Encouraging, Strong Claims, but Scant Support

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> Abstract • Murphy and Gash present an encouraging approach focusing on meta-learning for children in disadvantaged areas. It is an interesting field study, but nevertheless with defective research support, and it underrates the difficulties low achievers meet in learning mathematics.

Handling Editor • Alexander Riegler

« 1 » In their target article, Fiona Murphy and Hugh Gash present an inspiring field study. Their efforts to develop and strengthen children's motivation and self-confidence to learn mathematics deserve respect. Low-achieving students and students from disadvantageous backgrounds are at high-risk of failure and exclusion in education.

« 2 » The growth-mindset approach has become very popular in psychology and educational practice, particularly in the US.[1] Leading proponents of the approach such as Carol Dweck (2006) and Jo Boaler (2015) often make bold claims about its effectiveness. Boaler (2013) maintains that research has proven the efficacy of the growth-mindset approach and that the mindset revolution is reshaping education.

« 3 » I will examine whether these claims are justified from a radical constructivist perspective. My objections are both empirical and philosophical. I argue that the authors underrate the difficulties low achievers meet in mathematics education, and therefore they overrate their intervention. Although the mindset approach seems to show some similarities to constructivism, its philosophical roots are in behaviorism. Recent research on the mindset approach shows the inefficiency of the mindset approach.

1| See "Schools are buying 'growth mindset' interventions despite scant evidence that they work well" by Brooke Macnamara at https: //theconversation.com/schools-are-buying-growth-mindset-interventions-despite-scant-evidence-that-they-work-well-96001

Studies on low achievement

« 4 » Individual differences in mathematics performance are marked during school age. The range of normal distribution of mathematical skills and knowledge in an average school class is typically several years (Cockcroft 1982). Some students struggle to learn the most elementary topics, while others seem to pick up both procedure skills and conceptual thinking without any observable effort. Why some students seem to display less capacity for learning mathematics than others has been accounted for in many ways from very disparate standpoints. Differences between students in mathematics are a difference in degree, not in kind. Low achievement in mathematics, or mathematical difficulties, can be seen as the lower end of the normal distribution (Dowker 2005). Also, we know that students from minority groups or with low socio-economic status are overrepresented among students having difficulties in mathematics.

« 5 » In a series of studies on low achievement during the 1950s (Magne 1958; Engström & Magne 2010) more than 6,000 students in compulsory school (*Folkskola*) were involved. Besides the mathematical performance of the students, various psychological, social, and medical conditions were investigated. About 15 percent of the population got marks in mathematics below the pass standard according to the current marking system. The majority (more than 90 percent) of those students were slow learners. Other frequent observations were reduced working capacity, failing concentration, failing motivation, and mathematical anxiety. Less frequent were symptoms of nervous disorders, and low socio-economic status and poverty.

« 6 » In Engström & Magne (2003, 2010) we conducted a study on changes of mathematical skills and knowledge in the comprehensive school (*Grundskola*) in a Swedish municipality of about 25,000 inhabitants. Originally conducted in 1977, the study was replicated twice, the first time in 1986 and the second time in 2002. It comprised all students in grade 1 through 9, approximately 2,000 students each year. During this span of 25 years, different educational reforms and curriculum changes took place. The most striking result was probably the stability of students' achievement over the years. Despite educational reforms and curricular changes, the outcome of mathematics education was almost the same during the period from 1977 to 2002. Curricular changes on the national level seem to have only minor impacts on students' achievements. What matters is the educational practice in the classroom.

« 7 » In our studies, special attention was paid to low achievement. There was the same proportion of low achievers in all three investigations They seemed to commit the same types of errors in all investigations, and no valid gender differences were found. The low achievers lagged behind their classmates already from the beginning and the achievement gap between high and low achievers increased during the school years. We could mainly confirm the results already reported in Magne (1958). Students identified as low achievers at the beginning of elementary school were very likely to be low achievers when leaving school.

