Students need both interest and self-efficacy to enter mathematics and science or related fields. Although both constructs are necessary for entering any field, possessing high enough interest and strong enough confidence appears to be particularly critical in the decision to pursue mathematics- and science-related college majors and careers. In this chapter, we report on the mean levels of and the associations between interest and self-efficacy across multiple academic subjects among Korean secondary school students, using two existing data sets. By analyzing gender difference in interest and self-efficacy toward mathematics and science, comparing the strength of the association between interest and self-efficacy in mathematics and science and that in language arts, and estimating the predictive relationship between interest and self-efficacy in mathematics over time, we present evidence that interest and confidence do and should go hand in hand for learning and career decision making in mathematics and science.

Gender and Career Choices in Mathematics and Science

The Gender Gap in STEM College Majors in Korea

Our investigation started with the observation that a considerable gender gap still exists in the number of applicants for science, technology, engineering, and mathematics (STEM) college majors in Korea. According to the statistical yearbook of education published annually by the Center for Education Statistics of the Korean Educational Development Institute (2011, 2012), 31.64% and 33.36% of all college applicants in 2011 \((N = 3,536,371)\) and 2012 \((N = 3,757,378)\), respectively, applied for STEM majors. We excluded traditionally female-typed majors such as home management, food and nutrition, clothing and dressmaking, and general living science from the computation of STEM majors, although these majors were classified as part of the natural sciences in the original sources.

Among the applicants for science- and mathematics-related majors, 47.19% and 46.25% were women and 52.81% and 53.75% were men in 2011 and 2012, respectively. The broader domain of the natural sciences includes majors such as forest and horticultural science, life science, biology, and environmental science, for which approximately equal numbers of female and male students applied in both years. Excluding these relatively gender-neutral majors increased the gender gap in science- and mathematics-related majors to 44.12% and 41.72% women and 55.88% and 58.28% men in 2011 and 2012, respectively. The gender imbalance was even greater in engineering majors than in natural science.
majors. Among the applicants for technology- and engineering-related college majors, only 21.68% and 21.75% were women and 78.32% and 78.25% were men in 2011 and 2012, respectively.

Such a large and persistent gap in the numbers of Korean female and male students wanting to enter STEM fields prompted us to investigate the possible causes behind this troublesome phenomenon. Our literature search indeed generated a massive literature on related topics, as gender difference has been of particular interest in the research on mathematics and science for a long time. We briefly review only some of the major findings related to mathematics and science below.

The Gender Gap in Mathematics and Science Performance and Motivation

Several studies have demonstrated that the gender gap in mathematics and science performance has been reduced to a negligible degree in recent years. The Third International Mathematics and Science Study (TIMSS), for example, reported gender equity across nations in mathematics achievement (Beaton et al., 1996). Hyde et al.’s (Hyde, Fennema, & Lamon, 1990; Hyde, Lindberg, Linn, Ellis, & Williams, 2008) meta-analyses showed that the overall difference in mathematics performance between girls and boys, computed as an effect size, was small. Lindberg, Hyde, Petersen, and Linn (2010) also reported no gender difference in their meta-analysis. These results suggest that girls and boys are now performing comparably in mathematics and we can no longer blame the lower number of girls in the STEM area on their lower competence in mathematics.

Gender gap in mathematics and science self-efficacy. This does not mean, however, that girls and boys assess their competence similarly. Fredricks and Eccles (2002) observed that boys rated themselves to be more competent than girls in mathematics, although the gender gap tended to decrease as children advanced to higher grades. In TIMSS, boys emerged with a higher self-concept of ability compared to that of girls in mathematics, despite their equal performance in this subject. In science, boys outperformed girls in both self-concept of ability and achievement (Beaton et al., 1996). As documented in these reports, girls continue to judge their mathematics and science abilities significantly lower compared to boys. Self-concept of ability is closely related to students’ course enrollment, performance, and occupational decisions (Meece, Eccles, Kaczala, Goff, & Futterman, 1982). Therefore, it seems no longer the difference in actual abilities but the difference in perceived abilities that prevents girls from pursuing college majors and careers in mathematics and science.

