create more homogeneous student groups is to require students who are lagging behind to repeat a grade (Jackson, 1975). Based on their performance in the previous year, students who are deemed to have not acquired the prescribed skills and knowledge repeat the grade to become more like their peers next year. The effectiveness and potential damage of grade retention has been as

controversial as tracking and ability grouping (Jackson, 1975; Jimerson, 2001; Manacorda, 2012).

Remedial Programs and Tutoring. Students at all levels of education who are deemed to have not made satisfactory progress in academics are also provided supplemental remedial programs and tutoring in school, outside school, or during the summer (Anderson & Pellicer, 1990; Ascher, 2006; Gamoran, 2007; Jacob & Lefgren, 2004; Zimmer, Hamilton, & Christina, 2010). The purpose is to make sure that students catch up with their peers so they can be more like the students who are making the right amount of progress in mastering the prescribed skills and knowledge.

Special Education and Gifted Education. Special education (Clark, Dyson, & Millward, 2005; Harry & Klingner, 2014; Kauffman & Hallahan, 1995; Stainback & Stainback, 1992) and gifted education (Colangelo & Davis, 2002; Dai, 2010) are programs created to serve students who deviate significantly from the "normal" student. Although other factors are considered, student mastery of the prescribed knowledge and skills (i.e., academic achievement) as measured by standardized tests is a major factor in the deciding who is selected for gifted and talented programs and who requires extra support through special education. IQ scores also play a major role. Both special education and gifted education systems rely on creating homogenous student bodies from naturally varying human beings. One difference between gifted and special education is that the latter often intends to help students to catch up with the "normal" students while the former intends to support further academic advancement. A second difference relates to values. Gifted education is deemed valuable because the gifted and talented students

possess the same qualities prescribed as needed for productive members of a society. Students with disabilities, on the other hand, may be viewed as lacking the qualities needed to be a productive member of society.

The effectiveness of these strategies in helping students to acquire the prescribed skills and knowledge remains contested as exemplified by the frustratingly persistent "achievement gaps" that exists among different groups of students (Harris & Herrington, 2006; Jimerson, 2001; Jones, 2013; Ladson-Billings, 2006; Reardon, 2011; Zhao, 2016b). It is even questionable whether all students can possibly be achieving the same level in the same domains at the same time (Zhao, 2016b). But it is certainly true that traditional education, intentionally and unintentionally, has aimed to reduce human diversity as a liability. As a result, individual uniqueness has been subject to active suppression. Millions of children are subjected to remediation, corrective programs, and supplemental activities to be normalized and homogenized.

From Liability to Asset: Rethinking Diversity

It may have been necessary to homogenize children in order to ensure they are all equipped with the same knowledge and skills, and to help them progress along the same path at the same pace in the past. After all, human societies for a long time can only make use of a narrow set of skills and knowledge in a limited range of domains (Zhao, 2012). It would have been irresponsible for education not to help them acquire the necessary skills and knowledge in order to succeed in life. In a society that rewards homogeneity over diversity, individual uniqueness is indeed a liability to be reduced.

However, society has dramatically changed and we, therefore, must change our thinking. Individual uniqueness has become the only asset that human beings have for surviving and thriving in the new age to be dominated by smart machines. Education cannot and should not try to reduce diversity anymore. Instead it should aim to enhance individual diversity and amplify uniqueness.

Education is always in a race with technology (Goldin & Katz, 2008). Gradual technological advances accumulate into a revolution and transform civilization. Such transformation often leads societies to reconsider the value of previously prescribed skills and knowledge. Different societies value different skills and knowledge. What is useful and desirable in one society may not be equally useful or desirable in another. Likewise, what is useful and desirable in the past may become obsolete in the future. Thus societies have often engaged in exercises to define and redefine human qualities worth cultivating in schools throughout history, especially when they go through significant changes (Broudy, 1982; Goldin & Katz, 2008).

The Arrival of the Second Machine Age

We are in the midst of major societal change. Starting in the 1970's waves of technological advancement have led to massive societal transformations that ushered in the Third and Fourth Industrial Revolutions (Schwab, 2015) or the Second Machine Age (Brynjolfsson & McAfee, 2014). Unlike the first rounds of industrialization, the fourth industrial revolution features "smart" machines or artificial intelligence (AI) and AI-based automation, as well as global networks of things (Executive Office of the President, 2016; Schwab, 2015). These "smart" machines have already brought about disruptive changes and will continue to do so in the future. These changes have

significant implications for the definition of useful and desirable human qualities, and consequently, what schools should be teaching.

