

Student Differences in Self-Regulated Learning: Relating Grade, Sex, and Giftedness to Self-Efficacy and Strategy Use

Barry J. Zimmerman
Graduate School and University Center
City University of New York

Manuel Martinez-Pons
Brooklyn College
City University of New York

Forty-five boys and 45 girls of the 5th, 8th, and 11th grades from a school for the academically gifted and an identical number from regular schools were asked to describe their use of 14 self-regulated learning strategies and to estimate their verbal and mathematical efficacy. The groups of students from both schools included Whites, Blacks, Hispanics, and Asians. Students came from middle-class homes. Gifted students displayed significantly higher verbal efficacy, mathematical efficacy, and strategy use than regular students. In general, 11th-grade students surpassed 8th graders, who in turn surpassed 5th graders on the three measures of self-regulated learning. Students' perceptions of both verbal and mathematical efficacy were related to their use of self-regulated strategies. Evidence of relations between students' strategic efforts to learn and perceptions of academic self-efficacy is concordant with a triadic view of self-regulated learning.

During the past few years, a number of theories have been proposed to describe how students become regulators of their own learning (e.g., Corno, 1989; Henderson, 1986; Mace, Belfiore, & Shea, 1989; McCombs, 1989; Paris & Byrnes, 1989; Pressley, 1986; Rohrkemper, 1989; Wang & Peverly, 1986). These theories of self-regulated learning share a view of students as metacognitively, motivationally, or behaviorally active promoters of their academic achievement (Zimmerman, 1986, 1989b). Unlike other learning models, self-regulation theories seek to explain students' differences in motivation and achievement on the basis of a common set of processes. A number of theorists (e.g., Lepper & Malone, 1987; McCombs, 1984; Paris & Byrnes, 1989; Ryan, Connell, & Deci, 1984; Zimmerman, 1985) have been interested in explaining an "intrinsic" motive to learn by self-regulated students, especially under adverse circumstances.

Recently, Zimmerman (1989a) proposed a formulation to explain self-regulated academic learning based on Bandura's (1986) triadic theory of social cognition (see also Schunk, 1989). He suggested that students' efforts to regulate their learning involves three classes of determinants: their personal processes, the environment, and their behavior. Strategies enable student learners to personally (self-) regulate their behavior and environment as well as their covert functioning.

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Correspondence concerning this article should be addressed to Barry J. Zimmerman, Program in Educational Psychology, Graduate School, City University of New York, 33 West 42 St. New York, New York 10036.

Students' selection and use of strategies depends directly on their perceptions of their academic efficacy and reciprocally on feedback through a cybernetic loop: If monitoring indicates a deficiency in performance, learners' self-efficacy will be affected, and this, in turn, will affect their subsequent motivation and choice of strategies. According to this triadic formulation, students' self-regulated learning is not an absolute state of functioning, but rather varies on the basis of the academic context, personal efforts to self-regulate, and outcomes of behavioral performance. Self-regulated learners are assumed to understand the impact of the environment on them covertly and behaviorally during acquisition and to know how to improve that environment through the use of various strategies.

Research has shown that students' self-efficacy perceptions are related to two aspects of the proposed reciprocal feedback loop: self-monitoring (Diener & Dweck, 1978; Kuhl, 1985; Pearl, Bryan, & Herzog, 1983) and students' academic motivation and achievement (Schunk, 1984). However, little attention has been devoted to the relation between efficacy perceptions and students' use of self-regulated learning strategies. This was one goal of the present investigation.

Considerable progress has been made in identifying strategies that students use to regulate their (a) personal functioning, (b) academic behavioral performance, and (c) learning environments. For example, the strategies of organizing and transforming (Baird, 1983; Corno & Mandinach, 1983), rehearsing and memorizing (McCombs, 1984; Paris, Newman & Jacobs, 1984), and goal setting and planning (Bandura & Schunk, 1981; Mischel & Patterson, 1978) focus on optimizing personal regulation. Strategies such as self-evaluating (Bandura & Cervone, 1983, 1986) and self-consequating (Mace & Kratochwill, 1985) were designed to enhance behavioral functioning. The strategies of seeking information (Baird, 1983; Wang, 1983), record keeping and self-monitoring (Spates & Kanfer, 1977), environmental structuring (Thoresen & Mahoney, 1974), seeking social assistance (Zimmerman, 1983), and reviewing academic materials (Wang, 1983) are intended to optimize the students' immediate learning environment. Pre-

viously, we (Zimmerman & Martinez-Pons, 1986) developed a structured procedure, termed the Self-Regulated Learning Interview Schedule (SLRIS), to measure students' use of these self-regulated learning strategies. Students were asked to describe the methods they used in a series of common learning contexts, and measures of strategy use were derived from their answers. These measures of strategy use were found to be highly correlated with the students' academic achievement.