In fact, social cognitive theory has long acknowledged the importance of one’s perceived, rather than actual, competence in individuals’ choice, effort, persistence, and performance. Perceived competence is a core ingredient in self-efficacy (Bong & Skalvik, 2003), which refers to the subjective convictions that one can successfully execute the requisite behaviors for attaining a desired outcome (Bandura, 1997). Self-efficacy has emerged as a strong predictor of not only achievement outcomes but also occupational development and pursuit (Hackett, 1995). The distinctive role of self-efficacy beliefs in determining individuals’ commitment to college majors and careers related to mathematics and science has been clearly demonstrated (Betz & Hackett, 1997; Hackett, 1985).
Consistent with the gender gap in mathematics- and science-related career choices, gender partly explains differences in self-efficacy toward mathematics and science as well. Boys maintain stronger self-efficacy in these areas than do girls (Hyde, Fennema, & Lamon, 1990). Weaker perceptions of mathematics and science self-efficacy of girls compared to those of boys result in fewer girls enrolling in advanced high school and college mathematics courses or joining the science-related workforce (Lent, Lopez, & Bieschke, 1991). These differences have been attributed to gender role socialization (Hill & Lynch, 1983), which imbues girls and boys with different beliefs regarding their performance capabilities in mathematics, science, and related fields.

**Gender gap in mathematics and science interest.** In addition to the difference in perceptions of mathematics and science competence, there are also differences in the overall attitudes toward these subjects. Boys display a more positive attitude toward mathematics and science than do girls (Hyde et al., 1990; Weinburgh, 1995). Compared to girls, boys also express higher levels of interest in mathematics and science (Fredricks & Eccles, 2002; Jacobs, Hyatt, Eccles, Osgood, & Wigfield, 2002) and stronger beliefs that mathematics and science would be more useful in their future (Fennema, 1981). Interest, in particular, deserves special attention because when students are interested in a specific task or content, they show greater attention, persistence, and achievement (Ainley, Hidi, & Berndorff, 2002).

Interest refers to a psychological state that entails individuals’ focused attention, cognitive engagement, and affective involvement in an activity (Hidi & Renninger, 2006). Interest can be distinguished into situational and individual interest (Bergin, 1999; Hidi, 1990; Renninger, Hidi, & Krapp, 1992). Situational interest is triggered by environmental factors and tends to be short-lived. Individual interest, in comparison, develops slowly over time and is shaped by—as well as influences—individuals’ knowledge, value, and feelings toward a set of tasks, activities, or domains. Our definition of interest in this chapter as liking and enjoyment of a particular subject matter domain is most similar to that of individual interest (Hidi, 1990). Interest in mathematics and science leads to vocational interest and career aspirations in related areas (Lent et al., 1991). Higher levels of interest that boys show in these subject domains compared to girls, therefore, undoubtedly contribute to the higher number of men in the mathematics and science fields.

**Interest and Self-Efficacy in Mathematics and Science**

**Concurrent Association of Interest and Self-Efficacy**

Previous research to date has clearly established the role of interest and self-efficacy in decisions related to science and mathematics. What piqued our interest further in the current investigation was the association between these two motivational constructs. There are many reports attesting to the positive association between perceived competence and value beliefs, including interest (Eccles & Wigfield, 1995). Some attribute this relationship to shared knowledge (Renninger, 2000) because the constructs exhibit exceptionally strong relationships to each other when assessed in reference to the same subject domains (Zimmerman & Kitsantas, 1999). Hidi, Berndorff, and Ainley (2002) pointed out that domain-specificity and predictive
utility for various outcomes are shared characteristics of interest and self-efficacy. Interest and self-efficacy thus appear intricately connected to each other, each playing a vital role in individuals’ performance and decision making (Hidi et al., 2002). More important, this alliance between the two appears to be particularly strong in mathematics and science.

A recent meta-analysis indeed showed that interest and self-efficacy are more strongly correlated to each other in mathematics and science than in other subject areas. Rottinghaus, Larson, and Borgen (2003) obtained the mean effect size estimate of .59 for the correlation between interest and self-efficacy across multiple content domains. However, the effect was noticeably stronger in mathematics ($r = .73$), followed by science ($r = .69$) and art ($r = .62$). When the correspondence between interest and self-efficacy was compared across Holland’s hexagon, the correlation was again stronger in Realistic ($r = .67$), Investigative ($r = .68$), and Artistic domains ($r = .64$) than in Social, Enterprising, or Conventional domains (all $rs \leq .54$).

