Working Paper

Supporting Student Learning Outside the Classroom:

A Research Agenda for STEM Academic Support at the Undergraduate Level

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Abstract: Research on STEM academic support is limited in comparison to that focusing on STEM teaching. This paper lays out an agenda for research on STEM student learning support at the undergraduate level, developed through a structured process with engagement of a large group of STEM faculty and learning-support specialists. The agenda describes critical research questions within five domains of STEM undergraduate academic support — programming structure, identity and diversity, psychological factors, cognition and metacognition, and institutional factors — and identifies key literature and methodological approaches to support future work.

Introduction

Over the past several decades, considerable effort has supported research to create more inclusive, engaging, and well-scaffolded STEM education pipelines, and much of this effort has focused on higher education. However, STEM attrition levels in college remain high relative to other disciplines, and disparities in attrition based on demographic factors remain (Seymour et al., 2019). The National Center for Educational Statistics reports that 48% of students who enter college in the United States with the intention of majoring in a STEM discipline are not completing their degrees (X. Chen & Soldner, 2013; President's Council of Advisors on Science and Technology, 2012). Most of the attrition in the STEM fields takes place after the first year; student experiences in introductory science courses are identified as one of the major reasons for this early attrition (X. Chen & Soldner, 2013). Attrition rates are also higher for women and for students with marginalized racial/ethnic identities. For instance, in a large national sample, 29% of African American students who had initially intended on a STEM major dropped out of college between 2003 and 2009, and 36% switched to non-STEM majors. For comparison, the figures for white students are 20% and 28%, respectively (X. Chen & Soldner, 2013). In tandem with these attrition trends, STEM employment opportunity is expected to continue to increase over the next decade (US Bureau of Labor Statistics, 2021). In order to meet the growing needs of the workforce and to compete globally, it is crucial to increase the number of STEM graduates and particularly to diversify the STEM talent pool.

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The Need for Additional Research on STEM Academic Support

According to the Learning Support Centers in Higher Education (LSCHE, n.d.), there are 1,540 individual college/university learning support center websites in the United States. Academic support activities, whether they are offered by the learning centers or by other units or campus, play a central role in students' college experiences and academic success. They provide opportunities for students to develop effective learning strategies and self-regulation skills, and to receive course-specific support through interactions with peers, near peers, and professional staff (Grillo & Leist, 2013; Kuh et al., 2006; Wibrowski et al., 2017). In addition to the role that academic support programs play in a student's learning experience, they may offer important extra-academic benefits: previous research provides evidence that students' engagement in non-course activities that promote psychosocial well-being (e.g., self-efficacy, sense of belonging, identity, motivation etc.) can positively influence decisions to stay in the STEM fields (Anderman & Freeman, 2004; Daniels et al., 2019; Pfund et al., 2006; Tinto, 1993; Wald & Reis, 2010). Indeed, Seymour & Hewitt's (1997) foundational work has shown that a majority of the students who switch from STEM majors do so due to factors that are non-academic.

Despite its importance, STEM academic support programming has a very small evidence base (with notable exceptions including the Peer-Led Team Learning model). In comparison to the widespread research attention over the past two decades focused on classroom STEM teaching, little attention has been directed toward undergraduate academic support activities in the form of tutoring, formal group study, academic coaching, and the like provided by academic support centers/learning centers. There is a dearth of research, for example, on the comparative benefits of different modes of support, on academic help-seeking behavior among different groups of students, on the communication and messaging involved in attracting students to appropriate programming, on the models for effective collaboration between academic

departments and academic-support offices, or on the impact of the interactions of different programmatic experiences on student success. Given that these support activities are typically a salient feature of the student academic experience, and one which in many institutions occupies a formal place within the organizational structure, decision-makers need an understanding of what works well, for whom, and why. This paper provides a high-level agenda for research into academic support practices in STEM undergraduate education.

