Consequences Of Learning About Great Scientists

Posted on May 11, 2020

Introduction

The study “Even Einstein Struggled,” by Xiaodong Lin-Siegler and colleagues, examined whether stories about famous scientists’ difficulties could improve high school students’ motivation and performance in science. The researchers challenged a familiar instructional habit: presenting scientists only as unusually gifted people who made discoveries through brilliance. Such accounts can inspire admiration, but they may also imply that success belongs to people with exceptional natural ability. By contrast, stories that describe intellectual confusion, failed experiments, rejection, poverty, discrimination, or persistence may help students interpret their own difficulty as part of learning rather than proof that they do not belong in science. (Lin-Siegler et al., 2016)

The original review identifies the central topic but reverses the independent and dependent variables and describes survey measures unclearly. The instructional story condition is the independent variable. Student beliefs, interest, and course performance are outcomes. A careful analysis should distinguish what the study actually found from broader claims about growth mindset, motivation, and science education. (Dweck, 2006)

Research Question

The main question was whether exposure to struggle-oriented stories about accomplished scientists would affect students differently from exposure to achievement-only stories or ordinary instruction. The study also asked whether two types of struggle mattered differently. Intellectual struggle concerned failed attempts, difficult problems, and persistence in scientific work. Life struggle concerned personal obstacles such as poverty, prejudice, displacement, or family hardship.

The practical problem is important because many students see textbooks as collections of completed facts. The uncertainty, revision, disagreement, and persistence that produce scientific knowledge are hidden. Students may therefore believe that confusion signals inability, even though authentic research depends on confronting uncertainty.

Conceptual Framework

The study draws on research about achievement motivation, beliefs about ability, attribution, and role models. Students interpret success stories by comparing themselves with the person presented. An extraordinary achievement can be motivating when the model appears attainable, but discouraging when the model seems fundamentally different.

Struggle stories can change attribution. A disappointing grade may be explained as evidence of low fixed ability, or it may be interpreted as a signal that strategy, effort, help, and time are needed. The intervention was not simply a message to “work harder.” It provided narrative evidence that accomplished scientists faced obstacles and that progress involved sustained problem-solving.

Independent Variable

The independent variable was the type of biographical material students received. Students were assigned to conditions that emphasized scientists’ intellectual struggles, life struggles, or achievements without comparable discussion of struggle. The stories concerned major scientists, including Albert Einstein, Marie Curie, and Michael Faraday.

This design allowed the researchers to ask whether the content of the biography mattered. All groups could read about famous scientists, but the framing differed. The achievement-only condition tested the common assumption that impressive success itself motivates students.

Dependent Variables

The most important dependent outcome was students’ science course performance after the intervention. The researchers also examined motivational beliefs and students’ perceptions of scientists. Measures included beliefs about intelligence and effort, interest, and responses to the biographical material.

The original essay calls “science struggle” the dependent variable and motivation the independent variable. That is incorrect. Struggle was a feature of the instructional treatment, while motivation-related measures and grades were outcomes. Clear variable identification is essential because it determines what causal claim the experiment can support.

Participants and Setting

The study was conducted with high school students in real science classes rather than a short laboratory simulation. Classroom research improves practical relevance because students encounter the intervention within an ongoing course, with actual grades and teachers. It also creates complexity: classes differ, teachers influence learning, and students talk with one another.

The participants came from schools serving many students from lower-income and underrepresented backgrounds. This context matters because science narratives may be especially consequential for students who have fewer opportunities to identify with stereotypical images of scientists.

Operationalization

Abstract concepts such as motivation cannot be observed directly. Researchers operationalize them through survey items, behavior, and performance. Beliefs about intelligence may be measured through agreement with statements about whether ability can change. Beliefs about effort may be measured through views about whether difficulty means learning is occurring or ability is lacking.

Operationalization always has limits. A Likert-scale response may reflect what a student thinks is socially desirable, and broad beliefs about intelligence may not predict behavior in one science course. Grades reflect learning but also attendance, prior knowledge, teacher practices, and assessment design. The study therefore used several kinds of evidence rather than treating one survey item as motivation itself.

Main Findings

Students who read about scientists' intellectual or life struggles improved their science course performance relative to students who read achievement-only accounts. The effect was especially meaningful for students who had been performing less well. Achievement-only stories did not produce the same benefit and may have reinforced distance between ordinary students and celebrated geniuses.

The intervention did not transform every general belief measure. This is important. Improved course performance did not require a large measurable change in students' broad theories of intelligence. The stories may have affected more specific interpretations, attention, engagement, identification, or persistence without changing an abstract worldview captured by a survey.

Why Struggle Stories May Work

First, the stories humanize scientists. Students see that scientific achievement involved error, uncertainty, and revision. Second, the stories make a process visible. Instead of receiving only the correct formula or discovery, students encounter the work behind it. Third, life-struggle accounts can show that social and economic barriers affect opportunity without defining a person's capacity.

Fourth, the narratives may reduce upward-comparison threat. A perfect genius is difficult to imitate; a skilled person who experienced setbacks provides usable information about persistence. Finally, struggle stories can alter classroom norms by making questions and mistakes legitimate.