Lent et al. (1991) also assessed the self-efficacy and interest of college students in mathematics-related courses, along with the science-relatedness of their career choices. Self-efficacy and interest in mathematics-related college courses demonstrated a strong positive correlation to each other ($r = .60$). When self-efficacy entered the regression equation predicting interest, other variables such as past standardized test performance (i.e., mathematics ACT scores) could not make significant additional contributions to the prediction of interest. When self-efficacy and past standardized test performance were used to predict the science-relatedness of students’ career choices, only self-efficacy emerged as a significant predictor. However, when interest entered the equation first, self-efficacy no longer predicted the career choices. These results attest to the importance of interest and self-efficacy in science-related career choices as well as the strong correlation between the two constructs in mathematics.

The investigators replicated these findings in their subsequent study of college students’ intentions to enroll in mathematics-related courses (Lent, Lopez, & Bieschke, 1993). Self-efficacy and interest were again strongly correlated ($r = .61$). Self-efficacy and mathematics ACT scores were significant positive predictors of course enrollment intentions in the absence of interest. When interest entered the equation first, neither self-efficacy nor mathematics ACT scores significantly contributed to the prediction of students’ enrollment intentions in mathematics-related courses. The researchers thus concluded that mathematics self-efficacy mediates the relationship between past performance and interest and that mathematics interest mediates the relationship between self-efficacy and occupational aspirations in science.

**Longitudinal Association of Interest and Self-Efficacy**

Whereas a more-than-reasonable basis exists in the literature to expect a particularly heavy concurrent interdependence of interest and self-efficacy in science- and mathematics-related subjects (Lent et al., 1991, 1993; Rottinghaus et al., 2003), evidence is less clear about the nature of their association over time. Expectancy-value theorists suggest that perceived competence, a core ingredient in self-efficacy (Bong & Skaalvik, 2003), leads to increased interest in and value for a task such that when students are feeling competent at a task or domain, they tend to be more interested and perceive greater value in it (Eccles & Wigfield, 1995). Harter (1982) has also shown that students become intrinsically motivated only
when they perceive that they are competent. Bandura and Schunk (1981) stated, “A sense of personal efficacy in mastering challenges is apt to generate greater interest in the activity than is self-perceived inefficacy in producing competent performances” (p. 587).

A different argument also exists in the literature, which states that increased interest leads to subsequent improvement in actual and perceived competence. For example, Hidi et al. (2002) acknowledged that self-efficacy beliefs develop from diverse sources and stated, “When students engage in an activity with interest, they tend to be focused, persistent and effortful, and experience positive emotions. . . . With such engagements, one would expect improved performance and a corresponding increase in their self-efficacy” (p. 433). In addition, some individuals do not show interest, despite their high levels of self-efficacy (Renninger, Cai, Lewis, Adams, & Ernst, 2011). Conversely, others show interest in specific activities or domains, even when their competence levels toward those activities and domains are low (Renninger, Ewen, & Lasher, 2002). While the positive interdependence between interest and self-efficacy has been well documented, the causal predominance between them remains contested.

It is therefore difficult to draw a firm conclusion regarding the exact nature of the reciprocal and temporal relationships between interest and self-efficacy. This is an important question though, because understanding how these two constructs operate in concert will give us a better idea of how to design an intervention program that attracts more students, especially girls, into mathematics- and science-related fields. We tried to address this question by presenting empirical evidence from our analysis of a longitudinal data set spanning a four-year period.

Empirical Investigation

Based on the review of the relevant literature, we generated several hypotheses that could explain both the gender gap observed in mathematics-related college majors among Korean adolescents and the role of interest and self-efficacy in mathematics and science. Consistent with the literature, we hypothesized that Korean boys would demonstrate significantly higher interest and stronger self-efficacy in science and mathematics compared to Korean girls. Also consistent with the literature, we hypothesized that the interest and self-efficacy of Korean students would correlate more strongly in these two subjects than they would in other subjects. Finally, we hypothesized that interest and self-efficacy would significantly predict each other over time, although we did not generate any specific hypothesis regarding the relative utility of each construct for predicting the other.

We tested our hypotheses using two independent data sets. Data Set 1 came from a previously published study (Bong, 2001). Data Set 2 was a nationally representative longitudinal data set called the Korea Education Longitudinal Study (2005) collected by the Korean Educational Development Institute. We selected these data sets for analysis because they contained measures of interest and self-efficacy, both of which were assessed in reference to multiple subject matter domains. Table 1 describes the general characteristics of Data Sets 1 and 2.
Is There a Significant Gender Difference in Interest and Self-Efficacy Toward Mathematics and Science?