Subsequently, we (Zimmerman & Martinez-Pons, 1988) investigated the construct validity of the SLRIS with the use of teacher ratings of students' level of self-regulation in their classes. We assumed that teachers are in position to observe directly not only students' use of many self-regulated learning strategies but also many related motivational aspects of students' functioning, such as their promptness, comprehensiveness, and commitment in completing assignments or preparing for class. Several items of the scale that we developed for use by teachers dealt with students' intrinsic interest in academic tasks. Factor analyses of the teachers' ratings along with students' scores on a standardized test of mathematics and English revealed a single self-regulated learning factor that accounted for nearly 80% of the explained variance. Students' reports of using self-regulated learning strategies during the interview correlated .70 with the obtained teachers' rating factor. These outcomes indicated a substantial relation between students' use of self-regulated learning strategies and their motivation. However, no attempt was made in this research to determine the underlying source of this motivation.

The present investigation sought to demonstrate the usefulness of two measures of students' academic efficacy in predicting their use of triadic self-regulation strategies in conventional learning settings. This descriptive analysis will serve as a basis for subsequent experimental tests of reciprocal relations between self-efficacy and strategy use in laboratory settings. In view of previous evidence (Zimmerman & Martinez-Pons, 1988) that students' mathematics and verbal achievement were highly correlated with their use of many self-regulated learning strategies in the SLRIS, we decided to assess students' academic self-efficacy in these same two content areas.

Related research has shown that students develop separate verbal and math self-concepts by the 5th grade because of their growing ability to distinguish their competence on different academic tasks (Marsh, 1986). Although no comparable developmental data exist for measures of children's self-efficacy, it is hypothesized that measures of students' verbal and mathematical efficacy would predict their use of self-regulated learning strategies. The students' ability to appraise academic competence accurately can be expected to lead to grade-level increases in self-efficacy above the fifth grade that are based on students' acquisition of verbal and mathematical knowledge. It was hypothesized that the self-efficacy of 11th graders would exceed that of 8th graders, whose self-efficacy would, in turn, surpass that of 5th graders.

In addition to their grade level, students' degree of giftedness was expected to influence their perceptions of efficacy. Gifted students are of particular interest because they exhibit not only high intellectual ability but also two characteristics

closely associated with self-efficacy: "persistence of motive and effort" and "confidence in their abilities" (Cox, 1976, p. 23). For this reason, it was expected that intellectually gifted students would display greater academic self-efficacy than regular students. Although no sex differences in academic self-efficacy were predicted, they were explored. The issue of sex differences in self-regulated learning has received some attention (Mandinach & Corno, 1985); however, information is lacking regarding developmental changes in students' strategy use and academic self-efficacy among academically gifted and regular students.

Method

Sample

From one gifted and three regular schools, equal numbers of boys and girls were chosen randomly from each of three grades. Thirty fifth-grade students, 30 eighth-grade students, and 30 eleventh-grade students were drawn from a highly selective school for intellectually gifted children in New York City. The school is run on a tuition-free basis by a collegiate school of education for students who are selected on an open, competitive basis. Students enter the school in two waves: in elementary and in junior high school. Approximately 60 children are chosen randomly, from a large pool scoring at or above the 99th percentile on a standardized test of mental ability, to enter the elementary school and to continue through high school. The second wave of students are admitted on the basis of their scores on an achievement test constructed by the faculty of the school. Any student who scores above the ninth-grade level on a standardized test in mathematics and English and who resides in the city of New York may take this examination. From a large pool of applicants, approximately 200 students are selected on the basis of their total score on the selection test. During both waves of testing, an effort is made to recruit and admit qualified minority students. The 1989 graduating class of the high school achieved the highest score on the Scholastic Aptitude Test of any school in the United States; over 50% of the class members were designed as National Merit finalists.

In addition to these students, 30 fifth graders were drawn from a regular, nonselective elementary school, 30 eighth graders from a regular, nonselective junior high school, and 30 eleventh graders from a nonselective public high school affiliated with a different collegiate school of education in the same city. In both gifted and regular schools, students came generally from middle-class homes and varied in race. (The sample included White, Black, Hispanic, and Asian students.) No precise figures on students' ethnicity or social class were gathered because of restrictions in school policy. The attrition rate in all schools in the sample was judged by school officials as very low.

Self-Regulated Learning Interview Schedule

This structured interview was developed to assess 14 classes of self-regulated learning strategies. The strategies were: self-evaluating; organizing and transforming; goal-setting and planning; seeking information; keeping records and monitoring; environmental structuring; self-consequating; rehearsing and memorizing; seeking peer, teacher, or adult assistance; and reviewing tests, notes, and texts. One category of non-self-regulated learning responses (labeled *other*) was also included. Definitions for each strategy are provided by Zimmerman and Martinez-Pons (1986).

Eight different learning contexts were described to each student: in classroom situations, when completing writing assignments, when

completing mathematics assignments, when checking science or English homework, when preparing for a test, when taking a test, when poorly motivated to complete homework, and when studying at home. These contexts represent a revision and extension of six contexts that were presented in previous research (Zimmerman & Martinez-Pons, 1988). These learning contexts are presented in Table 1. For each context, students were asked to indicate the methods they would use. If the students gave an answer, they were asked to describe any additional methods. If any student failed to offer an answer, a probe was given (see the last question in each context). If the student still failed to mention any self-regulated learning strategies, questioning was discontinued for that learning context. Research (Zimmerman & Martinez-Pons, 1988) on the construct validity of this interview procedure has indicated it provides significant control for the biasing effects of student verbal expressiveness and for background knowledge not associated with self-regulated learning.

