Although a majority of under-represented minority (URM) students begin their postsecondary education at community colleges, little is known about barriers to success and retention for transfer-bound science students. This study focuses on some of the barriers that affect these students’ ability to study adequately for a community college “gateway” course. It tests whether instructors’ expectations of study time were realistic for community college students and whether students reported facing external barriers, such as job and family responsibilities, or internal barriers to studying, such as lack of motivational, cognitive, and metacognitive abilities, all of which have been shown to impact academic success and retention. It also tests whether students who faced such barriers were less likely to succeed in and complete the course, as well as whether time spent studying was related to course success. The findings reported here show that community college students do not have enough available time to study and that external and internal barriers are both prevalent among these students. In addition, students who faced such barriers are more likely to fail or drop the class. Results also show that study time is positively correlated with retention, but not performance, as well as with some motivational, cognitive, and metacognitive dimensions of self-regulated learning. These findings lead to new questions, including whether student success in a community college class is associated with the use of cognitive and metacognitive learning strategies for students with no prior degrees, and whether increased course structure may improve success for college students with lower self-regulated abilities.

INTRODUCTION

In the 2011 report Expanding under-represented minority participation: America’s science and technology talent at the crossroads, The National Academies warned that in order to meet its science, technology, engineering, and mathematics (STEM) labor workforce objectives, the US would need to quadruple its under-represented minority (URM) graduation levels in STEM in the decades to come (4, 10). However, these reports also acknowledged that, although URM students major in STEM at the same rate as other students, they face greater barriers to persistence and completion than others. Many undergraduate science educators have been working on reducing the achievement gap of under-prepared students who come in to introductory biology courses at four-year institutions and have found, among other things, that the use of active learning and increased course structure could prevent URM attrition in STEM (7, 9, 10).

The majority of URM students begin postsecondary study at community colleges, but less than half of community college students who plan on earning a baccalaureate degree actually transfer to a four-year college (1, 3, 8). Therefore, in order to increase URM completion rates in STEM, it is essential to explore ways to increase the retention and success of transfer-bound students in community college STEM courses. The present study focuses on barriers to success and retention in students enrolled in a “gateway” chemistry course at a large urban community college with a very diverse student population. A large majority of students in this course are transfer-pathway students who do not plan on majoring in chemistry and who therefore represent the population that would likely transfer to different STEM programs at four-year institutions.

Of particular interest are the barriers affecting students’ ability to study adequately. One reason why a structured course has been hypothesized to help reduce the achievement gap in four-year college science classes is that it may provide underprepared students with an opportunity to learn how to apply concepts with feedback in class, something that college students, as self-regulated learners, are expected to do independently when they study. College students who have learned to be self-regulated learners not only know how to practice applying what they have learned...
to new problems when they study, they are also able to cluster their new knowledge into new groups of ideas, as well as to rehearse and elaborate on what they have learned (14, 19, 21). In addition to these cognitive strategies, self-regulated learners question themselves on new material learned and on information missed, and correct their study behavior to acquire the material, a process called metacognition.

This study asks whether community college students with lower self-regulated learning abilities (referred to here as internal barriers to studying) were less likely to successfully complete a gateway chemistry course. Underprepared college students exhibit lower self-regulated learning abilities than their peers, and evidence supports the existence of a relationship between self-regulated learning and academic success (12). Students' self-regulated learning abilities may be context-dependent; i.e., they may vary across different classes, depending on the student's interest in the topic and the instructor's teaching style. Therefore, the relationship between self-regulated learning ability and course grades is stronger than the association of self-regulated learning ability with grade point average (GPA) (6, 13, 15, 22, 23).

In addition to these internal barriers to studying, this study focuses on external barriers such as paid employment and family responsibilities, two known risk factors for attrition and lack of degree completion. Community college students are far more likely than four-year college students to work full time, to be financially independent, and to have dependents or be single parents, all of which are known to impact degree completion rates (3).

One way that these risk factors can impact student success is by restricting students' availability to study. The hypothesis for this study was that most students understood the instructors' study time expectations, but that these expectations were unrealistic for many students because external barriers impacted their available study time. This study asked whether students reported facing these two external barriers and whether this had an impact on success and retention in the course, as others have shown (16).