The Fall of Rote Memorization and Simple Skills

Some of the knowledge and skills cultivated by traditional education have become increasingly rendered less valuable or even obsolete by smart machines (Pink, 2006; Wagner, 2008, 2012; Zhao, 2012). The goal of technological development is to enhance and extend human abilities, to make human beings more effective and more efficient, to help human beings perform tasks that would otherwise be impossible, and to free people from mundane, harmful, or dangerous tasks. Over the past two centuries, technology has significantly increased human productivity, extended human capabilities, and freed more humans from mundane and dangerous tasks. A collateral effect is the disappearance of traditional production line jobs and displacement of some human workers. This occurs because machines have been increasingly equipped with the same knowledge, skills, and other human qualities to perform tasks previously performed by human beings. In fact, machines are much more superior to human beings for some tasks, and very often machines cost much less, are consistently obedient, and can work longer hours without complaint than human beings. Machines have gradually taken the jobs schools have traditionally prepared human beings to perform, rendering the prescribed qualities that have been valued less useful and desirable. As a result, schools must focus on developing human qualities that cannot be replaced by machines.

Rote memorization, information processing, and repetitive procedural knowledge are among the first to be rendered less useful by recent information and communication

technologies. For example, the best Jeopardy! and chess players in the world are computers, demonstrating the superiority of machines' capacity for information storage and processing. Traditionally valued low-level cognitive skills are easily replaceable by machines as are traditionally valued and machine-like qualities such as following instructions and obeying orders without questioning (Brynjolfsson & McAfee, 2014; Common Core State Standards Initiative, 2011; European Communities, 2006; Partnership for 21st Century Skills, 2007; World Economic Forum, 2016a).

There is already evidence suggesting that test scores, the primary measure of what has been valued in education, are not a strong predictor for life's success. IQ, for example, has been used as the primary measure of the most important human quality for over a century, but longitudinal studies suggest that IQ alone accounts for little variation in one's success in life (Firkowska-Mankiewicz, 2002; Goleman, 1995; Sternberg, 1987; Zhao, 2016b). SAT and ACT scores, the measures of supposedly most useful qualities for college success in the United States, have had a history of weak association with success in college (Zhao, 2016). Test scores or school performance measures have not been able to predicate success at work either (Brunello & Schlotter, 2010; Levin, 2012).

The Rise of Undervalued Skills

At the same time, the Second Machine Age (Brynjolfsson & McAfee, 2014) has created opportunities for traditionally undervalued talents to become valuable. For example, when jobs that require rote memorization disappear, the number of jobs requiring higher order thinking such as creativity increases. As a result, as manufacturing class declines, the creativity class rises (Florida, 2012). When jobs that favor so-called

"left-brain" skills such as linear and logical thinking are automated, the "right-brained" based talents become more useful and desirable (Pink, 2006).

More importantly, increased productivity brings about more leisure time and disposable income, which allows human beings to expand their consumption beyond physical necessities (Zhao, 2012b). Whereas underdeveloped countries must focus on basic survival (e.g., food, clean water, shelter, basic medicine), humans in technologically developed economies are able to invest in psychological, aesthetic, intellectual, and social needs of its populace. Thus in developed economies, education, entertainment, healthcare, travel, fashion, beauty, and other industries that serve psychological, intellectual, aesthetic, and social needs have become as large as, if not larger than, industries that meet the basic needs for physical survival such as food and housing.

These new industries provide unlimited potential for traditionally undervalued talents to become useful and desirable. For example, interpersonal and intrapersonal talents became very valuable as the industry in counseling, all sorts of therapy, personal coaching, and interpersonal communications expanded. Artistic talents have become more valuable as more people consume arts in various forms such as visual arts, video games, aesthetically appealing devices and furniture, artisan food, and films. Similarly, the ever-expanding television and video industry has created opportunities for individuals talented in storytelling, acting, and being funny.

As a result, many new skills proposed as necessary for the new age (Zhao, 2016a) have not been valued in schools. Under the big umbrella of 21st Century Skills (Partnership for 21st Century Skills, 2007; Trilling & Fadel, 2009) are a host of skills and

characteristics necessary for the 21st Century, but they have not been considered important before: communication, critical thinking, creativity, and collaboration (Common Core State Standards Initiative, 2011; European Communities, 2006; Trilling & Fadel, 2009). Besides 21st Century Skills, there are numerous other skills, abilities, and characteristics proposed to be valuable in the new age but have not been valued in traditional education: dispositions (Costa & Kallick, 2013), creativity and innovation (Florida, 2012; Wagner, 2008, 2012), right-brained skills (Pink, 2006), entrepreneurial skills and mindset (World Economic Forum, 2009, 2011; Zhao, 2012b), personal qualities (Duckworth & Yeager, 2015), global competencies (Reimers, 2009; Zhao, 2009a, 2009b), mindset (Dweck, 2008; Gardner, 2007) and non-cognitive or soft skills (Brunello & Schlotter, 2010; Levin, 2012; World Economic Forum, 2016a).