Student Academic Efficacy Scales

Two general areas of academic efficacy were of interest: mathematical problem solving and verbal comprehension. Following Bandura's (1986) recommendation that level of task be varied when self-efficacy is being assessed, each scale was composed of 10 items that increased in difficulty. The Verbal Efficacy scale involved 10 words that were selected from the Dolch word list and from the Thorndike and Lorge (1944) word frequency list. For each word, the students rated their efficacy in defining it, using a scale that ranged from 0% (*completely unsure*) to 100% (*completely sure*). The Mathematics Efficacy scale involved 10 problems that ranged in difficulty from simple arithmetic to algebra, probability, and statistics. A statistical problem was added, although statistics is not typically taught in high school, to provide sufficient ceiling for high school students using the scale. The students were asked to rate their efficacy for solving each mathematical problem using the same 100-point percentage scale that was used to measure verbal efficacy.

We wanted to ensure that the items in both the mathematics scale and the verbal scale would be able to discriminate varying perceptions of efficacy by 5th graders and 11th graders. To meet this objective, both scales included items that increased sharply in difficulty; however, this feature was expected to reduce interitem response consistency. Kuder-Richardson 20 analyses revealed coefficients of .64 for verbal efficacy and .69 for mathematical efficacy. Test-retest measures of stability were viewed as more appropriate for these two highly graduated scales. To examine this hypothesis, the two self-efficacy scales were given to 10 male and 15 female high school students chosen from the 9th through 12th grades of a nonselective high school affiliated with a collegiate school of education and were re-administered to the students 2 weeks later. This retest sample represented a broad range of academic achievement; it included students who were at academic risk as well as high achievers. As anticipated, the test-retest coefficients for mathematical efficacy (.73, $p < .02$) and for verbal efficacy (.78, $p < .02$) were higher than the interitem coefficients for students in the regular sample. These outcomes indicate acceptable levels of stability and reliability for 10-item scales. Students involved in retesting did not participate in other aspects of the study.

Procedure

Parental consent was obtained for students who were randomly selected to participate. Both parents and students were informed that the students would be interviewed about their study practices. The interview was conducted by a female graduate student with extensive training in individual testing. She was trained by the principal inves-

Table 1
Self-Regulated Learning Contexts

1. Assume your teacher is discussing with your class the history of the civil rights movement. Your teacher says that you will be tested on the topic the next day. Do you have a method that you would use to help you learn and remember the information being discussed? What if you are having trouble understanding or remembering the information discussed in class?^a
2. Assume your teacher asks students in your class to write a short paper on a topic such as the history of your community or neighborhood. Your score on this paper will affect your report card grade. In such cases, do you have any particular method to help you plan and write your paper? What if you are having difficulty with the topic?^a
3. Teachers usually expect much accuracy with students' math home work. Many of these assignments must be completed without the help of a teacher. Is there any particular method you use when you don't understand a math problem at home? What if the assignment deals with a very difficult type of problem?^a
4. When completing homework assignments such as science reports or English grammar exercises, do you use a particular method for checking your work after it is finished? What if it is a difficult assignment?^a
5. Most teachers give important tests at the end of marking periods, and these tests greatly affect report card grades. Do you have a particular method for preparing for these tests in English or history? What if you are preparing for an especially difficult test?^a
6. When taking a test in school, do you have a particular method for obtaining as many correct answers as possible? What if it is a difficult test question?^a
7. Many times students have difficulty completing homework assignments because there are other, more interesting things they would rather do, such as watching TV, daydreaming, or talking to friends. Do you have any particular method for motivating yourself to complete your homework under these circumstances? What if you are trying to meet a pressing deadline?^a
8. Some students find it easier if they can arrange the place where they study. Do you have a particular method for arranging the place where you study? What if you are having difficulty concentrating on your school work?^a

^a This is the follow-up question.

tigators to administer both the structured interview and the tests of academic efficacy. She recorded students' responses to the question for each context verbatim. A "strategy frequency" scoring procedure (see Zimmerman & Martinez-Pons, 1986) was used later to score the students' answers, and multiple strategies were tallied individually and summed across the eight contexts. A reliability check (Withall, 1949) by one of the principal investigators of more than 20% of the protocols revealed an agreement level of 85%. Areas of nonagreement were discussed with reference to the definition of the strategies and were resolved through mutual consent.

The students were brought individually to a separate room in their school by the interviewer. In one room, each student was seated across a table from the interviewer and was informed that he or she would be asked some questions about his or her study practices. The interviewer then administered the structured interview. With few

exceptions, students answered the interviewer's questions thoughtfully. After the interview was completed, the academic efficacy scales were administered.

