

## CHAPTER FIVE

# Confidence

*Joe Lorenzo, a physical science teacher, is scoring his students' exams. As he writes a "C" on Luisa's, he is filled with regret and frustration. "She knows this stuff, but her answers are vague," he says to himself. "I can see when she talks with her classmates that she understands this, but all of her comments start with 'I don't really know, but . . .' or 'I don't think this is right, but . . .' If she just had confidence, she would do so much better. What can I do to convince her that she can do this?"*

**M**ost teachers and parents don't need to see a lot of research to be convinced that confidence contributes to success. One of us (Jennifer) recalls being told repeatedly by a high school coach that "you have to believe it to achieve it." In this chapter, we will only briefly review the research, which confirms what most teachers and parents already know about the importance of confidence. We will focus more on where confidence comes from and how the factors that shape students' confidence for science may be different for boys and girls. We will then offer practical suggestions for teachers who want to help students improve their confidence.

## WHAT DOES IT MEAN TO HAVE CONFIDENCE IN SCIENTIFIC ABILITIES?

*Confidence* is an everyday term describing the beliefs people hold about their potential to achieve an outcome. We decided to use this term precisely because it is familiar to teachers and parents. Our use of the term is compatible with, and informed by, terms such as *self-efficacy* (Bandura, 1986) and *expectancies for success* (Eccles et al., 1983; Wigfield & Eccles, 2000, 2002), which are used by educational psychologists. These less-commonly used educational psychology terms refer to beliefs about succeeding (a) in particular domains, such as physics, biology, writing, or basketball, and (b) on specific tasks, such as using a pipette or memorizing the noble gases.

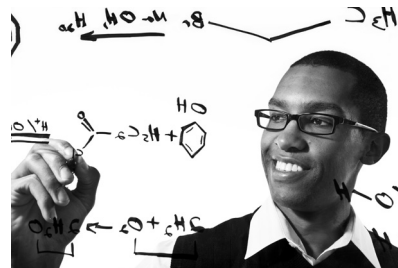
## WHY IS CONFIDENCE IMPORTANT?

Students' confidence contributes to what they choose to do and how they approach that choice. When a student has confidence, he or she tends to engage in activities more readily, work harder, and continue trying longer (Schunk & Miller, 2002). It should come as no surprise, then, that students tend to learn and achieve more as a result of higher confidence levels.

The high school years are a critically important time for the development of confidence. Confidence comes into sharp relief during adolescence, because the many developmental and environmental changes experienced by adolescents present challenges that require them to adapt and adjust. As students accommodate to those changes, they go through a self-appraisal process that includes comparing themselves to others and to standards that have generally become more demanding. This can take a toll on students' sense of confidence under the best of circumstances, so their confidence frequently declines across typical adolescent transition points, such as the move from elementary school to middle school and then from middle school to high school (Schunk & Miller, 2002; Wigfield & Tonks, 2002).

Although there is considerable variation within gender, an overall gender gap in confidence regarding science and science-related activities appears during high school, with girls losing far

more confidence than boys (Andre, Whigham, Hendrickson, & Chambers, 1999; Greenfield, 1996). We investigated high school students' confidence in science over the course of a single school year and found that not only did girls begin the year with less confidence than boys, but they were also more likely than boys to decline in confidence over the course of the year. Importantly, the extent and pattern of that change varied considerably between teachers, suggesting that teachers have the power to fend off a decline in confidence among their female students (Schmidt & Shumow, 2012). Indeed, classroom environments are very important for influencing confidence (Lloyd, Walsh, & Yailagh, 2005). Teachers can and do impact students' confidence in science and can be more effective if they know the information and have access to the resources presented in this chapter.



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## WHAT HAVE RESEARCHERS DISCOVERED ABOUT CONFIDENCE?

### Confidence Comes From Many Sources

It is important for teachers to know what contributes to students' confidence in a way that promotes achievement motivation. Bandura (1986, 1997) specifies four major sources of confidence. These sources can promote or undermine students' confidence. Of course, students' background characteristics may result in differing degrees of access to these important influences.

