Many adolescents, particularly female and minority students, choose not to pursue careers in math, science, and technology.

Mapping Leaks in the Math, Science, and Technology Pipeline

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For many years, the United States has been a world leader in technological and scientific innovation. This achievement has been accomplished by educating top scientists and engineers from all over the globe, who have gone on to work in universities and industries that have contributed to new discoveries and applications of those discoveries. The need for highly trained scientists and technicians remains high, especially for research, design, and engineering positions that require employees to have a college degree and skills in math, science, or technology. Yet these needs in the occupational market may not be met if current trends in educational attainment continue.

The pipeline into these jobs begins in high school, but many “leaks” occur before young people reach the highly educated workforce needed to sustain leadership in science and technology. Similar issues occur in other countries; however, the leaks in the pipeline vary depending on the particular country and its needs. For example, some developing countries have leaks prior to higher education generally, including low rates of high school completion, while other leaks are specific to certain ethnic minority groups and may or may not be focused on math and science education. Many Western countries have problems similar to those faced in the United States, with fewer and fewer young people choosing science and technology, while students from Asian countries do not show the same systematic biases.

Two of the largest leaks in the math, science, and technology pipeline in the United States are enrollment in college and earning a degree in these majors. Currently approximately 62 percent of high school graduates go on
to college of some sort, including two-year degree programs, and only about half of those attending four-year colleges complete degrees within six years (Forum for Youth Investment, 2004). Clearly, many students opt out of the pipeline by not completing their college education. The second major leak in the pipeline occurs because few college students select science or engineering majors. In 2001, only 32 percent of students who earned a bachelor’s degree majored in science or engineering (National Science Foundation, 2004). All groups of students continue to drop out of the educational pipeline in science and technology at alarming rates, but women and ethnic minority youth drop out at a faster rate at each transition within higher education.

The percentage of women who earn a degree in science or engineering majors is markedly lower than that of men at all college levels. In 2001, 28 percent of females who completed a bachelor’s degree earned that degree in science or engineering compared to 36 percent of males (National Science Foundation, 2004). This gender-typed pattern persists through graduate school. Only 6 percent of females and 10 percent of males who completed bachelor’s degrees went on to earn a master’s degree in science or engineering, and only 1 percent of females and 3 percent of males went on to earn a doctorate in those fields. Men’s and women’s pursuit of science and engineering dramatically declines in terms of advanced degrees. Women, however, are clearly underrepresented at all education levels.

Ethnic minority youth who are U.S. citizens or permanent residents are most likely to drop out of the pipeline before attending or completing college (Forum for Youth Investment, 2004). Ethnic minority youth make up a small portion of the college population. Of those completing a bachelor’s degree in 2001, 76 percent were Caucasian, while only 6 percent were Asian, 9 percent African American, 8 percent Hispanic, and 7 percent American Indian (National Science Foundation, 2004). Although the proportion of students who go on to receive graduate degrees is similar across ethnic groups (for example, 5 percent earn a master’s degree), the actual number of graduate degrees varies dramatically due to the low number of ethnic minority students. For example, the 5 percent of Caucasians who go on to receive master’s degrees in science and engineering represent 48,792 individuals, while the 5 percent of African Americans who receive master’s degrees in those fields represent only 6,117 individuals. The same pattern emerges for those receiving the doctorate.

Women and minorities are underrepresented in science and engineering degrees. They account for a small portion of the workforce in higher-paying and more innovative jobs that require advanced degrees. This schism between the skills necessary in our ever changing economy and the skill set that most young adults acquire is troubling. It leads us to ask the question that forms the basis for this volume: Why are adolescents and young adults, particularly women and minorities, opting out of the math, science, and technology pipeline?
For decades, researchers have grappled with understanding the precursors of adolescents’ occupational and educational choices. The Eccles et al. Expectancy Value Model has been instrumental in guiding researchers’ work concerning the antecedents to these achievement-related choices (Eccles, 1993). This model asserts that achievement-related choices and performance are influenced most directly by a set of individual beliefs, values, and goals, which in turn are influenced by inputs from one’s social world. Findings based on the model have been vital to our understanding of how adolescents’ beliefs predict choices. Psychologists, however, have much more to learn. Researchers have begun to recognize the important but nuanced gender differences in particular science domains, such as physical versus biological sciences. In addition, we need to examine the precursors of new fields that have emerged, such as information technology. Methodological and statistical advances enable research to shed new light on these issues.

This volume addresses gender and ethnic differences in the math, science, and technology pipeline from multiple approaches. In Chapter Two, Jacquelynne Eccles presents the Expectancy Value Model and provides a historical overview of the research on gender differences and the role of beliefs in predicting people’s choices in math, science, and information technology. Chapters Three through Six present empirical findings from four longitudinal studies examining the Eccles et al. Expectancy Value Model. In Chapter Three, Helen Watt examines the extent to which adolescents’ beliefs explain gendered participation in high school math courses in Australia. Sandra Simpkins and Pamela Davis-Kean address similar outcomes in Chapter Four by highlighting the importance of multiple beliefs in determining gender differences in high school course selection and career goals. In Chapter Five, Miriam Linver and Pamela Davis-Kean investigate the influence of math beliefs on course grades and the extent to which these predictions differ based on gender and school track. Nicole Zarrett and Oksana Malanchuk extend these topics in Chapter Six by describing the influence of gender and ethnicity on the relations between adolescents’ beliefs and their technology-related college majors when they are young adults. Janis Jacobs concludes in Chapter Seven with a retrospective view, as well as an evaluation of the empirical work presented in the volume, followed by a discussion of the practical implications of these findings for high schools, institutions of higher education, and the current workforce.

References


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