The verbal self-efficacy scale was administered first. The interviewer instructed the students as follows:

For each word presented below, estimate how sure you are that you can define it correctly. You must give your answer in 10 seconds or less, so you will not have time to write a definition. Give you best estimate of your confidence (any number between 0% and 100%) that your definition will be judged as correct by a teacher. Some words are very difficult, and most students cannot define them. It is important that you do not guess but give a realistic estimate of whether your answer is correct. If you are completely unsure of your answer, mark 0%; if you think you may have answer but are not sure of it, mark 50%; if you are completely sure of your answer, mark 100%.

The mathematical self-efficacy scale was administered next. The instructions were identical to those given for the verbal self-efficacy scale with the exception that the phrase "math problem" replaced "word" in the instructions, and the verbs "solve" or "solution" replaced "define" or "definition." These instructions were designed to prompt the students to give realistic estimates of their verbal and mathematical efficacy without actually attempting to figure out a specific answer.

Results

Student Differences in Academic Efficacy

In Table 2, the students' verbal and mathematical efficacy means are presented on the basis of their grade, sex, and giftedness. Each scale mean can be interpreted as a percentage of self-efficacy for the respective group by dividing the mean by 10 (items) (e.g., for male 5th graders' verbal efficacy, $591/10 = 59\%$). A 3 (5th, 8th, or 11th grades) $\times$ 2 (boys or girls) $\times$ 2 (gifted or regular ability) multivariate analysis of variance (MANOVA) was used with verbal and mathematical efficacy serving as dependent measures. The two efficacy measures were found to be correlated ($r = .56, p < .01$).

A main effect for students' sex was found, $F_{\text{mult}}(2, 167) = 4.62, p < .02$.¹ Univariate tests revealed that boys ($M = 681$) surpassed girls ($M = 536$), $F(1, 168) = 9.12, p < .01, MS_e = 0.11$, in verbal efficacy but not mathematical efficacy. Students' giftedness also produced a large main effect, $F_{\text{mult}}(2, 167) = 43.48, p < .001, R = .59$. Univariate tests indicated that gifted students displayed greater verbal efficacy ($M = 734$) than regular students ($M = 536$), $F(1, 168) = 85.66, p < .01, MS_e = 0.11$, as well as greater mathematical efficacy ($M = 724$) than regular students ($M = 638$), $F(1, 168) = 19.56, p < .01, MS_e = 0.17$. In addition, students' efficacy varied substantially by grade, $F_{\text{mult}}(4, 334) = 20.75, p < .01, R = .59$. Significant grade differences were found in both verbal and mathematical efficacy, smaller $F(2, 168) = 29.82, p < .01, MS_e = 0.11$. Post hoc comparisons were conducted using Newman-Keuls procedure. These test revealed significantly greater verbal efficacy by 11th graders ($M = 677$) than by 8th graders ($M = 619$), who in turn significantly surpassed 5th graders ($M = 528$), all $ps < .05$. Regarding mathematical efficacy, 11th graders ($M = 779$) and 8th graders ($M = 740$)

surpassed 5th graders ($M = 598$), both $ps < .05$. However, the difference in mathematical efficacy between students in the two higher grades failed to reach significance.

The only statistical interaction to reach significance occurred between students' giftedness and grade, $F_{\text{mult}}(4, 334) = 2.59, p < .04$. According to univariate tests, this interaction was confined to the students' verbal efficacy measures, $F(2, 168) = 4.64, p < .02, MS_e = 0.11$. Post hoc testing revealed that gifted children displayed a significant increase in verbal efficacy between the 5th ($M = 573$) and 8th ($M = 722$) grades but not between 8th and 11th ($M = 747$) grades. In contrast, regular students showed a significant increase in verbal efficacy between the 8th ($M = 525$) and 11th ($M = 608$) grades but not between the 5th ($M = 483$) and 8th grades, all $ps < .05$.

Student Differences in Strategy Use

Self-regulated learning strategy means are presented in Table 3 for each group of students based on their grade, sex, and giftedness. The same 3 (5th, 8th, or 11th grades) $\times$ 2 (boys or girls) $\times$ 2 (gifted or regular students) MANOVA model was used; however, the 15 self-regulation strategies served as dependent measures.

There was a main effect for students' sex, $F_{\text{mult}}(15, 154) = 2.09, p < .02$, grade, $F_{\text{mult}}(30, 308) = 4.26, p < .01$, and giftedness, $F_{\text{mult}}(15, 154) = 3.78, p < .01$, and an interaction between students' giftedness and grade, $F_{\text{mult}}(30, 308) = 2.21, p < .01$. Univariate tests revealed that gifted youngsters ($M = 0.57$) reported significantly higher use of organizing and transforming strategies than regular students did ($M = 0.36$), $F(2, 168) = 3.84, p = .05, MS_e = 0.52$. An unusual grade pattern in the use of this strategy emerged, $F(2, 168) = 6.70, p < .01, MS_e = 0.52$: Eighth graders ($M = .70$) surpassed 5th graders ($M = 0.29$) as expected ($p < .05$) but 11th graders ($M = 0.47$) did not. However, the difference in use of this strategy by 8th and 11th graders was not statistically reliable.