The Emerging Asset of Individual Uniqueness

The newly proposed skills are inherently more human than mechanical. Human beings cannot and should not compete with machines in mechanical qualities such as precision, repetition, uniformity, obedient, non-social, or dispassionate. Instead, human beings must be more human and more different than machines.

Being unique is human nature. Each individual has a jagged profile of strengths and weaknesses that makes him or her uniquely different from others. If fully developed, each individual human being cannot be mutually replaceable. But machines cannot be unique. No matter how complex a machine is, it can be replicated and produced in large quantity in identical quality.

Unique individuals are needed in the new world when economy becomes hyper-specialized (Malone, Laubacher, & Johns, 2011). In the new economy, human beings are unlikely to engage in mass production best suited for machines. Instead, they must become extremely creative and competent in a certain domain, occupying a small niche in a network of free agents or self-employed workers (Pink, 2002).

More unique human beings are needed for the new world where human psychological, aesthetic, social, and intellectual needs or desires can be better attended to due to rising productivity. Psychological, aesthetic, social, and intellectual needs are inherently much more personal and less uniform than physiological needs. To meet these needs require personalized approaches devised by human beings instead of machines. For example, the smartest computer today can beat the best human chess player and can use algorithms to deliver suggested news stories, Netflix shows, or even drug prescriptions. But no matter how smart the machine is, it cannot precisely predict a particular individual's desire and need in context because human needs vary in contexts. Only unique human beings can help other unique human beings.

Unique human beings, when fully developed, are the only way to participate in a rapidly changing society. Traditional education tries to anticipate what future may need and prepares people for the predicted future, but the future is uncertain. Machines can be equipped with the skills and knowledge to perform existing tasks, but machines cannot be equipped to do jobs that do not yet exist. Thus we need human beings to be not ready for jobs but ready to create jobs in the future.

In sum, human diversities and individual uniqueness, the qualities that distinguishes humans from machines, should not be considered a liability in education and society. Instead, they are what human beings have to succeed in the age of smart machines. Education thus needs to have a paradigm shift—from treating human diversity as deficiency to be overcome to considering it an asset to be developed.

Considerations for the Modern Education System

The current education system places value on a standards-based normalized system that supports sameness in outcomes across learners. Conversely, a pluralistic global civilization, where humans interact with smart machines, requires an acceptance and focus on variability. This new education paradigm requires the following changes:

1. Acceptance of learner variability as a norm, rather than attempting to fix deficiency with a focus on normalization. The education system should instead, enhance strengths and support learner passions.
2. Education should capitalize on the strengths, interests, and preferences of learners and foster continued growth, understanding, and mastery of learning rather than a narrow track of knowledge and skills based on guesses of what society may need in the future.
3. The role of education should be to create opportunities for individual learners to understand, hone, and authentically demonstrate their knowledge, skills, and talents across a variety of domains.
4. All education should be personalized (technology makes it possible) to meet the individual needs of all children, regardless of their variability.

Based on these values, education systems would address the needs of all learners, irrespective of the presence or absence of specific qualities.

Some Issues To Wrestle With

Developing an education system focused on the unique strengths and talents of individual learners, introduces a number of issues for the system to wrestle with in the adoption process. It is fairly clear that society requires some measure of success from both individual students and schools themselves, yet what is also clear is that current standards and standardized assessments devalue individual talent and support hypothetical notions of success. If there is a need to disrupt the current system with a greater acceptance of learner variability, a realignment toward strengths, interests, and preferences, and a focus on developing master learners through personalized learning then there is a need to wrestle with issues of integration and implementation. Here are some of the foreseen issues in establishing the needed system.