We performed independent-samples \( t \) tests to see if the gender difference was statistically significant between Korean girls’ and boys’ interest and self-efficacy in mathematics and science. Consistent with our expectation and findings of prior research, boys expressed significantly higher interest and stronger self-efficacy than did girls in both mathematics and science. As can be seen in Tables 2 and 3, the gender difference in motivation in these two subject domains favoring boys emerged consistently across the two data sets and across the multiple assessment points. No such consistent difference was evinced in the domain of language arts. The average effect size was \( d = .20 \), all \( ps < .05 \).

Do Interest and Self-Efficacy Correlate More Strongly in Mathematics and Science Than in Other Subjects?

We used Fisher’s \( Z \) transformation to compare the relative strengths of the association between interest and self-efficacy across domains. Again, consistent with our hypothesis and findings of the previous meta-analysis (Rottinghaus et al., 2003), the correlation coefficients between interest and self-efficacy in mathematics and science were significantly larger than the corresponding correlation coefficients in language arts across the two data sets. In Data Set 1, the correlation coefficient in mathematics was \( r = .69 \), and that in science was \( r = .72 \), both of which were significantly larger than the correlation coefficient in language arts, \( r = .55 \), all \( ps < .05 \) (see Figure 1). Also in Data Set 2, the correlation coefficients between interest and self-efficacy in mathematics, \( .63 \leq r_s \leq .67 \), were significantly and consistently larger...
Does Mathematics Interest Predict Subsequent Mathematics Self-Efficacy and Vice Versa?

Finally, we examined the reciprocal relationship over time between interest and self-efficacy in mathematics to explore the question of causal precedence between the two constructs. Using Data Set 2, we performed structural equation modeling with a cross-lagged longitudinal design that evaluated the four measurement points (Grades 7–10). Multiple fit indexes were consulted to evaluate the model fit, including the chi-square statistics, the Tucker-Lewis index, the comparative fit index, and the root-mean-square error of approximation. The cross-lagged model displayed an acceptable fit to the data, \( \chi^2(315, N = 5,189) = 3,892.76, p < .001 \) (Tucker-Lewis index = .955, comparative fit index = .965, root-mean-square error of approximation = .047). Figure 2 presents the standardized path coefficients from this analysis. Several findings are noteworthy. First, mathematics interest was considerably more stable over time than mathematics self-efficacy was. The stability coefficients of interest ranged between .62 and .65 from Year 1 to Year 4, while those of self-efficacy ranged between .37 and .40 during the same period. Second, both interest and self-efficacy assessed in previous years functioned as a significant positive predictor of the other construct in subsequent years. Third, the path coefficients associated with prior mathematics interest predicting subsequent mathematics self-efficacy, \( \beta = .28 \), were consistently larger compared to those associated with prior mathematics self-efficacy predicting subsequent mathematics interest, all \( \beta = .11 \), across all four assessment points. Mathematics interest, therefore, appears to be causally predominant to mathematics self-efficacy at least among the Korean adolescents who participated in the Korea Education Longitudinal Study 2005.

Table 2. Means and Standard Deviations of Interest and Self-Efficacy in Data Set 1

<table>
<thead>
<tr>
<th>Construct</th>
<th>Boys (n = 212)</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>Total (N = 424)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language arts</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td>2.86</td>
<td>1.18</td>
<td>3.01</td>
<td>1.14</td>
<td>2.93</td>
<td>1.16</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td>3.31</td>
<td>0.83</td>
<td>3.24</td>
<td>0.91</td>
<td>3.28</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>3.33</td>
<td>1.27</td>
<td>2.98</td>
<td>1.21</td>
<td>3.16</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td>3.31</td>
<td>0.83</td>
<td>3.24</td>
<td>0.91</td>
<td>3.28</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>Mathmatics</td>
<td></td>
<td>3.41</td>
<td>1.02</td>
<td>3.11</td>
<td>0.97</td>
<td>3.25</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td>3.24</td>
<td>0.99</td>
<td>3.16</td>
<td>1.50</td>
<td>3.24</td>
<td>0.99</td>
<td></td>
</tr>
</tbody>
</table>

Note. Different superscript letters denote significant difference between genders and different subscript numbers denote significant difference between subjects for each construct at \( p < .05 \).
Table 3. Means and Standard Deviations of Interest and Self-Efficacy in Data Set 2