### Prior Success

The first source of confidence is a history of prior success (also called *mastery experiences*). Researchers from a number of different theoretical traditions have identified prior success (or failure) as a primary contributor to a student's confidence (Bandura, 1986, 1997; Eccles, 1983; Wigfield & Eccles, 2000, 2002). A person's history of prior success refers to the degree to which he or

she has experienced success in a given domain, such as science. This is reflected in performance on particular tasks such as test taking, laboratory experiences, or writing laboratory reports. Chapter 6 addresses the role of success in depth.

### **Observing Others**

The second influence on confidence is observing the experience of others (also referred to as *vicarious experience*). Students learn from a wide variety of role models and, if a role model is perceived as similar to oneself, the influence is strengthened (Schunk & Hanson, 1985). For example, models close to an adolescent's age tend to have a greater effect than do adult models. However, adult role models can be influential, and in these cases, the same principle of similarity applies. A ninth-grade Spanish-speaking girl who was born in Mexico and is now living in Southern California is unlikely to see Stephen Hawking's success as a physicist as an indicator that she, too, could be a physicist. Exposure to an older woman from her neighborhood who emigrated from Latin America, obtained a college degree in physics, and works at NASA's Jet Propulsion Laboratory would likely have a far greater impact on her sense of what she herself can attain. Similarly, parents can serve as role models through careers and interests. Teachers should note that observing others struggle, cope, and eventually succeed at a task can contribute to confidence even more than watching someone for whom the task appears to come very easily. Conversely, watching a peer fail, especially one with whom the student identifies, can lead a student to expect failure.

### **Persuasion**

Persuasion, the third influence on confidence, entails efforts to convince students that they can be successful and to urge them to try a particular task. Persuasion often takes the form of verbal encouragement, such as "I'm sure you can do it." Encouragement can be most effective if the task is within the student's reach, but it can also be damaging if the task is out of reach and the student fails miserably. Students' confidence in themselves and in the teacher (or coach or parent) can be undermined when adult persuasion is based on unrealistic expectations, whether too high or

too low. An example of expectations being too low often occurs when stereotypes lead adults to think that certain students cannot or will not do well. Constructive feedback on student assignments can also operate as a form of persuasion when it is given in a way that tells students what they did that enabled them to be successful or convinces students that they are capable of improving by following specific suggestions (Schunk & Miller, 2002).

## **Emotional Experiences**

The final source of confidence is how students feel when they are in class or working on a particular task (also referred to as *physiological responses*). Feeling stressed or anxious in class undermines confidence. On the other hand, feeling good emotionally (enjoying oneself, feeling interested) while engaged in a learning situation is likely to promote self-confidence (Stipek, 1998). The impact of emotional experience is explored in depth in Chapter 10.

## **The Sources of Confidence in Science May Be Different for Boys and Girls**

In our research, we have found that these sources of confidence in science may operate slightly differently for boys than for girls, with some sources exerting greater influence than others. It is important to note that these gendered patterns in the sources of science confidence do not operate the same way in subject areas such as English (Pajares, Johnson, & Usher, 2007). In other words, boys and girls appear to develop their confidence for science in unique ways.

### *Mastery Experiences Influence Boys More Than Girls*

We found that girls' prior success experiences did not seem to have the positive effect on confidence that theory and prior research have suggested. Among girls in our study, the students with higher science grades did not have higher science confidence than their less successful peers. Thus objective successes did not have a positive influence on confidence. As a matter of fact, we found that girls generally reported feeling less successful than boys in science, even when their grades were higher. So focusing

only on creating opportunities for girls to achieve objective success may not be the most effective route to increasing girls' confidence in science. It may be most effective to couple supporting successful science achievement with other factors as described below. These types of objective success experiences, however, do appear to be the most highly motivating experiences among male students (Lent, Lopez, Brown, & Gore, 1996).