What Do We Mean by *Academic Support?*

For the purposes of this document, we define *academic support* as guided activity, typically provided outside of the regular classroom, intended to enhance students' ability to succeed in their courses. Such support might take the form of tutoring, peer study groups, office-hour support, academic coaching, or the like. This support is often provided through student learning support centers, but in many instances comes from faculty, advisors, or other institutional units (e.g., academic departments, schools). Within the academic-support domain, we focus in this paper on undergraduate-level coursework and on STEM course content: mathematics, natural sciences, engineering, computer and information sciences, and the social and behavioral sciences. Although curricular and pedagogical reforms (i.e., activities taking place within students' regular classroom experiences) are vital to the success of undergraduate education, they are beyond the scope of this paper.

Development of the Agenda

This research agenda was developed through a three-phase process.

Phase 1

Phase 1 involved development of a literature review, led by several of this paper's authors, to summarize existing research relevant to STEM academic support in higher education and identify overarching categories within which further knowledge might be built. Articles were

chosen to represent a variety of methods and theoretical perspectives, and were published in peer-reviewed journals, with a small handful of exceptions made for dissertations and reports which offered perspective lacking in the available body of peer-reviewed work. The final review included 142 articles, 78% of which were published after 2000, 14% between 1990 and 2000, and 8% before 1990. The literature reviewed fell into five broad thematic areas: forms of academic support, cognitive and metacognitive aspects of academic support, psychosocial facets of academic support, diversity issues in academic support, and institutional factors in academic support. This review provided groundwork for Phase 2 of the agenda development.

Phase 2

Phase 2 involved convening a group of approximately 100 STEM learning professionals, in summer 2019, at a National Science Foundation–sponsored conference at Northwestern University in Chicago,[1] to develop priorities for research into undergraduate STEM academic support. These individuals represented higher education institutions from around the U.S. and Canada; approximately half were faculty in the STEM disciplines, and the other half were education experts and/or learning-support professionals. The Phase 2 work comprised 5 individual steps. Step 1 involved discussions of the literature review, conducted in groups of 20–25 people to allow for interactive discussion, and facilitated by experts in one of the core topics represented in the literature review. Through these discussions, participants probed ideas within the literature review, shared knowledge and insights from their respective disciplinary or professional positions, and began to think about where gaps in knowledge might lie. Step 2 involved structured small-group conversations around one of the core themes, in which participants identified important gaps in existing knowledge, articulated problems in need of

[1] Developing a National Research Agenda for STEM Academic Support, DUE-1836657

solutions, identified knowledge required in order to arrive at solutions, explored practical significance, and began to formulate broad research questions. Step 3 involved discussion among several of these small groups, all working with a similar topic area, to rank proposed research questions and come to agreement on which were most pressing. Step 4 involved sharing out from these discussions in the full group of 100, and eliciting input from the full group on areas in need of refinement and potential issues overlooked. Finally, Step 5 of Phase 2 involved smaller thematically based groups re-engaging to refine ideas, re-articulate pressing research questions, and begin to sketch out plans for potential research projects.

Phase 3

Phase 3 involved a subgroup of 5–7 conference attendees refining the questions that had been generated during the two-day conference. Working in pairs or threes, and continually coming back to the larger group of six to achieve consensus, this team eliminated redundancies and deleted questions that fell outside of the broad theme of STEM academic support in higher education, eventually arriving at a smaller set of critical research questions. This work took place over approximately seven months.

Methodological Notes

Although guidance on educational research methods is outside of the scope of this paper, we offer two broad methodological notes below.

Determining What Constitutes Success

Studies of programming aimed at improving student academic outcomes must define what a successful outcome is. What outcomes do we care about? Are we interested in performance on a given measure, or long-term learning? For instance, is our goal to improve academic knowledge, or social and psychological well-being within the academic context, or both? We recommend that questions such as these be explicitly considered in the development of

any study of academic-support activities, and that the rationale for choosing particular outcome measures in a study be included in any research report.