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th></th>
<th>Year 2</th>
<th></th>
<th>Year 3</th>
<th></th>
<th>Year 4</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Total</td>
<td>Boys</td>
<td>Girls</td>
<td>Total</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td><strong>Interest</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Language arts</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.84</td>
<td>2.88</td>
<td>2.86</td>
<td>2.83</td>
<td>2.86</td>
<td>2.85</td>
<td>2.76</td>
<td>2.86</td>
</tr>
<tr>
<td>(SD)</td>
<td>(0.84)</td>
<td>(0.82)</td>
<td>(0.83)</td>
<td>(0.74)</td>
<td>(0.75)</td>
<td>(0.74)</td>
<td>(0.75)</td>
<td>(0.73)</td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>M</td>
<td>2.67</td>
<td>2.53</td>
<td>2.60</td>
<td>2.62</td>
<td>2.44</td>
<td>2.53</td>
<td>2.60</td>
<td>2.50</td>
</tr>
<tr>
<td>(SD)</td>
<td>(0.70)</td>
<td>(0.70)</td>
<td>(0.71)</td>
<td>(0.71)</td>
<td>(0.68)</td>
<td>(0.70)</td>
<td>(0.75)</td>
<td>(0.70)</td>
</tr>
<tr>
<td><strong>Self-efficacy</strong></td>
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<td>Language arts</td>
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<td></td>
</tr>
<tr>
<td>M</td>
<td>2.76</td>
<td>2.80</td>
<td>2.78</td>
<td>2.76</td>
<td>2.77</td>
<td>2.77</td>
<td>2.72</td>
<td>2.76</td>
</tr>
<tr>
<td>(SD)</td>
<td>(0.60)</td>
<td>(0.59)</td>
<td>(0.59)</td>
<td>(0.63)</td>
<td>(0.58)</td>
<td>(0.60)</td>
<td>(0.63)</td>
<td>(0.59)</td>
</tr>
<tr>
<td>Mathematics</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.70</td>
<td>2.53</td>
<td>2.61</td>
<td>2.61</td>
<td>2.40</td>
<td>2.51</td>
<td>2.61</td>
<td>2.42</td>
</tr>
<tr>
<td>(SD)</td>
<td>(0.64)</td>
<td>(0.61)</td>
<td>(0.64)</td>
<td>(0.66)</td>
<td>(0.62)</td>
<td>(0.65)</td>
<td>(0.67)</td>
<td>(0.63)</td>
</tr>
</tbody>
</table>

Note. Different superscript letters denote significant difference between genders and different subscript numbers denote significant difference between subjects for each construct at $p < .001$. $ns = 2,672$ and 2,489 in language arts and 2,686 and 2,503 in mathematics for boys and girls, respectively.
Summary of Findings

The significant gender gap in the mean levels of interest and self-efficacy in mathematics and science suggests that lack of interest and perceived competence is still the major culprit behind many Korean girls’ unwillingness to enter areas related to these two subject domains. The significantly stronger association of interest and self-efficacy in mathematics and science compared to their association in other subjects such as language arts further indicates that interest and self-efficacy play a more determining role for each other in these subjects than they do in other subjects. In addition, the four-year longitudinal relationships between interest and self-efficacy in mathematics demonstrate that mathematics self-efficacy depends more heavily on prior mathematics interest than mathematics interest does on prior mathematics self-efficacy for Korean adolescents.

Strong Interdependence Between Interest and Self-Efficacy in Mathematics and Science

Why would interest and self-efficacy correlate more strongly in mathematics and science than in other subject matter areas? We sought answers to this question from the hierarchical nature of mathematical and scientific knowledge, the inflexible characteristics of mathematics instruction, and the perceptions of mathematics and science as difficult subjects.

Hierarchical nature of mathematical and scientific knowledge. The exceptionally strong covariation between the two constructs in mathematics and science may be attributed partly to the hierarchical nature of knowledge in these areas (Stodolsky & Grossman, 1995). Particularly in mathematics, it is almost impossible to perform higher-level skills such as geometry and calculus well without adequate proficiency in lower-level skills such as arithmetic and algebra. In Lehrke’s study (as cited in Schiefele, Krapp, & Winteler, 1992), the hierarchical nature of mathematics skills proved to be the major reason behind the relatively large
number of underachieving students in this domain. Schmidt, Wang, and McKnight (2005) argued that science as a domain also displays hierarchical dependencies among its contents, although this hierarchy is not as stringent as that in mathematics. When knowledge and skills are organized in such a cumulative fashion, it is difficult to develop or maintain interest without the requisite competence.