Additionally, it is unclear whether reported study time is correlated with grades, and evidence suggests that the existence of this correlation may depend on the student population (17, 18, 20). Therefore, another question was whether study time was related to academic achievement for this population of students.

This study hypothesized (1) that community college students understand the study expectations of their instructor, but that they cannot study as much as expected, (2) that external and internal barriers that hinder the ability to study sufficiently (as indicated by the amount of time spent studying) and efficiently (as indicated by the use of self-regulated learning strategies) are prevalent among community college students, (3) that the presence of such barriers can impact course success and retention, and (4) that study time is related to course performance for this student population.

This is the first study focusing on barriers to studying and their relationship to course success and retention in community college science students. The findings of this study can provide data for faculty, administrators, and policymakers aiming to address the need for a more diverse STEM student population.

**METHODS**

**Participants**

A comparative study design was used to examine community college chemistry students' self-reported socio-demographic risk factors as well as motivation and learning strategies. The data presented here were collected from 110 out of 132 students enrolled in five laboratory sections of the same community college chemistry course taught by three different instructors. This course is a four-unit, seven-hour per week lecture/lab course and is a prerequisite for the university-transferable general chemistry sequence. Two of the instructors taught two sections each, each instructor with his or her own syllabus, and the author was not one of the instructors. The college's Institutional Review Board approved the study.

The ethnic breakdown of this population was 47% Asian, 22% White (non-Hispanic), 19% White/Hispanic, 3% African American, 3% Pacific Islander, and 2% Native American. Ninety four percent of respondents planned to transfer to a college or university. Sixty percent of respondents indicated that they only had a high school degree, 26% said that they had completed some college units, 8% had an Associate degree, 4% had a Bachelor's degree, 1% had a foreign degree, and 1% indicated "other."

**Data collection**

During the first two weeks of class in the spring 2012 semester, students anonymously and voluntarily completed a 30-question survey, followed by the Motivated Strategies for Learning Questionnaire (MSLQ) at the beginning of their lab period (14). Students were given a brief overview of the purpose of the study by a researcher and signed a consent form to share course and test grades for the purpose of the study. Faculty allowed extra class time to complete the survey and allocated extra credit points to students who participated in the study. Because a majority of students attending before the "drop" deadline participated in the study, the data presented here include students who dropped or withdrew from the course.

**Socio-demographic survey**

The 30-question socio-demographic survey included demographic questions as well as questions about risk factors, including time spent on paid employment. Students were asked three different types of questions about their study time: how much time they thought they felt they should be studying for this class each week (estimate
of class expectations), how much time they had available to study (available study time), and how much time they actually spent studying (actual study time). Students were given four options: fewer than two hours per week, two to four hours, five to seven hours, or more than seven hours.

To test the hypothesis that some students perceived external or internal barriers to success and retention at the start of the semester, the following fixed-response survey question was included: “If you are not able to study as much as you would need to, explain why (you may choose more than one answer).” Among the options provided, participants were allowed to select all that applied to their situation. Three external barriers that could limit their available study time were listed: family responsibilities, paid employment, and health issues. To address the hypothesis that cognitive, metacognitive, or motivational factors may come into play, students could also select the option “I can’t focus on my work” (internal barriers). Students were also provided with an option to indicate that they felt they had enough time to study, as a control. A last category, “I don’t know why I can’t study as much as I would need to” was also included. Some students also offered other choices.

**MSLQ Survey**

To allow the cognitive, motivational and metacognitive barriers students may be facing to be identified, they were asked to complete the MSLQ developed by Pintrich et al. (14, 15), which is widely used in higher education. The MSLQ is a retrospective self-report instrument composed of 81 items measuring six Motivation Scales (31 items) and nine Learning Strategies Scales (50 items) described in Table 1 (14). The survey uses a seven-point Likert Scale (1 being “not at all true of me” and 7 “very true of me”). For each individual, the score for each scale is calculated as the mean of all the items that make up that scale (except for reverse coded items).