Researchers should consider the following questions as they identify outcome variables of interest:

1. What are the particular goal(s) of the activity or program under study? For instance, was the activity designed to improve grades in a given course? For all students, or for students with lower incoming grades, or some other group? To improve retention or graduation rates? To improve the sense of belonging in a department or major? Is an increase in the overall number of participants or in certain subpopulations desired, or is the quality of the experience more relevant?
2. How can we most meaningfully operationalize success indicators? For example, does "improvement in grade" mean any improvement? An improvement of a particular magnitude? An improvement relative to some previous assessment score?
3. What are the most practically meaningful outcomes for the particular students (or other constituents) in the study? For example, is grade improvement the result that is most likely to allow students to achieve their short- or long-term goals? Is demonstrated understanding of particular concepts more relevant than grade, given those goals? Are psychosocial outcomes, such as belongingness or confidence, equally or more important in achieving those goals?

For the purposes of this paper, we assume that the desired outcomes are up to the individual researcher to determine, so that the research questions we present are stated in fairly broad terms.

Comparison Groups and Self-Selection in Evaluation Research

When we examine whether a particular intervention is successful, a meaningful point of comparison is needed in order to judge the relative change in outcome variables. A key concern

in developing a comparison-group study design is self-selection, or the extent to which students who opt into support programming may be predisposed to do well because of factors other than the support programming. Potential pre-existing differences between students who opt in and those who do not — for instance differences in motivation, high school GPA, or executive control skills — are sometimes ignored in evaluation studies of academic-support programming (Van der Meer & Scott, 2009). Also often ignored are potential differences in other activities students may be engaging in, such as counseling or attending office hours, which may impact academic outcomes. Such variables can confound the results of an analysis, making it appear as if the intervention is responsible for some observed change when in fact a third, underlying variable was at play. There are various approaches to minimizing such confounding effects, the gold standard being true experimental designs, which integrate random selection and control groups, and thus allow researchers to draw conclusions about the causal impact of an intervention. However, experimental studies are often difficult to carry out in educational settings, and indeed, only a small number of academic-support studies have used experimental design (e.g., as with Arco-Tirado et al., 2011). Others have used quasi-experimental methods (Shadish et al., 2002) such as nonequivalent comparison-group design with control variables (Gattis, 2002; Kostecki & Bers, 2008; Munley et al., 2010), or case-control or propensity score matching (White & Sabarwal, 2014), to minimize the impact of potential confounders.

Research Area 1: Structure and Form of STEM Academic Support

Academic support in STEM comes in many different forms (e.g., tutoring, peer-led study groups, academic coaching, workshops), and some of these forms have received greater research attention than others. Group study, whether Peer-Led Team Learning or another model, has received the most research attention; research on this type of model has by and large shown improvements in academic performance, retention, and attitudes about the course, as well as

sense of community and persistence (Amstutz et al., 2010; D. Arendale, 2017; Carlson et al., 2016; Gafney & Varma-Nelson, 2008; Gosser, 2011; R. Hodges et al., 2001; Kochenour et al., 1997; Martin & Arendale, 1990; McGuire, 2006; Micari & Pazos, 2019; Pazos et al., 2007; Ruiz-Primo et al., 2011; Shook & Keup, 2012; Tien et al., 2002a). However, only a small number of these studies have taken an experimental approach, and not all have addressed the self-selection question. Research on individual or group tutoring, as distinct from the study-group model (Gerlaugh et al., 2007; Holliday, 2012; Perin, 2004; Perkin & Croft, 2004; Santee & Garavalia, 2006; Ticknor et al., 2014; Topping, 2001), is more limited; existing studies usually show positive relationships between tutoring and desired outcomes (Fullmer, 2012; Gallard et al., 2010; Hughes et al., 2011; Rath et al., 2012; Rheinheimer et al., 2010), although some have not produced positive outcomes (Cooper, 2010; Navarra-Madsen & Ingram, 2010; Topping, 1996); and again, few studies use control, equivalent, or even non-equivalent comparison groups to support causal effects of tutoring and avoid the difficult problem of controlling for self-selection. There is likewise limited research on the impact of study-skills support to students (that is, programming or instruction aimed at improving STEM learning and performance by focusing on how to study). There is, however, some evidence of increased learning skills among students engaging in study-skills courses (e.g., Hoops et al., 2015; Wibrowski et al., 2017), and through embedding study-skills training into STEM courses (e.g., Cook et al., 2013; Mutambuki et al., 2020).