« 8 » Our result was also confirmed in a German longitudinal study where 200 children were followed over 20 years from 3 years of age to 23 (Stern 1998; Weinert & Schneider 1999). The aim of the study was to investigate the development of individual differences and to ask whether it was possible to understand and predict later competencies from earlier ones. The most remarkable result was the high stability of inter-individual differences from the early beginning of data collection.

« 9 » Low achievement in mathematics shows a remarkable stability during the school years. Of course, this is not a destiny. Contrary to the field study, an intervention strategy must be adaptive, focused on content, and durable in time to be efficient.

The theoretical background

« 10 » Murphy and Gash see the growth-mindset approach as belonging to constructivism. I do not agree. The growth-mindset approach has its roots in the instructional design movement. During the 1940s and 1950s behaviorist-trained psychologists, such as B. F. Skinner, Robert Gagné, Benjamin Bloom, and Robert Mager, worked on different theoretical models of learning or performance objectives. The idea was that learning could be planned into a rational process. Teachers had to clearly and objectively state what they wanted students to learn, the conditions under which the students would learn specific content and how to assess the learning outcomes of the students. I am aware that proponents of instructional design in the US nowadays have pointed to the similarities to constructivist teaching, but this is, to my mind, on a surface level.

« 11 » Bloom (referred to in §61) was a very influential educational researcher in the twentieth century whose mastery-learning approach suggested a hierarchical model of taxonomy applied in education. His *Taxonomy of Educational Objectives* (1956) and *Learning for Mastery* (1968) have much in common with the growth-mindset approach. They both refer to diverse categories of instructional methods. However, his ideas were met with hard criticism already in the 1970s, particularly in the mathematics education research community. A number of researchers, for instance, Stanley Erlwanger (1975), Richard Skemp (1976), and Hans Freudenthal (1978, 1979), rejected Bloom's hierarchical model. Robert Slavin (1987) refuted the strong claims of the proponents of mastery learning in a best-evidence synthesis, summarizing:

> "the best evidence from evaluations of practical applications of group-based mastery learning indicates that effects of these methods are moderately positive on experimenter-made achievement measures closely tied to the objectives taught in the mastery learning classes and are essentially nil on standardized achievement measures." (Slavin 1987: 202)

The field study

« 12 » Since Murphy and Gash do not state any explicit aim of their field study, and do not mention any research questions, a number of questions arise. First, I read it as an intervention study. However, using a qualitative design made no sense to me. Usually qualitative research seeks to explore, describe and explain different phenomena, in this case conceptual change of mindsets. If so, why is the first conclusion in §65 that growth mindset has potential for preventing children from becoming marginalized in school? After only five weeks of research, one cannot predict any long-lasting effects. Even worse, one cannot predict any effects at all.

« 13 » Then I re-interpreted it as a classroom-based research study, focusing on conceptual change of students' and teachers' construction about learning. This would make more sense and would also strengthen the study, if the mindset approach were abandoned. Trying to build models of the students' conceptual changes of their mathematical understanding would be in line with constructivism in mathematics education.

« 14 » Different research designs address different questions. The design chosen here cannot answer any questions of potentiality, impact or effect of the growth mindset. If this was the aim, Murphy and Gash have chosen the wrong research design. I admit that the authors are seriously committed to children from disadvantaged school areas, but they have gone astray in their ambitions. It is understandable if Murphy and Gash set great hopes on the growth-mindset approach, but I must disappoint them. Many claims about growth-mindset theory and intervention may sound reasonable, but they are not. It would be wonderful, if it worked, but it does not. On the contrary, the strong claims made by the growth-mindset community lack a firm research ground. Let me give some short examples from studies that have examined these claims.