Girls ($M = 1.88$) displayed more goal-setting and planning than did boys ($M = 1.56$), $F(1, 168) = 6.61, p < .02, MS_e = 1.28$. Students' use of this strategy also varied based on their giftedness and grade, $F(2, 168) = 6.97, p < .01, MS_e = 1.28$. Post hoc tests revealed a decline in use of this strategy between 8th and 11th grades for both gifted and regular students (both $ps < .05$). This decline was greater for gifted students (from $M = 2.30$ to 1.00) than for students of regular ability (from $M = 2.04$ to 1.30).

With regard to students' keeping records and monitoring, significant differences were found by sex, $F(1, 168) = 15.30, p < .01, MS_e = 0.91$, and grade, $F(2, 168) = 2.94, p < .05, MS_e = .91$. Girls ($M = 2.04$) kept records and monitored more frequently than boys ($M = 1.50$). Although 11th graders ($M = 1.82$) and 8th graders ($M = 1.86$) kept records and monitored more than 5th graders ($M = 1.63$), these differences did not achieve significance during post hoc testing. Girls ($M = 0.74$) surpassed boys ($M = .55$) in environmental structur-

¹ This test was based on Wilks's lambda multivariate criterion.

Table 2

Students' Verbal and Mathematical Efficacy Means and Standard Deviations by Grade, Sex, and Giftedness

Academic self-efficacy	Gifted						Regular					
	Male			Female			Male			Female		
	5th	8th	11th	5th	8th	11th	5th	8th	11th	5th	8th	11th
Mathematics												
<i>M</i>	616	690	842	626	741	830	610	653	712	541	576	758
<i>SD</i>	135	113	110	141	70	138	155	175	151	97	111	137
Verbal												
<i>M</i>	591	736	793	555	709	700	533	539	598	433	492	619
<i>SD</i>	116	58	60	115	104	132	112	125	112	104	106	90

Note. 5th, 8th, and 11th grades.

ing, $F(1, 168) = 3.91$, $p < .05$, $MS_e = .41$, and gifted students ($M = 0.36$) gave more self-consequences than regular students ($M = 0.18$), $F(1, 168) = 6.47$, $p < .02$, $MS_e = 0.22$.

Univariate tests revealed also that gifted students ($M = 0.54$) displayed higher levels of seeking peer assistance than regular students ($M = 0.29$), $F(1, 168) = 6.84$, $p < .01$, $MS_e = 0.43$. On the basis of their giftedness and grade, students differed also in their seeking adult assistance, $F(2, 168) = 3.49$, $p < .04$, $MS_e = 0.43$: Gifted students ($M = 1.33$) surpassed regular students ($M = 0.75$) at the 5th-grade level, $p < .05$, but not at 8th- or 11th-grade level. With regard to seeking teacher assistance, grade differences were found, $F(2, 168) = 3.34$, $p < .04$, $MS_e = 0.19$. Post hoc tests revealed that the 11th-grade students ($M = 0.28$) surpassed both 8th-grade ($M = 0.08$) and the 5th grade ($M = 0.16$) students, although only the former contrast reached statistical significance, $p < .05$. Students from the latter two grades did not differ significantly.

Concerning the strategy of reviewing notes, gifted students ($M = 0.88$) surpassed regular students ($M = 0.58$), $F(1, 168) = 7.53$, $p < .01$, $MS_e = 0.54$, and in addition, grade differences were found, $F(2, 168) = 6.08$, $p < .01$, $MS_e = 0.54$. Newman-Keuls tests revealed that the 11th graders ($M = 0.97$) significantly surpassed the 5th graders ($M = 0.59$), $p < .05$, but not 8th graders ($M = .72$). Students' review of texts was negatively related to their grade level; 11th graders ($M = 1.20$) reported less text review than 8th ($M = 1.32$) and 5th ($M = 1.64$) graders, $F(2, 168) = 6.54$, $p < .01$, $MS_e = 0.81$. However, no pairwise differences between these groups achieved significance.

Boys ($M = 0.46$) gave significantly more *other* responses than girls ($M = 0.23$), the only non-self-regulated category of learning, $F(1, 168) = 8.48$, $p < .01$, $MS_e = 0.29$. In addition, there was an interaction between students' giftedness and grade, $F(2, 168) = 5.56$, $p < .01$, $MS_e = 0.29$, for the *other* category; however, no pairwise comparisons achieved statistical significance.

Academic Efficacy and Self-Regulated Strategy Use

In order to determine the relation of students' perceptions of academic efficacy to their use of specific self-regulated learning strategies, two multiple regression analyses were per-

formed in which students' self-regulated learning strategies were used to predict their verbal and mathematical efficacy separately. Overall, students' perceptions of mathematical efficacy were correlated with their use of self-regulated learning strategies, $R = .41$, $F(14, 165) = 2.31$, $p < .01$. More specifically, mathematical self-efficacy was related significantly to the strategy of reviewing notes, $\beta = .26$, $p < .01$, and was related marginally to the strategy of seeking adult assistance, $\beta = -.14$, $p < .08$. The latter negative standardized regression coefficient indicated that students' reliance on adults for assistance was negatively correlated ($r = -.14$) with their perceptions of mathematical efficacy.