**Data analysis**

A two-sample equal-variance unpaired t-test was used to analyze the statistical significance of differences observed when comparing MSLQ scores (combined Likert Scale) between two or three groups (e.g., Group 1, 2, and 3 MSLQ data). After the MSLQ analysis, the False Discovery Rate Control test was applied to eliminate unreliable p values \((d = 0.05)\). Among the two p values of 0.01, one appeared as trustworthy, while the other did not. Therefore, both values were excluded from the analysis.

Spearman’s Rho was used when analyzing the relationship between student success and study time. As in other studies, grades were standardized to control for differences in instructor grading (15).

Analysis of variance (ANOVA) was used when analyzing the relationship between MSLQ scores, study time, and student success.

**RESULTS**

**Are instructors’ expectations realistic for community college students?**

In order to determine whether instructors’ expectations of time spent studying were realistic for community college students, students were asked how much time they felt they should be studying for this class each week (estimate of class expectations), how much time they had available to study (available study time) and how much time they actually spent studying (actual study time). Course instructors estimated that this four-unit, seven-hour per week lecture/lab chemistry course required at least seven hours of study time per week, with an ideal study time between nine and twelve hours a week. Only 37.3% of students understood these study expectations, while 31.8% estimated that the course required five to seven hours of study time a week, and 28.2% estimated that the course required two to four hours of study time per week (Fig. 1), showing that a majority of students did not understand their instructor’s expectations regarding study time.

With regard to available study time, only 25.5% of students indicated that they had more than seven hours per week available for this course, 30.9% had five to seven hours available, while 37.3% only had two to four hours. Therefore, only one quarter of students were able to study as much as their instructor expected. When it comes to reported number of hours worked for pay per week, 54.5% of respondents had a job, with 35.3% of all students working more than 16 hours per week and 11.1% more than 30 hours per week (data not shown).

Only 7.3% of students reported actually studying as much as recommended by the instructors. Another 13.8% reported studying five to seven hours per week, while 53.2% studied two to four hours and 25.7% devoted fewer than two hours per week to studying. Therefore, a large majority of students studied fewer than seven hours per week, the recommended study time.

**Do students perceive any barriers to studying?**

In order to determine whether they perceived external and/or internal barriers to studying, students were asked why they could not study as much as they thought they would need to (Table 2). When asked why they did not study as much as they should, 31.4% of the 105 respondents selected the option indicating that they felt they had enough time to study (no barriers), and 22.9% indicated this as their sole response. Among the remaining students, 45.8% indicated that they could not focus on their work (internal barriers), 34.7% indicated that they had family responsibilities that took up their time (external barriers), and 36.1% indicated that they had a job that took up their time (external barriers). The majority of students who chose “Other” indicated other classes as the reason for not having enough time to study. Therefore, external and internal barriers to studying are prevalent among community college students.
Do perceived barriers affect students’ course success?

To find out whether these perceived barriers were associated with lower rates of success or retention in the course, students were organized into three groups based on their answers to the previous question: group 1 (chose option 1 – no reported barriers), group 2 (options 2 or 3, job or family responsibilities – external barriers), group 3 (option 5, inability to focus on work – internal barriers). Each group included students who had only selected a single answer to the question and excluded students who had given multiple answers.

As shown in Figure 2, group 2 (external barriers) and 3 (internal barriers) students were 30% and 50% more likely, respectively, to fail the class than group 1 students (group 1: 16.7% failed; group 2: 21.7%; group 3: 25%) and 25% and 20% more likely, respectively, to drop the class (group 1: 20.8% dropped; group 2: 26.1%; group 3: 25%). Therefore, students who faced barriers to studying were more likely to either drop or even fail the class than their peers.
Do students who perceive internal barriers actually have lower self-regulated learning abilities?

To confirm whether students who reported an inability to focus had lower self-regulating learning abilities than other students, MSLQ results were compared for the three groups of participants (Table 3). As expected, group 3 displayed lower cognitive and metacognitive strategy scores than groups 1 or 2 when it came to rehearsal, elaboration, or organization of knowledge, which are essential processes for storing information in long-term memory and constructing connections between concepts.

