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INTRODUCTION

# How Psychological Science Can Improve Our Classrooms: Recommendations Should Bridge the Laboratory and the Classroom

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It is uncontroversial to claim that student outcomes matter. More education is associated with higher salaries, a lower incarceration rate, better health, and increased volunteerism (for a summary, see the College Board's *Education Pays 2013*; Baum, Ma, & Payea, 2013). Student outcomes in turn can influence the amount of state and federal funding schools receive, potentially setting up a cycle whereby low achieving schools lose the resources needed for improvement.

What is more controversial are claims about how best to improve student outcomes. It is an understatement to claim that many factors contribute to student success (or lack thereof). Hattie's (2009) synthesis of 800+ meta-analyses implicates characteristics of the student, the home, the school, the teachers, and the curriculum that matter, with factors as diverse as teacher-student relationships, socioeconomic status, motivation, and phonics instruction all predicting student outcomes. This issue reflects that diversity, with articles focused on basic learning processes (see Putnam's, 2015 paper) fitting the theme just as well as articles on peer relations and seating arrangements (see the paper by Audley-Piotrowski, Singer, & Patterson, 2015).

We believe that the translation of psychological science to education is particularly tricky, given all of the moving parts. It could be argued that recommendations from basic science will constitute a "drop in the bucket" when implemented in complicated real world settings. Basic research on (say) learning foreign language word-pairs seems completely removed from the inner city classroom filled with students dealing with all kinds of problems at home. But individual success stories, teacher and student opinions, and popular-press books are not the kind of data on which we should base educational reform, no matter how intuitively appealing they feel. In the remainder of this editorial, we discuss the importance of basic science work that bridges the laboratory and the classroom.

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Educators bring a wealth of knowledge into the classroom, and good teaching clearly contributes to positive student outcomes. However, educational practice cannot be based solely on one's personal experiences or intuitions about what works—such impressions can be wrong and lead the learner astray. For example, college students report their main study strategies to be rereading and highlighting their notes and textbooks—but much research shows these strategies are not in fact effective, even though they

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require students' time (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013).

A second example involves the popular idea of learning styles—the concept that students have different learning styles, and that learning is optimized when instruction matches an individual's specific style. For example, someone with a "visual learning style" is predicted to learn better if allowed to read the material rather than listen to a lecture. However, to date, there is no scientific evidence to support this practice (Pashler, McDaniel, Rohrer, & Bjork, 2008). Despite the lack of evidence, the belief in learning styles is common among both children and adult students. Furthermore, teachers and administrators are not immune to this incorrect belief; teachers are often advised to assess students' learning styles and tailor instruction to match each student's style. Such incorrect beliefs are not without costs, as assessing learning styles requires purchasing assessment tools and wastes both student and teacher time.

The psychological literature is ripe with examples such as these, where beliefs do not match science. It becomes clear very quickly that learning could be improved and a great deal of resources saved if educational practices were informed by basic psychological science.

## Kathleen M. Arnold
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From the perspective of a scientist, the classroom is a very messy environment. It is often impossible to randomly assign students to conditions, due to requirements to treat all students similarly. The scientist is unlikely to be able to control or measure (or perhaps even have knowledge of) all of the factors that might influence the target behavior. There is often no way around these constraints, such as when one wants to study shy children in the classroom (see the paper by Kalutskaya, Archbell, Moritz Rudasill, & Coplan, 2015). However, as outlined below, working in this noisy environment has real benefits.

First, the scientist may discover behaviors of which he or she was unaware, or determine that the questions educators need answered are quite different from the preconceived ones of the researcher. For example, Fan's (2015) paper on "drawing to learn" points to several classroom exercises that suggest interesting directions for psychological research. More generally, if the goal is to understand and predict behavior in the real world, then one cannot place so many constraints on the situation that it becomes quite unlike a real classroom (Rubin, 1989). Doing so runs the risk of missing important variables (which are misclassified as extraneous factors) and reduces the likelihood that the results will generalize across situations.

Consistent with this concern, strict controls sometimes produce different effects from what occurs naturally in the classroom. For example, there is a robust laboratory finding called test expectancy, whereby students who expect an open-ended test (recall) later outperform those who expect a multiple-choice test (recognition), regardless of the format of the final test. However, a meta-analysis of classroom research showed that students perform best when they expect the type of test they are actually given: a very different result (Lundeberg & Fox, 1991). It cannot be assumed that all experimental findings will generalize to the classroom.

Letting go of experimental control is not easy, in part because reducing control also reduces the research's statistical power—making it more difficult to detect an effect. However, in that reduction of power, scientists gain something even more important—a chance that their research can be applied in real classrooms and improve the lives of real students.

In summary, successful translation should be grounded in both laboratory and classroom research. The U.S. Department of Education has laid out a set of standards to determine "what works" (to search for recommendations about particular interventions, go to http://ies.ed.gov/ncee/wwc/findwhatworks.aspx). To be recommended, it is not enough just to show an effect of an intervention; the rating also depends on whether there are confounds, control group(s), and some degree of random assignment. Similarly, when evaluating interventions, laboratory demonstrations are not sufficient; the Department of Education only recommends strategies such as retrieval practice (via flashcards or other methods of self-testing) because the effects have been observed in both the laboratory and the classroom. Classroom experience and scientific methods must come together to develop the educational experiences our students deserve.

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