Basic Skills

An individualized or personalized approach that begins with a focus on the talents, interests, and preferences very likely cannot replace the need for some basic skills such as arithmetic and literacy. For instance, it is generally thought that some basic level of literacy is foundational for developing current and future knowledge and skills, but also for discovering new interests, talents, and preferences. This means basic skills must be identified. However, defining "basic skills" presents a problem to a personalized approach to teaching and learning because defining such skills institutes normative standards. For example, what level of literacy should be deemed "basic" or fundamental,

and how will this be decided? Should students be expected to achieve the basic skill by a specific age? If so, who will decide the expected timeline and how will this standard be applied to individual learners? If not, at what point should instruction in the basic skills be abandoned for more beneficial instruction? After all, not every child will benefit equally or at all from literacy skills. Whatever the answers, it is clear that applying the basic standard to every learner remains a flawed goal; there will always be individuals for whom an expectation does not apply. This means a basic standard must be both general and specific. For example, civil laws must be sufficiently precise to allow for practical application, but also blunt enough to limit the number of (inevitable) exceptions. Broad standards for basic knowledge and skills will always encounter exceptions, and personalized instruction can account for this.

Both gifted and special education might provide some points of reflection for some of the issues presented. For instance, federal law requires that students with disabilities be provided an individualized education precisely because the universal standards of education may be incongruous with desired outcomes. For example, an education team comprised of professionals and parents may decide that a learner with multiple disabilities (i.e., severe physical and intellectual disabilities) does not need to learn physics, algebra, or Shakespeare because (1) he does not appear to have any interest in learning these skills and (2) learning these skills will not confer benefit to his quality of life (Ayres, Lowrey, Douglas, & Sievers, 2011). Instead, the education team may identify specific strengths, interests, and preferences, as well as what skills are needed to improve his quality of life, and invest resources into developing those skills.

While the fields of special and gifted education provide foundational models for supporting individualized approaches, personalized learning environments that scale to all learners, rather than a select few, would still require integrating new practices and tools. Being dynamic and learner centered, these environments would require supporting learners and educators in the use of data to make day-to-day decisions. In fact, practices and models have begun to emerge that integrate effective foundational frameworks, uses of data as well as technology, and most importantly support large roles for student self-agency in the decision making process. For instance, Basham et al., (2016a) found that an urban district that meaningfully adopted personalized learning, had many students make over one year competency-based growth, during a one year period. Specifically, the researchers found that a personalized system that was foundationally based on the Universal Design for Learning (UDL) framework, and integrated the effective use of technology, data, and other environmental design principles supported better than expected individualized learning progress. The researchers found the personalized learning environments also heavily integrated student voice and learner self-regulation. While the model discussed by Basham et al. was limited by the need to conform to some traditional normalizing aspects of the current standards-based education system, the work served as a steppingstone toward a system that identifies with the implications discussed in this article.

Costs and Benefits

The current standards based approach provides a simplistic but misguided model for evaluating cost-benefit. For instance, the current model complicates decisions about

whether curriculum or instruction should be modified or delivered at a more rapid pace, enhanced, halted, or even abandoned. Many districts now adopt prepackaged vendor-based instructional materials and district pacing guides (Harrison & Killion, 2007) that encourage teachers to move all students through day-to-day lessons, materials, and scope-and-sequence that is directly tied to standards. Teachers are not asked to evaluate cost-benefit and they are led to believe the curriculum provider and associated vendor know best (Basham, Smith, & Satter, 2016; Smith, Basham, Rice, Carter, 2016). Moreover, many of these materials are not designed for student variability and make it difficult to modify or enhance to individualized student needs (Basham et al., 2016b). Based on the desire to have all students meet the standards, research projects have been conducted to figure out whether behavioral techniques can be used to train students with significant disabilities to perform in a standards-based curriculum.

For instance, for students with some of the greatest needs, researchers have developed methods for teaching advanced academic skills, such as algebra, to students with intellectual disabilities (e.g., Browder, Jimenez, & Trela, 2012). Such demonstrations are remarkable testaments to the advancements of the technology of teaching, especially given the history of maltreatment and low expectations associated with these learners. But, as Ayres et al. (2011) pointed out, the costs associated with such achievements may not justify the benefits to learners with intellectual disabilities. Decisions about instruction must be and are rightly based on a cost-benefit analysis. Those skills that are deemed to confer the most benefit to the individual and society (e.g., literacy, arithmetic) are deemed worthy of investment. Unfortunately, as aforementioned

this benefit is focused on weak understandings of the future, and misaligned focus on norming all students. The inability to design for individual learners, to question cost-benefit and value of needing to learn X, Y, Z, or to provide differentiation from the normative standards may make life simpler for the teacher but is negligent in advancing the needs of humans in age of smart machines.