Students' perceptions of verbal efficacy were also correlated with their use of self-regulated learning strategies, $R = .42$, $F(14, 165) = 2.55$, $p < .01$. More specifically, verbal self-efficacy was related significantly to students' use of the strategies of reviewing notes ($\beta = .21$, $p < .01$), organizing and transforming ($\beta = .16$, $p < .05$), and seeking peer assistance ($\beta = .18$, $p < .03$). The self-regulated learning strategy of seeking adult assistance was marginally related to verbal self-efficacy, $\beta = -.15$, $p < .06$. As with mathematical efficacy, students' verbal efficacy was negatively correlated with their seeking adult assistance ($r = -.16$).

Discussion

These initial developmental data indicate that students vary widely in their perceptions of academic self-efficacy and use of self-regulated learning strategies. On the basis of evidence that even 5th graders can appraise their math and verbal competence accurately (Marsh, 1986), it was predicted that students in the present study would display increases in perceived efficacy from the 5th through the 11th grade that were due to their growing verbal and mathematical knowledge. As was hypothesized, high school students' academic efficacy surpassed that of junior high school youngsters, and the efficacy of junior high school students, in turn, surpassed that of elementary school children. Although 11th graders' verbal and mathematical efficacy exceeded that of 8th graders, only the former difference achieved statistical significance. However, the 8th-grade students significantly surpassed 5th-graders in both verbal and mathematical efficacy. These develop-

Table 3
Self-Regulated Learning Strategy Means and Standard Deviations by Grade, Sex, and Giftedness

Self-regulated strategy	Gifted						Regular					
	Male			Female			Male			Female		
	5th	8th	11th	5th	8th	11th	5th	8th	11th	5th	8th	11th
Self-evaluating												
<i>M</i>	2.53	2.87	2.53	2.80	2.27	3.87	3.40	2.80	2.73	3.20	2.67	2.60
<i>SD</i>	1.30	1.30	0.92	1.57	1.10	1.41	1.68	1.57	1.49	1.27	1.45	1.24
Organizing & transforming												
<i>M</i>	0.13	0.80	0.40	0.47	0.73	0.87	0.20	0.47	0.33	0.07	0.80	0.27
<i>SD</i>	0.35	0.86	0.74	0.83	0.88	0.92	0.41	0.83	0.62	0.26	0.94	0.59
Goal setting & planning												
<i>M</i>	0.80	2.20	0.73	1.20	2.40	1.27	1.93	1.87	1.13	2.60	2.20	1.60
<i>SD</i>	0.94	1.01	0.80	1.21	1.35	1.34	1.10	1.25	0.99	1.30	1.08	1.06
Seeking information												
<i>M</i>	1.80	2.60	2.00	2.00	2.20	1.60	1.80	1.87	2.00	2.27	2.13	1.47
<i>SD</i>	1.38	0.74	1.20	1.46	1.01	0.99	1.37	1.41	1.31	1.03	1.19	1.06
Keeping records & monitoring												
<i>M</i>	1.40	1.93	1.53	1.73	2.06	2.27	1.27	1.47	1.27	1.87	2.47	1.80
<i>SD</i>	1.24	0.80	0.99	1.33	0.59	1.03	0.88	0.52	0.80	0.99	0.92	1.01
Environment structuring												
<i>M</i>	0.33	0.73	0.60	0.80	0.73	0.60	0.87	0.33	0.40	0.73	0.93	0.60
<i>SD</i>	0.62	0.70	0.74	0.68	0.80	0.63	0.74	0.49	0.63	0.46	0.46	0.63
Self-consequating												
<i>M</i>	0.07	0.40	0.47	0.27	0.40	0.53	0.26	0.00 ^a	0.27	0.13	0.20	0.20
<i>SD</i>	0.26	0.63	0.64	0.46	0.51	0.64	0.46	0.00	0.46	0.35	0.41	0.41
Rehearsing & memorizing												
<i>M</i>	0.80	0.27	0.27	0.33	0.47	0.47	0.53	0.67	0.20	0.80	0.73	0.60
<i>SD</i>	1.08	0.46	0.59	0.49	0.64	0.74	0.74	0.11	0.41	0.94	0.70	0.51
Seeking assistance												
Peer												
<i>M</i>	0.60	0.80	0.53	0.53	0.40	0.40	0.13	0.33	0.33	0.20	0.27	0.47
<i>SD</i>	0.91	0.78	0.64	0.74	0.51	0.83	0.35	0.62	0.72	0.41	0.46	0.64
Teacher												
<i>M</i>	0.27	0.00 ^a	0.20	0.20	0.13	0.33	0.07	0.13	0.33	0.00 ^a	0.07	0.27
<i>SD</i>	0.80	0.00	0.56	0.41	0.35	0.49	0.26	0.35	0.49	0.00	0.26	0.59
Adult												
<i>M</i>	1.07	1.20	0.40	1.60	1.00	0.53	0.80	1.20	0.46	0.67	1.27	0.40
<i>SD</i>	0.80	0.68	0.74	0.91	0.76	0.74	0.78	1.08	0.64	0.72	0.96	0.63
Reviewing												
Tests												
<i>M</i>	0.40	0.13	0.13	0.53	0.33	0.13	0.13	0.33	0.53	0.20	0.27	0.20
<i>SD</i>	0.51	0.35	0.35	0.74	0.62	0.35	0.35	0.49	0.64	0.41	0.46	0.41
Notes												
<i>M</i>	0.67	0.53	1.20	0.60	0.93	1.33	0.27	0.73	0.53	0.47	0.67	0.80
<i>SD</i>	0.62	0.64	0.94	0.74	0.80	0.98	0.46	0.96	0.52	0.52	0.72	0.68
Texts												
<i>M</i>	1.20	1.07	1.47	1.80	1.27	1.40	1.87	0.80	1.13	1.67	1.13	0.80
<i>SD</i>	0.78	0.70	0.64	0.94	0.80	0.91	1.30	0.78	1.06	1.05	0.74	0.86
Other												
<i>M</i>	0.73	0.27	0.67	0.40	0.33	0.07	0.13	0.47	0.53	0.00 ^a	0.27	0.33
<i>SD</i>	0.80	0.46	0.62	0.63	0.62	0.26	0.35	0.64	0.64	0.00	0.46	0.49