What the Findings Do Not Prove

The study does not prove that every inspirational biography improves learning. The selection, writing, timing, and classroom context matter. A story of hardship can become manipulative if it romanticizes suffering or implies that effort always overcomes structural barriers. Students may reasonably recognize that discrimination, poverty, disability, and unequal schooling cannot be solved by attitude alone.

The results also do not mean teachers should hide achievement. Scientific accomplishment is worth studying. The lesson is that achievement should be presented as the outcome of inquiry, collaboration, failure, social opportunity, and persistence rather than as evidence of effortless genius.

Strengths of the Study

A major strength is ecological validity. The intervention occurred in classrooms and used course outcomes. The inclusion of more than one struggle condition helped distinguish intellectual difficulty from personal adversity. The comparison with achievement-only biographies directly tested a familiar educational practice.

The study also connected a modest intervention with measurable performance. Teachers can revise stories and textbook framing more easily than they can redesign an entire school system. A low-cost intervention is valuable when it supports, rather than replaces, deeper improvement.

Limitations

The effect size was not enormous, and the intervention was studied in a particular context. Results may differ by age, subject, country, teacher, or prior achievement. Famous scientists' stories may become less effective if repeated mechanically. Students may also respond differently depending on whether they trust the account or identify with the scientist.

Grades are influenced by teachers and course structures, and the study cannot reveal every psychological mechanism. Some measures did not change as expected. Longer follow-up would be needed to determine whether effects persisted into later courses, college majors, or career choices.

Historical Accuracy

Using struggle narratives creates an obligation to be accurate. Einstein should not be reduced to the false claim that he failed mathematics. Marie Curie's achievements should not be separated from gender barriers, dangerous exposure, collaboration, and historical context. Faraday's limited formal education should not be used to dismiss the importance of education itself.

Biographies should explain sources and uncertainty. A simplified anecdote that produces motivation through misinformation is poor science education.

Avoiding the Lone-Genius Myth

The original study focused on famous individuals, but modern science is highly collaborative. Textbooks should also present technicians, data collectors, research participants, engineers, institutions, rivals, and communities. Discoveries emerge from networks and inherited knowledge.

Students need examples of diverse scientific roles. Not everyone becomes an iconic theorist. Laboratory work, public health, field research, software, teaching, policy, communication, and skilled technical practice all contribute to science.

Application in the Classroom

A teacher can introduce a concept through a short, sourced account of the difficulty involved in its development. Students can compare an early incorrect model with later evidence, analyze a scientist's revised explanation, or identify the collaboration behind a discovery. The story should connect directly with the lesson rather than function as unrelated entertainment.

Teachers can also model their own problem-solving carefully. Saying "I do not know; let us examine the evidence" demonstrates scientific practice. Assessments can permit revision and feedback so the course structure supports the message that initial error can lead to learning.

Equity and Representation

Stories should include women, Black scientists, Indigenous knowledge holders, disabled scientists, researchers from the Global South, and people whose work was historically undercredited. Representation is not merely visual. Students should learn how institutions distributed access, recognition, and resources.

At the same time, members of underrepresented groups should not be presented only through trauma. Their curiosity, humor, collaboration, ordinary work, and intellectual contribution deserve attention. Every biography should not have to become a heroic story of overcoming prejudice.

Proposed Follow-Up Study

A useful follow-up would compare four conditions across several schools: achievement-only biographies, intellectual-struggle biographies, life-and-structural-struggle biographies, and process narratives about collaborative scientific teams. Students would be randomly assigned within classes where feasible. The study would measure course grades, persistence on difficult tasks, help-seeking, interest, belonging, and interpretations of mistakes.

Researchers should collect baseline data, use validated measures, preregister hypotheses, and follow students into the next academic year. Interviews could explain how students interpreted the stories. Fidelity checks would confirm that teachers delivered each condition as intended.

Ethical and Methodological Considerations

Students should not be deceived about scientists' lives or told that failure guarantees success. Privacy must be protected when linking survey responses with grades. Researchers should avoid labeling students publicly as low performers.

Analysis should examine whether effects differ by prior achievement, gender, race, language background, and socioeconomic context without treating subgroup results as fixed traits. Replication across settings would show whether the intervention is robust. (Bandura, 1997)

Conclusion

Learning about great scientists' struggles can improve science education when the stories reveal the process behind achievement. Lin-Siegler and colleagues found that intellectual- and life-struggle narratives improved course performance relative to achievement-only accounts, with important benefits for students who were previously performing less well. The intervention did not simply change every broad belief about intelligence, suggesting that motivation operates through specific interpretations, identification, engagement, and classroom context.

The study's lesson is not that hardship is desirable or that effort overcomes every barrier. It is that presenting science as effortless genius misrepresents both learning and research. Accurate struggle stories, collaborative histories, diverse role models, and classroom opportunities for revision can make difficulty understandable. Students need to know that confusion is not the opposite of science. It is often where scientific work begins.

References

Lin-Siegler, X., Ahn, J. N., Chen, J., Fang, F. F. A., & Luna-Lucero, M. (2016). Even Einstein struggled: Effects of learning about great scientists' struggles on high school students' motivation to learn science. *Journal of Educational Psychology, 108*(3), 314–328. https://doi.org/10.1037/edu0000092

Dweck, C. S. (2006). *Mindset*. Random House.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. W. H. Freeman.