Measurement, Accountability, and Outcomes

A personalized approach to teaching and learning is complicated by collective ignorance about how to best measure the instructional effectiveness for the individual (i.e., learner progress). Frequent, valid, and reliable assessment of student performance remains difficult and resource intensive, but a behavior analytic (i.e., natural science) approach that involves a priori operationalizations of expected behaviors (e.g., demonstrations of knowledge and skills) and systematic manipulation of the environment to observe student responses may prove useful, especially given the crisis of confidence in the social sciences (see, for example, Travers, Cook, Therrien, & Coyne, 2016). More specifically, because special educators often teach skills that are not amenable to convenient, standardized assessment (e.g., communication skills, on-task behavior, social skills) they have experience in evaluating individualized outcomes to support decision-making and accountability. Often special educators define *a priori* conditions and responses that are targeted for improvement, then systematically measure student responsiveness to instruction (ideally student voice and authentic data are tied into this process). Such an approach may prove immensely useful for personalized approaches to

education that are concerned with unique individuals with unique learning goals in dynamic environments.

An additional challenge relates to recognizing and responding to the evolving nature of learner interests and talents. The discovery of information new to the learner can have profound effects on interests, lead to the development of new talents, and stimulate desire for deeper understanding. However, new information can also function as a barrier to these outcomes, especially if the new information conflicts with cherished beliefs or is difficult to acquire. A personalized approach to learning requires that teachers have the tools, skills, equipment, materials, and sufficient personal knowledge of the individual learner to make decisions about when to support exploration of new information, recognize budding interests, and when to shift instruction (Basham et al., 2016a). Without these, teachers may not make appropriate decisions about an individual learner and cannot be evaluated for teaching effectiveness.

Decisions about what to teach an individual should be based on the actual (i.e., immediate) and anticipated benefits the knowledge and skills will have on long term outcomes. Currently, the education system is organized by gates of accomplishment predicated on the belief that each gate represents acquisition of knowledge and skills that will benefit the learner throughout their lifetime. This often leads to rationalizing current instruction by appealing to future benefits that are (1) too distal to motivate immediate investment by the student to learn the content and (2) never actually realized for a large subset of students. Consequently, much instruction is perceived valuable exclusively because it is prerequisite to future knowledge that will (allegedly) confer benefit(s) to the

learner. This means teachers often do not have good reasons for teaching content, but deliver instruction nonetheless with the promise that it will be useful for learning future content that, to the learner, is equally vacuous.

Gifted education aims to support the growth and development of each learner's talents and ability by appealing to individual strengths, interests, and preferences (Subotnik, Olszewski-Kubilius, & Worrell, 2011). Special education similarly attempts to design instruction based on the unique features of the learner. Gifted and special education prioritize the individual over the standards for the specific purpose of improving immediate and long term outcomes. However, "successful" outcomes are often arbitrary factors, such as university attendance, income, and property ownership. Although special education has attempted to develop instruments to better measure quality of life as a means of evaluating the effects of educational programming and supports (Schalock, Bonham, & Verdugo, 2008), valid instruments that reliably measure short- and long-term outcomes of personalized learning are lacking.

Conclusion

Vast resources and attention are bound up in ensuring all students meet academic standards and specific checkpoints. Consequently, investment in the talents of gifted children became second priority (Subotnik et al., 2011), and much attention was dedicated to getting lower performing students, including as many students with disabilities as possible, to pass high-stakes exams. In both circumstances, the value of individualization was discounted and academic achievement was prioritized over all other

areas of child development. In the end, the costs of the No Child Left Behind Act did not appear to have conferred the promised benefit.

As identified in the recent passage of the Every Student Succeeds Act (2015) there is a greater push toward designing a system that is focused on capitalizing on the strengths of learners while leveraging the power of technology to design a personalized education system that meets the needs of all learners. To support success begins with redefining how educators identify, support, and hone human talent. A personalized education system cannot extend from a standards-based normalized model of success and sameness because it conflicts with the fundamental intent of personalization. A pluralistic and advanced global civilization, where humans utilize and work alongside smart machines, requires various pathways to develop master learners who thrive and refine their talents throughout their lifespan. This conceptualization of education is starkly different from existing models that prepares citizens for an unpredictable future using "knowledge stocks" (Hagil, Seely, Brown, & Davison, 2009), where the focus is on banking information today for use in an increasingly unpredictable future. A modernized system of education must value a diverse group of master learners who can actively participate in the world of "knowledge flows" (Hagil et al., 2009) necessary to capitalize on the ever changing information base of the world.

The development of a personalized education system requires thinking differently about teachers, learners, the purpose, and measures of learning. Through serving learners on the margins, both gifted education and special education, have an understanding of what it means to support the variability associated with learners. By investigating and

reflecting on what has worked for the students on the margins, education can begin to advance a system of the future by understanding how to effectively support the uniqueness of all learners.

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