Note. 5th, 8th, and 11th grades.

^a No students in these cells used this self-regulated learning strategy.

mental effects accounted for 35% of the variability in students' perceptions of self-efficacy ($R = .59$).

These outcomes are interesting theoretically because they stand in contrast to developmental trends in students' self-ratings of academic competence. There is extensive evidence (Benenson & Dweck, 1986; Nichols, 1978; Stipek, 1981) that children's self-perceptions of competence decline from the time they enter school through high school, with the most dramatic drop occurring during junior high. Presumably this

occurs because of competitive grading and students' growing sense of their ability as an endowed trait (see Paris & Byrnes, 1989). Thus, at a time when students' self-perceptions of academic competence are declining, their perceptions of self-efficacy are increasing, according to the present data. This apparent anomaly can be resolved if one considers the distinctive nature of these two measures. Self-competence measures typically involve social comparisons between a rater and his or her classmates (e.g., Stipek, 1981). In contrast, self-

efficacy measures involve estimates of performance success that are unrelated to the skills of classmates. These developmental data suggest that instructional procedures that draw on or enhance students' perceptions of self-efficacy, such as participant modeling or mastery learning (Bandura, 1986; Schunk, 1984; Zimmerman, in press), may hold particular promise for motivating junior and senior high school students. Developmental research specifically comparing children's academic self-efficacy and perceived competence measures is needed.

As expected, student's giftedness was associated with high levels of academic efficacy. The size of this effect was large ($R = .59$) and accounted for 35% of the variance in students' academic efficacy. The gifted students' verbal and mathematical efficacy item means were 73% and 72%, respectively, whereas the means for regular students were 54% for verbal efficacy and 64% for mathematical efficacy.² It appears that these gifted youngsters were more distinguished by their verbal efficacy than by their mathematical efficacy. These self-efficacy findings provide empirical support for anecdotal evidence that gifted students display extraordinary academic motivation and self-confidence (e.g., Cox, 1976).

The data also revealed that gifted youngsters displayed different developmental patterns in their math and verbal efficacy from regular students. Gifted students showed an increase in verbal efficacy between the 5th and 8th grades, whereas regular students displayed a significant increase in verbal efficacy between the 8th and 11th grades. Gifted youngsters appear to acquire confidence in their verbal comprehension at a younger age than regular students; however, some caution is in order when one is interpreting these findings because the gifted students attended a separate high school with a highly accelerated academic program. This academic milieu undoubtedly affected the perceptions of efficacy and use of self-regulated learning strategies of these students. It should be mentioned that the academic programs at the regular schools were considered to be of high quality.

Evidence that boys perceive significantly greater verbal self-efficacy than girls and comparable mathematical self-efficacy was unexpected. In general, the literature on sex differences in ability (e.g., Maccoby & Jacklin, 1974) indicates that boys often surpass girls in mathematics and but not in verbal ability. These ability differences convey similar expectations regarding measures of academic efficacy; however, a very different pattern of sex differences emerged. Unfortunately, no performance data or standardized measures of achievement were available for students in the present sample, so we could not determine if boys' and girls' self-efficacy perceptions were equally accurate. It is possible that boys' verbal self-efficacy reports may have been too optimistic or that the girls were too pessimistic. The implications of either of these possible outcomes for understanding sex differences in self-regulated learning are important and should be investigated further.

Analyses of sex differences in use of self-regulated learning strategies revealed that girls reported significantly more record keeping and monitoring, environmental structuring, and goal-setting and planning than did boys. The boys surpassed girls

in only the single non-self-regulated *other* category. These findings show greater use of self-regulated learning strategies by girls despite their being lower than boys in verbal efficacy. The picture that emerges from these data—of girls as greater users of strategies but as less self-efficacious than boys—is provocative.