*Persuasion and Observing Others Are Effective Strategies for Influencing Girls' Confidence in Their Scientific Abilities*

A number of researchers have found that persuasion and vicarious experiences are particularly influential sources of motivation for girls in mathematics, life science, and physical science (Britner, 2008; Lent, Brown, Gover, & Nijjer, 1996; Zeldin & Pajares, 2000). Role models show female students that science is an attainable and approachable field (Society of Women Engineers-Assessing Women and Men in Engineering Project [SWE-AWE], 2009), and successful female scientists often point to role models as having been highly motivating to them (Zeldin & Pajares, 2000). In a study of women who had attained success in science, technology, engineering, and mathematics (STEM) fields, Zeldin and Pajares (2000) reported that many women identified supportive and encouraging high school teachers as instrumental to their success. In our research, student ratings of their science teachers' confidence in them (which we interpreted as a form of persuasion) predicted students' own confidence, though it was not related to change in confidence over time.

*Emotional Experience Matters for Girls*

Emotional experience in science also appears to exert particularly strong influence on girls' confidence in their abilities. In our research, girls were far more likely than boys to report feeling stressed in science, and feeling stressed during class was related to a decline in their confidence. Britner (2008) also found that negative emotional states such as anxiety and stress play a prominent role in lowering female students' self-confidence in science, but these same emotions do not exert such strong influence on males' science confidence.

## **Teachers Are an Important Source of Science Confidence**

In several studies, female students have attributed their confidence about doing well in STEM fields to their teachers' qualities more often than have male students (Britner, 2008; Lent, Brown et al., 1996). Given girls' attributions and the different patterns of change in student confidence that we observed in different teachers' classrooms in our study, we set out to learn more about how teachers' practices were related to changes in boys' and girls' confidence (Schmidt & Shumow, 2012). To do so, we looked carefully at the practices of three female biology teachers. In one teacher's class, both male and female students increased in confidence over the school year. In another teacher's class, boys' and girls' confidence levels remained static. Boys' confidence levels in the remaining teacher's class increased but girls decreased in confidence. These findings tied teacher practices to student perceptions.

When we analyzed each teacher's interaction patterns with students, we saw that the ways teachers interacted with students was consistent with changes in students' self-efficacy in their classroom. The teacher whose students grew more confident engaged her students and promoted their thinking far more than did the teacher whose students did not change. We interpreted the way she called on and interacted with her students as a form of persuasion to participate in learning. Furthermore, this teacher engaged her male and female students at equal rates. The teacher whose male students improved but whose female students declined engaged her male students nearly twice as often as her female students. The teacher whose students did not change did little to encourage her students to participate. In our interviews with the teachers, we ascertained that the teachers' beliefs about gender differences and equity in science aligned with their practices and with their students' confidence.

The fact that female students' confidence is often low initially, drops across the school year, and is related to the teacher's beliefs and practices highlights the importance of trying to intervene. Girls' confidence in science, rather than objective measures of achievement, appears to be the central factor in whether or not they continue to study or choose careers in science (i.e., their motivation for studying science). It is important to remember that

one of the teachers we studied reversed the general trend through her efforts. Teachers may want to try some of the suggestions and use some of the resources provided in the following sections, so as not to contribute to a loss of confidence in their students.

### **Families Influence Confidence**

Parents exert a powerful impact on their children's confidence (Frome & Eccles, 1998). We found that parental involvement at school predicted students' in-the-moment confidence when they were engaged in science classroom activities (Shumow, Lyutykh, & Schmidt, 2011) but did not contribute to change in their general science confidence during the school year (Schmidt & Shumow, 2012). In other words, parents influenced their children's daily motivation and engagement. Parental involvement at school (e.g., attending events, volunteering, talking to teachers) might serve to communicate to students that school is important. Other researchers have highlighted the role of parents as role models themselves, as providers of role models (e.g., finding, recognizing, and pointing out female scientists in person or in the media), and as cheerleaders who encourage their children's efforts and success in science (SWE-AWE, 2009).

## **HOW CAN TEACHERS BUILD STUDENT CONFIDENCE?**

There are at least four approaches that can be used to build confidence. Those are described here.