In addition, group 3 displayed strikingly lower levels of metacognitive self-regulation behavior (group 3: mean [M] = 3.72, standard deviation [SD] = 0.87; group 1: M = 4.90, SD = 0.87, p = 0.0002; group 2: M = 4.84, SD = 0.75, p = 0.0001), indicating that these students also have issues activating prior knowledge, monitoring their knowledge, and adjusting their learning strategies to improve learning. Group 3 also showed significantly lower motivational scores for task value than either group 1 or group 2 (group 3: M = 5.25, SD = 1.01; group 1: M = 6.13, SD = 0.73, p = 0.003; group 2: M = 6.18, SD = 0.87, p = 0.003). Together, these results show that students who reported an inability to focus scored lower on several dimensions of the MSLQ.

Is study time related to course success?

This study also asked whether study time was related to academic achievement for this population of students. There were no significant differences in average percent grade or distribution of grades on the first exam based on reported study time (data not shown). Additionally, there was no correlation between final course letter grade or retention in the course and reported study time (Spearman’s rho correlation coefficient: 0.011, p = 0.907, n = 108), or between pass rates and study time (Fig. 3; < 2 hours, pass rate (P) = 61%; 2–4 hours, P = 44%; 5–7 hours, P = 67%; > 7 hours, P = 63%), indicating that study time was not related to course success.

It is worth noting, however, that students who studied more than seven hours were twice as likely to persist through the course as students who studied fewer than four hours (> 7 hours, withdrawal rate (W) = 13%; 2–4 hours, W = 25%; < 2 hours, W = 25%) indicating that study time may be related to student retention, but not performance.

### Table 2.

Perceived barriers to studying.

| Question: If you are not able to study as much as you would need to, explain why: | Percentage of all Respondents | Percentage of Respondents with Reported Barriers |
| --- | --- | --- |
| 1. I feel I have enough time to study | 31.4% | — |
| 2. I have family responsibilities that take up my time | 23.8% | 34.7% |
| 3. I have a job that takes up my time | 26.7% | 36.1% |
| 4. I have health issues that make it difficult for me to study | 2.9% | 2.8% |
| 5. I can’t focus on my work | 39% | 45.8% |
| 6. I don’t know why I can’t study as much as I would need to | 15.2% | 19.4% |
| 7. Other | 2.9% | 4.2% |

Both external and internal barriers to studying were prevalent among study participants. Selection of options in a multiple-choice survey question about reasons for not studying enough for the course expressed as a percentage of all respondents (first column) and as a percentage of respondents who did not select option 1 (second column). Percentages reflect the fact that students were allowed to select multiple answers. Choice of option 1 indicates no barriers to studying; options 2 to 4 reflect external barriers to studying; option 5 corresponds to internal barriers.
Is there a relationship between study time and study effectiveness, and is it dependent on course success?

If students were equally as likely to pass the course whether they studied fewer than two hours or more than seven hours per week, were students who studied less better at using self-regulated learning strategies than their peers? In other words, is there any relationship between study time and use of self-regulated learning strategies, and is the relationship dependent on course success (defined as Pass, Fail, and Withdrawal)? Results show a positive and modest but significant relationship between study time and several MSLQ scales using ANOVA. All these relationships are independent of student success, meaning that the relationship is the same whether students passed, withdrew from, or failed the course.

On motivation scales, study time increased with intrinsic goal orientation \((p = 0.007, R^2 = 0.14, \text{partial } \eta^2 = 0.118)\) and task value \((p = 0.006, R^2 = 0.183, \text{partial } \eta^2 = 0.12)\). On the learning strategies scales, increased study time was related to increased mastery of cognitive and metacognitive strategies, such as rehearsal \((p = 0.019, R^2 = 0.191, \text{partial } \eta^2 = 0.099)\), elaboration \((p = 0.004, R^2 = 0.191, \text{partial } \eta^2 = 0.129)\), and metacognitive self-regulation \((p = 0.249, \text{partial } \eta^2 = 0.185)\). Study time was also positively related to resource management strategies, such as management of time and study environment \((p = 0.021, R^2 = 0.122, \text{partial } \eta^2 = 0.097)\) and effort regulation \((p = 0.001, R^2 = 0.246, \text{partial } \eta^2 = 0.16)\).