All of these forms of academic support traditionally take place face-to-face, although there has long been some degree of virtual tutoring, advising, and other services available. The COVID-19 pandemic prompted a large-scale shift to online academic support of all kinds (Johns & Mills, 2021). The research into the relative benefits of virtual vs. in-person support, and the features which enhance the benefit of virtual support, is small but growing (Brummernhenrich &

Jucks, 2013; De Smet et al., 2008; Hanham et al., 2021), although there is already a substantial body of literature more generally focusing on virtual communication and virtual learning.

Critical Research Question 1: What is the relative impact of various tutoring practices on student outcomes?

Overall, far less research exists on the impact of tutoring programs than on sustained group-study programs, most likely because tutoring encounters can be one-off and brief, making impact more difficult to capture. Because of sample size constraints, most studies on tutoring lack the statistical power to examine differential effects of tutoring on specific student groups or to determine the relative effectiveness of different approaches to tutoring – for example, individual vs. group-based tutoring, appointment-based vs. drop-in tutoring, in-person vs. virtual settings, and professional vs. peer tutoring. The area which appears to have the greatest evidence base is that of pedagogical strategies in tutoring; this work suggests that a less directive approach (i.e., guiding students in actively solving problems rather than showing them how to arrive at an answer) and greater attention to concepts rather than isolated pieces of information are linked to better student outcomes (Chi, 1996; Kulatunga & Lewis, 2013; Micari et al., 2010; Topping & Bryce, 2004). These findings align with theoretical assumptions that peer learning encourages students to do more meaning-making than memorizing (Repice et al., 2016) and learn actively (Ashwin, 2003; Knight, 2013). Finally, there is very little evidence on the relative effectiveness of various approaches to tutor training. Indeed, few studies detail the type of training that tutors receive (see Critical Research Question 5) beyond noting the use of broad models (e.g., the College Reading and Learning Association tutor training program certification), which can vary in implementation (Colver & Fry, 2016)..

Critical Research Question 2: What is the relative impact of various models of academic support across subpopulations of students?

Within the group-based support literature, there is some evidence that the relationship between participation and desired outcomes can be higher for students with marginalized identities than for other students, as well as for students with lower levels of preparation as compared to those with more preparation (Drane et al., 2014a; Micari & Pazos, 2019; Peterfreund et al., 2008). On the whole, however, there is limited research on whether and how various forms of support might differentially impact particular subgroups of students. We know little, for example, about how specific STEM support models and approaches work for students with marginalized identities or first-generation students, or for students who come to support voluntarily versus those who are referred to, or required to, access support.

Critical Research Question 3: Within group support settings, what impact does group composition, in terms of academic preparedness and demographic characteristics, have on student outcomes?

Although there is a sizable literature on the impact of group composition more broadly, including within the K-12 arena and in the workforce, there is very limited research examining the composition of small-group learning at the college level. Overall, evidence is mixed, perhaps due to methodological differences among studies. In studies on K-12 education on the effects of grouping by preparedness level, there is some evidence of a benefit to grouping, but other studies show a detriment, and yet others show differential effects for students at different levels of preparation (e.g., Gijlers & De Jong, 2005; Leonard, 2001; Saleh et al., 2005). In the college environment, the picture is equally muddy: Some work (e.g., Heller & Hollabaugh, 1992; Micari et al., 2016) has found that diversity in academic preparation within a group generally benefits student grade outcomes, while other work shows a benefit for homogenous grouping by