Inflexible characteristics of mathematics instruction. Both interest and self-efficacy are highly context-specific constructs (Bong, 2001; Hidi & Renninger, 2006; Pajares, 1996). Levels of students’ interest and self-efficacy differ by the characteristics of tasks, subject matter areas, and classroom atmospheres (Wigfield & Eccles, 1994). Researchers generally agree that mathematics classes differ from other subject classes in terms of teachers’ instructional styles, the flexibility of course objectives, and the diversity of activities and materials (Stodolsky & Grossman, 1995; Stodolsky, Salk, & Glasner, 1991). These differences could affect students’ interest and self-efficacy in mathematics-related subject domains.

Compared to English, social studies, or science, mathematics is a clearly defined domain with higher consensus regarding the curriculum content (Stodolsky & Grossman, 1995). Owing presumably to the hierarchical nature of knowledge, mathematics instruction is typically highly structured, covering topics in a sequential and unidirectional manner. Teachers explain concepts and algorithms. Students then engage in seatwork exercises on
those concepts and algorithms. In contrast, social studies instruction is much more flexible and dynamic, combining various instructional methods such as lecture, group discussion, and projects as well as materials such as textbooks, newspapers, films, and maps (Stodolsky et al., 1991). According to a classroom observation study, English instruction also makes use of diverse activities and materials, which relate more closely to students’ interest and backgrounds compared to those used in mathematics instruction (Evertson, 1982).

In other words, it may be easier to accommodate students’ individual interest in language arts and social studies than in mathematics classes. Lack of flexibility in mathematics instruction likely makes the existing levels of interest students bring to class more important for actively engaging in mathematics learning, thus further strengthening the already-tight connection between interest and self-efficacy in mathematics-related areas.

**Perceptions of mathematics and science as difficult subjects.** The aforementioned features of mathematics and science knowledge and instruction contribute to students’ perceptions of these subjects as being difficult. In fact, Stodolsky et al. (1991) found significant differences in fifth graders’ responses regarding the reasons for times they liked and disliked the subject matter domain between mathematics and social studies. While describing the reasons for times they liked mathematics, 53.4% of the students mentioned “easy” and “successful.” Only 25% of the students provided similar reasons for liking social studies. Likewise, when describing the reasons for times they disliked mathematics, 69.2% of the students answered “hard” and “unsuccessful.” Again, this number contrasts with only 28.3% of the students listing the same two reasons for disliking social studies. Judgment of task difficulty is an important factor that defines one’s perceptions of ability toward the given task. Because students view mathematics and science as more difficult than other subjects, they appear to find it more difficult to enjoy learning them. Students like these subjects when they consider the topics easy or their performance in the domain successful, thereby reinforcing the tie between interest and self-efficacy.

**Significance of Interest to Self-Efficacy in Mathematics and Science**

Previous research suggests that interest and self-efficacy are reciprocally related (Hidi & Ainley, 2008). Our cross-lagged model presents convincing evidence this was indeed the case. Prior interest augmented later self-efficacy, which in turn enhanced yet subsequent interest. While a direct test of causal predominance between interest and self-efficacy is currently lacking, a number of researchers presumed perceived competence or self-efficacy to precede interest. Bergin (1999), for instance, listed competence as one of the important individual factors that influence interest. He argued that perceived likelihood of becoming competent in a task determines whether one would be interested in engaging in that task. His idea is consistent with the suggestions of the expectancy-value (Eccles & Wigfield, 1995), perceived competence (Harter 1982), and self-efficacy theorists (Bandura & Schunk, 1981) that perceived competence leads to stronger interest in any given task or domain.

Our data, however, point to a slightly different conclusion. At least in mathematics and for the Korean youth, prior interest appears to be a more powerful determinant of subsequent self-efficacy than prior self-efficacy is of subsequent interest. According to the interest researchers, interest triggers feelings of enjoyment, involvement, and value in tasks or subject
matter domains (Hidi, 1990, 2000; Hidi & Renninger, 2006), all of which in turn predict use of effective strategies and deep comprehension (Schiefele, 1991; Schiefele & Csikszentmihalyi, 1994). Bandura (1997) also acknowledged that pleasure in mastery experiences is one of the critical factors that influence the development of competence.

