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VIEWPOINTS/ CONTROVERSIES

Side effects in education: Taxonomy of educational outcomes

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Abstract Outcomes in education are complex and numerous. Seemingly simple instructional choices can have far reaching implications for a student's interest in a subject, their social network, and even their psychological well-being. These types of outcomes are rarely studied however. Interest in short-term instructional outcomes is far more prevalent, as made evident by the popularity of yearly high-stakes testing. Combatting this trend will require educators and policy makers to consciously investigate the various outcomes, even if only informally. This article offers a taxonomy of educational outcomes to help with this process. The taxonomy assists stakeholders at all levels understand the potential impact of their decisions. The article discusses a variety of delineations to help readers examine potential outcomes, including instructional and educational, short and long-term, and cognitive and non-cognitive. Finally, it provides a series of guiding questions with examples taken from the research literature to facilitate the process of exploring these outcomes.

Keywords Educational outcomes · Side effects · Purpose of education · Taxonomy · Education reforms · Pedagogy

One of the biggest problems in education is the multiplicity of outcomes. Every education system has a wide range of expectations for students. We want them to develop literacy and numeracy, to learn history and geography, to be scientifically and technologically

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competent, and to become capable citizens of society. At the same time, we want them to be socially and emotionally healthy, to have creativity and curiosity, to master 21st century skills, and to have a growth mindset and grit so they can thrive in the future. These are wonderful outcomes, and all schools should work hard to help every student develop them.

These outcomes do not necessarily benefit or support each other, however. They might even conflict. Achieving one may negatively affect others. In *What Works May Hurt: Side Effects in Education* (Zhao 2018), Yong Zhao discusses how outcomes in education can contradict each other. For instance, there is direct competition for time among the various subjects. When time is spent on math, that same time cannot be spent on reading. When time is devoted to reading and math, that time is not available for other subjects.

Outcomes can also involve both cognitive and non-cognitive abilities. Cognitive abilities are the knowledge and skills a person has, while non-cognitive abilities refer to a person's psychological and emotional state. A person may be able to do something but has no interest in doing so. A person can develop knowledge and skills but has no interest in applying them or lack the confidence to do so. For example, international assessment programs have found that test scores have a negative correlation with confidence. In the Trends in International Mathematics and Science Study (TIMSS) data, Loveless (2006) found a negative correlation between math test scores and confidence and student enjoyment. The Programme for International Student Assessment (PISA) has shown that test scores are negatively correlated with student life satisfaction (OECD 2019), as well as entrepreneurship confidence (Zhao 2012).

Outcomes can also be short or long-term. When we learn something, we want to be able to apply it in the long run. In education, there are methods that help us learn something or memorize something quickly, but a few weeks later we have forgotten what we learned and are unable to apply it. There are also methods that seem inefficient in the short-term because it takes more time to implement them. However, what we learned from those more time-intensive methods transfers to other situations better over the long-term. Many researchers have conducted experiments that show focusing on quick, short-term outcomes can cause long-term harm (Dean and Kuhn 2007; Kapur 2016).

Instructional outcomes can also affect educational outcomes. Education aims to cultivate the long-term abilities, attitudes, and perspectives that affect a person's life. These abilities, attitudes, and perspectives change, of course, as the person receives more education and has more life experiences, but they are with the person from a very early age. Instruction is part of education. Instructional activities aim to help a person learn certain things, but it can either help or hurt long-term educational outcomes. For example, a teaching method can help a person acquire knowledge but can possibly damage the person's curiosity or confidence. Teaching can also cause a person to develop antipathy toward the subject being taught. Additionally, research has found that explicit instruction can hurt students' creativity and curiosity (Bonawitza et al. 2011; Buchsbauma et al. 2011; Peterson 1979). It has also been found that early achievement may not result in higher quality of life later on (Kern and Friedman 2008).