The results indicated that gifted students made greater use of certain self-regulated learning strategies than did regular students. Gifted students displayed greater organizing and transforming, self-consequating, seeking peer assistance, and reviewing notes. It is interesting to note that these strategies represent the triadic spectrum for self-regulating learning: namely, for regulating personal processes (organizing and transforming), one's behavior (self-consequating), and one's environment (reviewing notes and seeking peer assistance). In addition to peer assistance, gifted students sought significantly more adult assistance than did regular students during the fifth grade. Generally, gifted students obtained this assistance from their parents; thus, gifted youngsters took greater advantage of parental resources at home. Whether this outcome was due to greater parental interest, parental availability, or parental academic skills is unknown.

The use of a number of self-regulated learning strategies was related to students' grade level in school. These results proved to be more complex than anticipated. For example, a significant decline occurred in students' reviewing texts across the three grades (although pairwise comparisons did not prove significant according to Newman-Keuls criteria). This decline is perplexing unless attention is focused on reciprocal changes in students' use of a closely associated strategy, reviewing notes: Students displayed an increase in their review of notes across the three grades. Together these data indicate that, with increasing age and grade level, students shift their reviewing activities from published text materials to self-recorded notes.

A similar reciprocal relation occurred between two social assistance strategies. A significant decline in student reliance on adult assistance occurred between the 8th and 11th grades; however, during the same time period, there was an increase in students' seeking of teacher assistance. Analyses of individual protocols indicate that these data reflect students' shift during high school from using their parents as sources of assistance to using their teacher. Furthermore, the regression analyses revealed that students' reliance on adults (generally their parents) for assistance tended to be negatively related to both verbal and mathematical efficacy, whereas seeking assistance from peers was positively related to verbal self-efficacy. It appears that students' perceptions of academic self-efficacy develop in concurrence with their increasing independence from their parents. These outcomes will be of interest to both Vygotskian (e.g., Diaz & Neal, in press) and social cognitive (e.g., Zimmerman, in press) researchers who view children's development of self-regulation as an achievement of socialization processes.

² The item means were calculated by dividing the academic efficacy test total by the number of items (i.e., by 10).

Significant increases occurred in students' keeping of records and monitoring between the 5th and 8th grades, and this level of use was sustained during the 11th grade. With the strategy of organizing and transforming, students' use increased significantly between the 5th and 8th grades also; however, this was followed by a nonsignificant decline in the use of this strategy in the 11th grade. The results indicate that students' use of the strategies of keeping records and monitoring and organizing and transforming leveled off after junior high school.

A significant increase in goal-setting and planning occurred between the 5th and 8th grades; however, this increase was followed by a significant decline between the 8th and 11th grades. We can offer no explanation for the diminished use of this strategy by 11th-grade students; however, we are reluctant to accept that high school students engage in less goal-setting and planning than junior high students. It is possible that high school students are more covert in their use of this strategy than are 8th graders and that additional probing may be necessary to detect the use of this strategy by the former. For example, if a student mentioned task components but not their timing or sequential accomplishment, the interviewer might provide further probes to determine if these temporal criteria were implicit.

On the basis of developmental research indicating that students' verbal and mathematical self-concepts become differentiated by the fifth grade (Marsh, 1986), we hypothesized that measures of verbal and mathematical self-efficacy would each be predictive of students' use of self-regulated learning strategies. Regression analyses revealed support for this prediction: Students' perceptions of verbal and mathematical efficacy were each correlated significantly with strategy use. However, verbal self-efficacy proved to be more highly correlated with strategy use than mathematical self-efficacy both in terms of the variance explained (18% vs. 16%, respectively) and number of strategies used (four vs. two, respectively). Interestingly, verbal efficacy was correlated with use of the self-regulated learning strategies of organizing and transforming, reviewing notes, and seeking peer assistance. Evidence that gifted students displayed precocious development of these three strategies as well as verbal efficacy suggest that a developmental link between these strategies and verbal efficacy may exist.

In conclusion, it is clear that students' efforts to strategically regulate their learning are associated with higher self-perceptions of mathematical and verbal efficacy. Although we did not design this study to find a causal link between these components of a triadic self-regulation loop, we did discover that students displayed greater perceptions of efficacy and use of learning strategies as they advanced in school. This initial developmental study revealed several additional findings of interest to educators. First, in view of evidence that students' perceptions of their academic efficacy increase during the junior high school years (in contrast to their perceptions of academic competence), teachers may wish to use instructional or assessment procedures that reduce social comparison and focus on task mastery to ensure optimal motivation. Second, evidence that gifted students display very high levels of self-efficacy precociously (particularly in the verbal area) can

explain the extraordinary motivation and achievement of these students. Teachers may wish to use self-efficacy measures to better understand students with little motivation as well as to better identify areas of students' giftedness. Third, the fact that gifted students made greater use of learning strategies designed to regulate personal processes, behavior functioning, and environmental events is noteworthy. The achievement of these students in school indicates that a triadic model of self-regulation may have merit for training students to become more effective learners. Together these findings suggest that students' perceptions of academic efficacy can provide an important window for understanding individual differences in learning and motivation.

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