**DISCUSSION**

Community college students report internal and external barriers to studying that can affect success and retention

The results of this study show that when it comes to study time in a gateway community college chemistry course, only a minority of students (1) understood the instructor’s recommendation for study time, (2) were available to study as much as the instructor recommended, and (3) reported studying as much as the instructor expected. Therefore, these findings support the initial hypothesis that instructors’ study expectations are not realistic for the community college population.

Consistent with other studies, these findings also show that external (job or family responsibilities) and internal (poor self-regulating abilities) barriers to studying were prevalent among community college students and that they negatively impacted student success and persistence in the course (3, 16, 18).

**TABLE 3.** Perceived barriers and self-regulated learning strategies.

| MSLQ Scales                  | GP 1 Mean±SD (n=24) | GP 2 Mean±SD (n=25) | GP 3 Mean±SD (n=16) | GP1-2 p     | GP1-3 p     | GP2-3 p     |
|------------------------------|---------------------|---------------------|--------------------|-------------|-------------|-------------|
| Task value                   | 6.13±0.73           | 6.18±0.87           | 5.25±1.01          | 0.81        | 0.003*      | 0.003*      |
| Rehearsal                    | 4.72±1.17           | 3.91±1.57           | 3.78±1.19          | 0.34        | 0.02        | 0.002*      |
| Elaboration                  | 5.45±1.27           | 5.20±1.04           | 4.23±1.29          | 0.45        | 0.005*      | 0.01        |
| Organization                 | 4.34±1.29           | 4.91±1.08           | 3.55±1.25          | 0.1         | 0.06        | 0.001*      |
| Metacognitive self-regulation| 4.90±0.87           | 4.84±0.75           | 3.72±0.89          | 0.8         | 0.0002*     | 0.0001*     |

Students who perceived internal barriers reported lower levels of motivation, as well as lower use of cognitive and metacognitive learning strategies. Only significantly different MSLQ motivation and learning strategies scales data are shown here. GP 1: no perceived barriers, GP 2: perceived external barriers, GP 3: perceived internal barriers. P values were calculated using a two-sample equal-variance unpaired t-test on Likert Scale questions. False discovery rate control was applied \((d = 0.05)\). MSLQ = motivated strategies for learning questionnaire; GP = group; SD = standard deviation.

* \(p < 0.005\).
Students who report internal barriers lack motivation as well as cognitive and metacognitive skills

As expected, students experiencing internal barriers, and who are at risk of failing or dropping the course, do not use some of the motivational, cognitive, and metacognitive strategies that could help them succeed in college. When it comes to motivation, these data show that students who lacked focus were less motivated because they found the material less relevant, useful, and interesting than others (lower task value scores). This result has implications for instructors looking to improve student performance, as it has been shown that students who report higher levels of task value invest more effort and perform better than other students (2). Others have shown that, by increasing task value, instructors could increase student engagement for a given assignment or activity, which could result in better learning (11). Therefore, by making the material more relevant, useful, and interesting for students, community college instructors could potentially help close to 40% of students learn and perform better in their course.

Another way instructors may be able to help these students is by incorporating content about study strategies into their courses. There is extensive evidence that the effect of motivation (such as task value) on academic performance is mediated by the use of learning strategies, and the present results indicate that students who face these internal barriers, and who therefore have lower task value scores, struggle with the use of learning strategies (6). These students particularly struggled with activating prior knowledge, storing information in long-term memory, and constructing connections between concepts (cognition). They also struggled with monitoring their knowledge and adjusting their learning strategies to improve learning (metacognition). These findings raise the question of whether community college instructors should help their at-risk students develop cognitive and metacognitive skills. In support of this suggestion, others have found that a single 50-minute lecture covering metacognitive learning strategies increased course performance in a 700-student gateway chemistry course at a four-year institution (5).