preparedness level (e.g., Baer, 2003; Jensen & Lawson, 2011), and yet other work shows differential impacts for different types of students (Jensen & Lawson, 2011; van der Laan Smith & Spindle, 2007). The demographic makeup of study groups in the context of academic support has not received much attention in the literature, but research on learning groups within STEM courses points to important gender-related effects. For example, Dasgupta et al. (2015) found that female engineering students had more positive outcomes when they were in female-majority learning groups than in more mixed groups. In regard to racial or ethnic factors in group composition, although there is an extensive body of research on diversity in classrooms, there is limited research at the level of small learning groups, or more generally at the college level. (We address this further in the Diversity and Inclusion section.) The complexities of how such diversity impacts student experience and learning within STEM support environments in particular is limited (see, for example, Fries-Britt & White-Lewis, 2020; Singaram et al., 2011).

Critical Research Question 4: How does the nature of interpersonal interactions during an academic-support encounter impact student outcomes?

Subquestion a: What are the characteristics of interpersonal and conversational dynamics within an academic-support encounter that lead to positive academic and psychosocial outcomes for students?

Subquestion b: In what ways are the answers to (a) above different in a virtual environment?

There is a small but growing body of research examining the characteristics of interpersonal interactions — such as the questioning practices used by tutors, the turn-taking behaviors within a group, etc. — within STEM academic-support activities (Chai et al., 2019; Chini et al., 2016; DeFeo et al., 2017; Dubey et al., 2017; Oshima et al., 2013; Repice et al., 2016). Much of this work is descriptive, or presents tools for analysis of interaction; there is room to apply these techniques to hypothesis-testing. There is a larger, but still modest, body of

research on online and reading-based tutoring interactions (Brummernhenrich & Jucks, 2013; H. Schmidt, 2011). The field is ripe for increased attention to evaluating the conversational characteristics and interpersonal dynamics of effective STEM support encounters. Similar studies of classroom dynamics (Chiu, 2008; Empson, 2003; Sfard, 2001; Webb et al., 2002; Wieselmann et al., 2020, 2021) can provide excellent models for future research.

Attention to these questions within a virtual setting is critical, since communication dynamics differ in important ways between face-to-face and virtual environments, and may differ further depending on students' identities and personal characteristics (Chang et al., 2019; Ruthotto et al., 2020).

Critical Research Question 5: What approaches to training of peer learning leaders (tutors, mentors etc.) are effective in promoting behavioral and attitudinal changes in leaders, in both cognitive and non-cognitive domains?

Subquestion a: Which training activities are most likely to impact leader approach and behavior as related to creating inclusive support environments?

Typically, academic-support programs that utilize peer tutors/leaders offer the tutors or leaders structured training. Training typically addresses topics such as interpersonal and communication skills (Roth et al., 2001), student regulation of learning and metacognitive skills (Leary et al., 2013; Roscoe & Chi, 2007), small-group dynamics and facilitation (Azer, 2005), diversity and inclusion, including topics such as microaggressions, anti-racism, belonging, stereotype threat, etc. (Lundmark et al., 2017; Roth et al., 2001; Tien et al., 2004), and cognition and learning (e.g., spaced retrieval, the testing effect). However, the training process varies widely across universities; there is no single standard approach to the amount or timing of training, or to what topics are included, how they are introduced, or how much time is allocated to each topic. That said, institutions may seek certification of tutor-training programs, for

example from the College Reading and Learning Association (Wilson & Arendale, 2011), and must adopt some standardized approaches to achieve this.

Some studies suggest that the use of mock tutoring sessions (Baroffio et al., 2007) and video scenarios (Bosse et al., 2010; Holland et al., 2017) can help tutors learn to navigate difficult tutoring situations. Additionally, some researchers highlight the value of content experts in developing the training curriculum and/or implementing them (Baroffio et al., 2007; Kail, 2003). There is considerable opportunity for more research into which content and training approaches are most likely to change peer leaders' attitudes and conceptions of the act of providing support, as well as their behaviors within the support relationship. In particular, attention to diversity and inclusion-related training activities could promote positive outcomes for students with marginalized identities. Theory and research from the teacher/faculty development literature focusing on both inclusion (Ash et al., 2020; Chavez et al., 2003; Dewsbury, 2017; Moriña & Carballo, 2017; Wiggan et al., 2020) and related pedagogical practices (Çetin, 2021; Hudson et al., 2015; Jacques et al., 2020; Nardi, 2021; Staub & Stern, 2002) will provide an excellent foundation for this work.