We believe that all three factors described earlier, presumed to be responsible for the strong association between interest and self-efficacy in mathematics and science, also help render interest as a particularly strong predictor of perceived competence in these subject areas: the hierarchical nature of knowledge in mathematics and science demands students to be equipped with proper knowledge and skills. This feature further contributes to students’ perceptions of these subject areas as being difficult. In such situations, holding high enough interest to stay in for continued engagement and learning would be imperative for students to develop the necessary competence.

In sum, the independent role of interest and self-efficacy in mathematics and science learning and occupational choice has been well documented. The present evidence adds to the literature by demonstrating that interest and self-efficacy go hand in hand in mathematics and science in secondary schools. High interest coupled with strong perceptions of competence, therefore, constitutes an essential prerequisite for entering mathematics- and science-related areas. In this respect, findings of Fredricks and Eccles (2002) are intriguing because the divergent trajectories associated with perceived competence and interest in mathematics in high school imply a dwindling relationship between the two during a period when students make important decisions regarding their future. Future research should explore the reciprocal relationship between interest and self-efficacy in other domains and locate important moderators of the association between interest and self-efficacy, such as personality types, goals, and classroom atmosphere. Understanding of the conditions under which the association between interest and self-efficacy becomes stronger or weaker should inform the design of motivational interventions that can be used to encourage capable students to pursue mathematics- and science-related fields.

**Concluding Thoughts**

The strong tie between interest and self-efficacy in mathematics and science, along with the stronger predictive utility of previous interest for subsequent self-efficacy than vice versa in mathematics, suggests that it may be imperative that students stay or become “interested” in these subject matter areas to feel competent. The fact that mathematics interest was more stable than mathematics self-efficacy across the four years spanning Grades 7 to 10 further suggests that achievement experiences may not wield as significant an impact on interest as they would on self-efficacy in mathematics. Enactive mastery experience is the most powerful source of self-efficacy information (Bandura, 1997), which explains why self-efficacy was less stable than interest in mathematics over time. At the same time, this means that simply providing students with frequent success experiences may not be sufficient for increasing their interest in mathematics. Considering that individual interest does not develop overnight, this also means that mathematics teachers, especially those in middle school, should invest persistent effort in designing their individual
lessons and assignments to be more interesting to their students. Though presenting lessons and assignments in ways that pique students’ interest is what teachers of every subject at every level should strive for, doing so appears to be particularly consequential in the subject of mathematics.

In this chapter, we analyzed two existing data sets to get a glimpse of possible causes underlying the persistent gender gap favoring boys in the number of Korean college applicants in mathematics and science majors. We observed that interest and self-efficacy in mathematics and science were indeed significantly and consistently lower among Korean middle school and high school girls than among Korean boys at the same grade level. Because one of our data sets contained responses from a nationally representative sample of nearly 7,000 Korean students, we find these results particularly perturbing. In our search for factors contributing to this gender gap in mathematics and science motivation, we learned that the correlation between interest and self-efficacy was significantly stronger in these two subject areas than it was in language arts. We also learned that interest in mathematics at the current grade level was a significant positive predictor of not only interest but also self-efficacy in mathematics at the subsequent grade level. Similarly, self-efficacy in mathematics was a significant positive predictor of both self-efficacy and interest in the following year.

It should be noted that the findings reported in this chapter came from Korean students, who are strong performers in mathematics and science, as evinced in many international comparison studies (Korea Institute for Curriculum and Evaluation, 2010). In addition, interest, which is the key motivational construct in this research, was assessed with the items that were originally designed to measure related constructs such as task value and intrinsic motivation but not interest per se. Some of the results may not hold, therefore, in different samples and with different interest measures. These limitations notwithstanding, we believe that the present findings still offer viable grounds for generating several instructional implications.

Because our data cover only Grade 7 and beyond, it is more than possible that earlier mastery experiences in mathematics and science had already shaped students’ interest in these subject areas by the time they entered middle school. This conjecture is in line with our earlier observation that many students perceive mathematics and science as difficult subjects. In other words, perceived competence could be more important to interest development during formative years, with the magnitude of its influence on interest gradually decreasing as children become older and more experienced. By Grade 7, interested students’ feelings toward mathematics and science may become more or less stable and not fluctuate too much with the changes in either their achievement levels or their self-efficacy. A longitudinal investigation that follows children from younger years in multiple subject domains will be able to paint a more accurate picture regarding the role of interest and self-efficacy in each other’s development in the subject domains of science and mathematics.

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References