Study time is correlated with retention, motivation, and study effectiveness, but not with performance

Like others before, this study did not show any correlation between reported study time and course performance or between study time and grades on the first exam, but did show a slightly positive relationship between study time and retention (18, 20). Is the lack of correlation between study time and performance due to the fact that students who study less study more effectively? Not surprisingly, students who studied more were more motivated to learn, better at resisting distractions, and valued the course materials more. However, these students were also better self-regulated learners, not poorer: they were better at using cognitive and metacognitive learning strategies, regardless of whether they passed, failed, or dropped the course.

Although this last result shows correlation, not causation, between study time and use of self-regulated learning strategies, it does suggest that perhaps students who study less may do so because they find the process of learning these specific materials uninteresting. Perhaps it is because they lack the skills to learn and to be metacognitive about their learning process that they do not persevere when studying. But, if that is the case, why do these students who study less perform as well as others? In other words, contradictorily to common thinking, studying longer and being a better self-regulated learner does not seem to create a performance advantage for these students.

A few hypotheses could be tested in future studies to explain this finding. First, perhaps students who studied less relied on prior knowledge to succeed in the course; students with stronger foundations in chemistry may have attained the same level of performance by studying less and using fewer self-regulated learning strategies. Other studies have also found a lack of correlation between study time and success, even when controlling for scholastic aptitude test (SAT) scores, which rules out prior academic performance as a possible explanation (20). It is however noteworthy that close to 40% of students in this course had more than a high school diploma, and it may be that these students did not need to study as much as their peers. Second, as in any study relying on self-reports, students could have misrepresented their abilities when completing the MSLO survey or could have incorrectly reported their study time. Rau and Durand hypothesized that reports of time spent studying may be inaccurate because of the irregularity in students’ study habits, such as the practice of “cramming” before exams (17). However, other studies have found that such
behaviors do not have any effect on performance (17, 20). Third, there may also be a threshold effect of study time: Schmid and Abell found that students who graduated from community college were more likely to study at least 11 hours per week than “nonpersisters,” that is, students who left college without completing their degree (18). Although this study did not distinguish among students who studied more than seven hours, any effect would be minor for this population because this group represents less than 7% of the class. Finally, it is worth asking whether the course structure was sufficient to allow students to practice applying concepts in class, and to prepare adequately for the exam without needing to use self-regulated learning strategies when studying independently. Considering the growing evidence that active learning can increase course performance for URM students, it would be interesting to study the relationship among class structure, study time, use of self-regulated learning strategies, and course success for students of diverse backgrounds, including prior education.

CONCLUSION

Taken together, these results show that many community college students are not able to meet the study requirements of college-level science courses because of job or family responsibilities, and/or because they are not equipped with the adequate motivational, cognitive, and metacognitive skills.

In fact, instructors may need to revisit their study time expectations, not only because these expectations may not be realistic for the community college population, but also because increasing study time may not affect performance in the course. These findings lead to new questions, including whether student success in a community college class is associated with the use of cognitive and metacognitive learning strategies for students with no prior degrees, and whether increased course structure may improve success for college students with lower self-regulated abilities.

As Schraw and colleagues explain: “Effective science instruction must not only increase learning, but also help students develop the metacognitive life-long learning skills needed to succeed at higher levels of science, and to reconstruct their conceptual knowledge and procedural strategies when necessary” (19).

ACKNOWLEDGMENTS

ASM’s Biology Scholars Research and Transition Residency program mentors, staff and participants, as well as Elaine Johnson and James Lewis at City College of San Francisco, were instrumental in the development of this study. Special thanks to Paul Heideman and Paula Soneral for their contributions. This project was supported by the Bio-Link National Advanced Technology Education Center of Excellence at City College of San Francisco and the Office of Career and Professional Development as well as the Student Academic Affairs division at the University of California, San Francisco. The author declares that there are no conflicts of interest.