Considering side effects in education

Unfortunately, assessment has always focused on a few academic subjects. International assessments such as the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) have typically focused on

reading, math, and science. National or state assessments that matter have typically focused on literacy and numeracy. As a result, despite the multiple outcomes, schools are expected to teach what is assessed. Students, parents, and the general public accept what is assessed as the only measure of educational outcomes. Policy makers pay attention to rankings based on PISA and TIMSS scores. Schools are held accountable for state or national test scores. Students are selected based on test scores of a few subjects. What is not assessed, despite its importance, attracts little attention in practice.

Typically, it is the short-term, cognitive, and instructional outcomes that are assessed in schools today. Schools follow a curriculum or a set of curriculum standards. Every teacher and state standardized test assesses how well students have learned the prescribed knowledge and skills. Very few teachers are advised to think about the non-cognitive, longer-term, and educational outcomes. Likewise, when companies promote their educational interventions or products, they are eager to show their effectiveness in promoting instructional outcomes. Rarely do they talk about the possible side effects or other, negative outcomes.

Although we do not have great instruments to judge whether an instructional activity or program or an educational intervention or treatment can cause damage to non-cognitive, long-term, and educational outcomes, we must be mindful of these outcomes. Educational policy makers and school leaders need to assess the short- and long-term cognitive and non-cognitive outcomes of educational programs for individual students. They must also ask product providers for evidence of a product's impact on long-term non-cognitive outcomes as well as educational outcomes. Teachers, as well, should pay attention to outcomes besides short-term instructional ones. Despite the increasing interest in assessing the multiplicity of outcomes (Duckworth and Yeager 2015; Emler et al. 2019; Zhao 2016), truly reliable and valid instruments are missing.

Instead of waiting for the perfect instruments, which may never come, we can develop other ways to help education policy makers, school leaders, and teachers with the job of assessing side effects in education. For instance, we can develop tools that can help stakeholders consider how educational policies and practices affect all educational outcomes. A taxonomy of educational outcomes is one such tool.

We have developed a taxonomy of educational outcomes, but we must acknowledge first of all that this taxonomy is not a precise tool for assessing the side effects of all educational outcomes. Second, there are so many outcomes that it is impossible to include all of them. Third, this is very preliminary work, and its purpose is for educators to think about the potential impact on all outcomes of any educational invention we aspire to achieve. It guides educators to consider the short-term instructional cognitive outcomes while keeping other outcomes in mind.

Taxonomy of educational outcomes

The taxonomy we have developed places educational outcomes into two large categories: instructional outcomes and educational outcomes. Instructional outcomes are typically what the curriculum or intervention intends to teach; they can be short-term and long-term. Short-term instructional outcomes are the immediate outcomes of the curriculum or intervention,

Table 1. Taxonomy of educational outcomes

Instructional Outcomes				Educational Outcomes
Short-term		Long-term		
Cognitive	Non-cognitive	Cognitive	Non-cognitive	

while long-term instructional outcomes are the application of the short-term outcomes over the longer term. Educational outcomes are life-long capabilities and interests. They can include many of the so-called 21st century skills such as creativity, critical thinking, communication, collaboration, entrepreneurship, social intelligence, and leadership. These skills, which are the ultimate goals of education, can take a long time to cultivate.

We then divided instructional outcomes into cognitive and non-cognitive. Cognitive outcomes are knowledge and skills that enable people to do certain things, while non-cognitive outcomes are the social, emotional, and psychological capabilities that determine whether one wants to do certain things and how persistent one's efforts are. The taxonomy is summarized in Table 1.

How to use the taxonomy

The taxonomy was created as a practical tool for evaluating the potential side effects of any educational intervention, initiative, or policy. We invite educators and policy makers to take a minute to explore the taxonomy informally. We recommend pondering side effects that they have either seen or personally experienced in each category. Perhaps they have seen the negative impact of an intervention on a student's interest in a subject. Or perhaps they have experienced a certain instructional program decreasing their own sense of self-determination during their formative years. We have also provided a series of guiding questions in each category to help stimulate this exploration (Table 2). These questions are by no means comprehensive, but are a good way to begin thinking about side effects. Additionally, for each question we have drawn specific examples that exemplify those side effects from the research literature.