The inefficiency of the mindset approach

« 15 » In a set of studies, Brooke Macnamara and Natasha Rupani examined claims about gender, intelligence, and mindset among adult samples, such as that women have a more fixed mindset compare to men, and that the more intelligent the female, the more likely she is to hold a fixed mindset. Their results "suggest gender differences of mindset and the bright woman effect are not consistent phenomena" (Macnamara & Rupani 2017: 59).

« 16 » In two meta-analyses Victoria Sisk and colleagues examined the relationship between mindsets and academic achievement, and the effect of growth-mindset interventions on academic achievement. The results do not support the claims that mindset interventions can lead to large gains in student achievement. The researchers conclude: "The evidence suggests that the 'mindset revolution' might not be the best avenue to reshape our education" (Sisk et al. 2018: 569).

« 17 » Yeu Li and Timothy Bates "found little or no support for the idea that growth mindsets are beneficial for children's responses to failure or school attainment" (Li & Bates 2019: 1653). Alexander Burgoyne, David Hambrick and Macnamara tested six key premises of mindset theory. Their research

> "suggests that the foundations of mindset theory are not firm, and in turn calls into question many assumptions made about the importance of mindset. Given the public spotlight on mindset, it may be prudent for mindset researchers to temper strongly-worded claims." (Burgoyne, Zambrick & Macnamara 2020: 20)

« 18 » In short, the mindset research community still has much work to do. Meanwhile, teachers interested in teaching low achievers in mathematics and students from disadvantaged schools should not worry about the growth-mindset approach. It probably will not do any harm, but money and efforts can better be put towards measures we know work in classrooms.

« 19 » The article is an ambitious attempt to widening the meaning of constructivism in mathematics education, but it has, in my opinion, obvious weaknesses from both a philosophical and an empirical viewpoint. From a radical constructivist point of view, it confuses constructivism with fashionable ideas in education, ideas that originate in behaviorism. Its foundation lacks necessary empirical support.

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Conceptual Change by Fiat?

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> Abstract • What Murphy and Gash are attempting to do is to solve a significant problem some students have being successful in school, one that is not often addressed in any significant way. The language used to describe the lessons has some significant departures from radical constructivism. It is, no doubt, beneficial that the students in the study may have developed improvements in self-image, but, as seen in other work, the application of radical constructivism to develop and extend the work started in the study could result in more and more lasting improvements.

Handling Editor • Alexander Riegler

« 1 » In the target article, Fiona Murphy and Hugh Gash are working with students who think they cannot be successful at school tasks. Murphy and Gash are trying to change the students' conceptions of themselves.

The need to cultivate a growth mindset in students

« 2 » One of the chief problems in schools is that children learn damaging views of themselves and their relationship to knowledge. We know that, early on, young girls "learn" that they are not good at math and science in school. While this may have begun to change, it has not stopped. Students who show some potential at something in school are easily "forgiven" for not doing well at something else. A prevailing notion is that some people are "just good" at some things, while others are not. This is soaked up as much by boys as girls and continues as they grow up to be young women and young men. It is as if we must be thankful for what small successes we see. However, that the result is substantial damage to our culture seems to go unseen. Of course, the damage is in the eye of the beholder. There are those who generally have sway over the schools, who benefit by having the "I can't" self-image be the result of schooling for many students (Bowles & Gintis 1976).

« 3 » I agree strongly with Murphy and Gash in the sense that our students are not served well by what they learn in school about their own abilities in school, their relationship to knowledge and the nature of knowledge. Students probably learn these things in more lasting ways than anything "taught" to them as content in school. Every year in school from K-16 (kindergarten through the 4th year in college), at least, instructors wonder: what were these students doing last year, why can't they do what they are supposed to have learned last year? This seems to have been going on for decades, as can be attested by teachers of long standing. And, these teachers will recall, when they were just beginning, teachers of long standing back then saying the same things.

« 4 » In my own field, physics education research, since about 1980, we have been documenting that students come to us already having constructed understandings of the physical phenomena we deal with in our introductory courses (Dykstra 2005). They have constructed a kind of toolbox