### **Promote Success**

As noted earlier in this chapter, successful experiences play an important role in predicting students' levels of confidence. It is important to remember that for female students, the role of success may be strengthened by pairing it with images of role models and providing encouragement. The role of success and how to promote it is so central in motivating students to learn science and in the work of a science teacher that we have devoted an entire chapter to it (see Chapter 6).



## Make Use of Role Models

Science teachers can arrange a variety of role models for their students, making sure that those models include females and racial or ethnic minorities. We have seen science teachers use students in their classrooms as effective role models from time to time by having a student show a particularly effective strategy or approach that they were using to complete a lab or other assignment. Notice that the focus is on a specific strategy or process that peers can use and not on some fixed ability (see Chapter 8). Choosing a specific instance opens the door to being able to highlight the success of a number of different students over time rather than just a few. The experienced high school teacher knows that peers influence one another, and given the research evidence that peer models are the most influential, this technique is especially promising.

Students can be asked to identify family, friends, or community members who might serve as role models, but role models do not have to be people whom the students know or with whom they interact directly. In other words, these role models can be presented using various media. Recall that students benefit most when they see models similar to themselves, so it is important to present models with different characteristics to increase the chance that all students will find an effective model (male/female, race/ethnicity, people with disabilities). Teachers can invite former students who have entered science careers to come back and talk to students. A highly acclaimed chemistry professor we know searches his undergraduate classes for female students who do well and who look like they are affiliated with different peer crowds (e.g., preppie, alternative) and from underrepresented groups; he then recruits them to do demonstrations in middle schools and high schools so that the adolescents see that people similar to them succeed in science.

An important caveat for teachers to consider in their identification of role models, however, is that when learners are anxious about their abilities to begin with, they tend to be intimidated by role models who look as though they never struggled and, instead, will learn more from role models who used to struggle with the material but, through their efforts, were able to achieve the competence that they demonstrate today. For struggling learners, seeing

that someone else struggled and eventually succeeded can be highly motivating. This may be true especially for girls in science, who tend to have greater levels of anxiety than boys.

### **Encourage Students, Especially Girls**

Encouragement (i.e., persuasion) contributes to student confidence. There is some evidence demonstrating that when teachers simply tell students that they believe that they can do something, this alone improves confidence. Encouragement is especially important for female students. It is important to remember that person praise (“You are so smart”) is different from encouragement (“If you continue to use the study strategies you used this year, I am sure you’ll be successful in AP physics next year”). Science teachers, guidance counselors, and parents can encourage girls to take higher-level science courses. If female students hear the message that they are equally capable of achieving in science, then they are more likely to assess their abilities more accurately (Hill, Corbett, & St. Rose, 2010). Encourage students to think about careers that they might not have considered and persuade them that they are good candidates for these science-based careers if such persuasion is warranted.

### **Communicate With Families**

Science teachers can let families know about how influential they can be in building students’ confidence through an announcement made at an open house or in an electronic or print communication. Parents can also benefit from understanding the potential differences between boys and girls when trying to encourage their children. Family members might have suggestions for potential role models. They might also appreciate written information and links to role models, posted on a class website. Families can provide more encouragement if they are aware of the career opportunities afforded by studying science and if they are encouraged to model interest in their children’s science class and to talk about and explore careers in science with their children. Keep parents informed of local science activities and events they can share with their child and invite them to contact you if they need more information or support for their child’s science study.

## **WHAT RESOURCES CAN SCIENCE TEACHERS USE TO PROMOTE CONFIDENCE?**

The companion website, <http://www.niu.edu/eteams>, contains useful resources to help teachers build confidence in their students or to recommend for parents of their students. The following and more can be found on the website:

- Links to sources that provide examples of women as science role models
- Links to professional organizations where classroom resources and guest speakers may be found
- Links for resources to help students with test-taking anxiety
- Streaming video clips of women role models in science and teachers who positively impact their students' confidence and competence
- Links and videos of interest to parents