The taxonomy is primarily a functional tool. It is critical to review the potential side effects when deciding to adopt a given intervention, initiative, or policy. Now, it is highly unlikely that users of the taxonomy will find adequate research literature to verify a potential side effect—that's the whole point: These are the kinds of questions that are rarely asked in education. However, our hopes are twofold: First, we hope that even attempting to think through the potential side effects will help educators develop a sense of how interventions can go wrong. They can then take steps to ameliorate potential harms. Our second hope is that educators start asking these questions. When a company tries to sell a school a new instructional platform, the school should inquire about whether the program can transfer to more complex knowledge and skills. When an academic entity touts the newest evidence-based policy to a district, the district should ask about its long-term effects on students' confidence in the subject area. Will they have answers? Probably not. But the expectation will be that there should be answers.

Table 2 Guiding questions

Guiding Questions for Taxonomy	
Short-Term Cognitive	Examples
What are the targeted outcomes of the intervention and were they achieved for all learners?	The Reading First program had a negative effect on student reading comprehension in some learners (Gamse et al. 2008).
What other content knowledge and skills were diminished due to time and resources spent on this intervention?	An exclusive focus on reading and math led to a significant reduction of time and resources to social studies, art, and physical education (Dee and Jacob 2011).
Short-Term Non-Cognitive	Examples
How does the intervention change the student's current thoughts, feelings, and moods?	Elaborative instruction was associated with less anxiety, anger, and boredom in the classroom (Goetz et al. 2006); over-challenge was associated with boredom in the classroom (Daniels et al. 2015).
How does the intervention change the student's attitude toward the subject of the intervention?	Attempts to make math simpler by reducing it to "list of rules" led to student disengagement with math (Nardi and Steward 2003).
How does the intervention change the student's concept of themselves as learners?	Students placed in gifted and talented programs said that high expectations had a negative impact because they felt pressure to succeed (Perrone et al. 2007).
How does the intervention affect the student's relationship to their classmates?	Educators reported that students receiving special education services were stigmatized by their peers (Haight et al. 2016).
Long-Term Cognitive	Examples
Does the target of the intervention lead to more complex content knowledge and skills?	Phonics interventions tended not to show transfer to non-targeted skills (Suggate 2016).
Does the intervention lead to poorer outcomes over the long-term?	Kindergarten retention led to poorer long-term outcomes compared to delayed entry or typical progression (Raffaele Mendez et al. 2015).
Long-Term Non-Cognitive	Examples
How does the intervention affect persistent psychological dispositions such as motivation, self-confidence, curiosity and more?	Direct instruction was found to inhibit creativity and curiosity in preschool children (Buchsbauma et al. 2011).
How do short-term effects of the intervention affect the student's long-term social network?	Student missed the opportunity to create local formative friendships when sent to a distant residential school (Shah and Priestley 2010).
Educational Outcomes	Examples
How do the combination of short and long-term cognitive and non-cognitive outcomes contribute to the higher order goals of education in society (i.e., career/college readiness, citizenship, community involvement, etc.)?	Suspended students were more likely to drop out (Chu and Ready 2018); early literacy skills were negatively associated with social-emotional well-being and adjustment later in life (Kern and Friedman 2008).
Alternative Interventions/Mitigation of Harm	Examples
Can the intervention not be provided or can it be changed to reduce potential harms?	Instruction that included choice-making and goal-setting increased self-determination skills (Burke et al. 2020).

Table 2 (continued)

Alternative Interventions/Mitigation of Harm	Examples
Can the intervention be provided in an inclusive way?	Embedded Instruction allows students to receive targeted interventions within the natural context of a general education class (Jimenez and Kamei 2015).
Can you adjust the dosage or frequency?	Lower frequency of language intervention can be more effective than higher frequency in children with language disorders (Justice 2018).

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