REFERENCES

1. American Association of Community Colleges. 2013. Students at community colleges. [Online.] www.aacc.nche.edu/AboutCC/Trends/Pages/studentsatcommunitycolleges.aspx. 2. Cole, J. S., D. A. Bergin, and T. A. Whittaker. 2008. Predicting student achievement for low stakes tests with effort and task value. Contemp. Educ. Psychol. 33:609–624.
3. Coley, R. J. 2000. The American community college turns 100: a look at its students, programs, and prospects. Policy Information Report, Educational Testing Service, Princeton, NJ.
4. Committee on Under-Represented Groups and the Expansion of the Science and Engineering Workforce Pipeline; Committee on Science, Engineering, and Public Policy; Policy and Global Affairs; National Academy of Sciences, National Academy of Engineering and I of M. 2010. Expanding under-represented minority participation: America’s science and technology talent at the crossroads committee on under-represented groups and the expansion of the science. The National Academies Press, Washington, DC.
5. Cook, E., E. Kennedy, and S. Y. Mcguire. 2013. Effect of teaching metacognitive learning strategies on performance in general chemistry courses. J. Chem. Educ. 90:961–967.
6. Credé, M., and L. A. Phillips. 2011. A meta-analytic review of the motivated strategies for learning questionnaire. Learn. Individ. Differ. 21:337–346.
7. Eddy, S. L., and K. A. Hogan. 2014. Getting under the hood: how and for whom does increasing course structure work? Cell. Biol. Educ. 13:453–468.
8. Fletcher, L. A., and V. C. Carter. 2010. The important role of community colleges in undergraduate biology education. CBE Life Sci. Educ. 9:382–383.
9. Haak, D. C., J. HilleRisLambers, E. Pitre, and S. Freeman. 2011. Increased structure and active learning reduce the achievement gap in introductory biology. Science 332:1213–1216.
10. Hrabowski, F. 2011. Boosting minorities in science. Science 331:125.
11. Johnson, M. L., and G. M. Sinatra. 2013. Use of task-value instructional inductions for facilitating engagement and conceptual change. Contemp. Educ. Psychol. 38:51–63.
12. Ley K, Young D. 1998. Self-regulation behaviors in underprepared (developmental) and regular admission college students. Contemp. Educ. Psychol. 23:42–64.
13. McKenzie, K., K. Gow, and R. Schweitzer. 2004. Exploring first-year academic achievement through structural equation modelling. High. Educ. Res. Dev. 23:95–112.
14. Pintrich, P., D. Smith, T. Garcia, and W. McKeachie. 1991. A manual for the use of the motivated strategies for learning questionnaire (MSLQ). National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, MI.
15. Pintrich, P. R., D. A. F. Smith, T. Garcia, and W. J. McKeachie. 2014. Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). Educ. Psychol. Meas. 53:801–813.

16. Pike, G., M. Hansen, and J. Childress. 2014. The influence of students’ precollege characteristics, high school experiences, college expectations, and initial enrollment characteristics on degree attainment. J. Coll. Student Retent. Res. Theory Pract. 16:1–23.

17. Rau, W., and A. Durand. 2000. The academic ethic and college grades: does hard work help students to “make the grade”? Sociol. Educ. 73:19–38.

18. Schmid, C., and P. Abell. 2003. Demographic risk factors, study patterns, and campus involvement as related to student success among Guilford Technical Community College students. Commun. Coll. Rev. 31:1–16.

19. Schraw, G., K. J. Crippen, and K. Hartley. 2006. Promoting self-regulation in science education: metacognition as part of a broader perspective on learning. Res. Sci. Educ. 36:111–139.

20. Schuman, H., E. Walsh, C. Olson, and B. Etheridge. 1985. Effort and reward: the assumption that college grades are affected by quantity of study. Soc. Forces 63:945–966.

21. Zimmerman, B. J. 2008. Investigating self-regulation and motivation: historical background, methodological developments, and future prospects. Am. Educ. Res. J. 45:166–183.

22. Zimmerman, B. J., A. Bandura, and M. Martinez-Pons. 1992. Self-motivation for academic attainment: the role of self-efficacy beliefs and personal goal setting. Am. Educ. Res. J. 29:663–676.

23. Zimmerman, B. 1998. Academic studying and the development of personal skill: a self-regulatory perspective. Educ. Psychol. 33:73–86.