Research Area 2: Identity and Diversity in STEM Academic Support

The research on social identities in STEM education clearly demonstrates a relationship between a student's social identity and the quality and outcomes of that student's educational experiences. The picture is multi-faceted and complex for several reasons. First, social identities are many, encompassing race and ethnicity, religion, gender identity, socioeconomic status, disability status, age, sexual orientation, and more. Furthermore, a single individual's experience will be affected by the intersections of their identities, as well as by other individual factors such as life experiences and personality. All this complexity notwithstanding, we know that diversity and social identities matter in STEM higher education. First, there is uneven representation in

STEM degree completion. At the undergraduate level, in 2016, women earned 19 percent of bachelor's degrees in both physics and computer science, and 21 percent in engineering, despite making up 57 percent of the 4-year-institution undergraduate population. The same year, Hispanic or Latinx students earned just under 14 percent of science and 10 percent of engineering degrees; and Black or African American students earned 9 percent and 4 percent, respectively (National Science Foundation, 2019). For comparison, 36 percent of bachelor's degrees awarded in 2015-16 were to Black/African American students, and 40 percent to Hispanic/Latinx students (US Dept of Education, 2020). Second, institutional type makes a difference. For instance, the top 8 undergraduate institutions of female Black/African American STEM doctorate-earners in the US were minority-serving institutions (National Science Foundation, 2019), meaning that predominantly white institutions send fewer Black students on to earn doctoral degrees. Factors identified in the research as suppressing achievement of BIPOC students in predominantly white institutions include enacted racism and stereotypes, lack of representation, lack of mentoring and connection to faculty, social isolation, and perceived pressure to prove oneself, among others (Museus et al., 2011). Students with marginalized identities frequently report experiences reflective of an institutional climate that devalues their contributions and discourages their confidence (Gusa, 2010; McGee, 2016; Rankin & Reason, 2005; Reid & Radhakrishnan, 2003).

Critical Research Question 1: What programmatic features of academic support are associated with positive outcomes for students with marginalized or underrepresented identities?

Subquestion a: How do bias, microaggressions, and racism play out in academic-support environments, and how can they most effectively be mitigated?

Academic support is sometimes more beneficial for students with marginalized identities than for other students (Drane et al., 2014b; Nasim et al., 2005; Rheinheimer & Mann, 2000). However, it is unclear whether particular forms or features of academic support programming have a differential impact for certain groups of students. The largest existing body of evidence related to differential impacts of academic support by student population focuses on collaborative study groups (e.g., Supplemental Instruction, Peer-Led Team Learning), which are a popular academic-support approach across the U.S. For instance, a number of studies have shown that study groups especially benefit academically students whose identities are marginalized in higher education (A. F. Cabrera et al., 2001; Fries-Britt et al., 2010; Treisman, 1992), as well as for less-academically prepared students (Báez-Galib et al., 2005; Drane et al., 2014b; Hall et al., 2014; Micari et al., 2016b; Shields et al., 2012; Snyder et al., 2016). Still, it is not clear which particular features of such programming are key to producing benefits. However, other studies have produced contradictory evidence related to gender (Chan & Bauer, 2015; Hockings et al., 2008; Tien et al., 2002b), racial or ethnic backgrounds (Chan & Bauer, 2015; Frey et al., 2018, p. 201; Hockings et al., 2008; Tien et al., 2002a), and students with different levels of academic preparedness (S. E. Lewis & Lewis, 2008). It is important to note that research on collaborative study groups reflects many different programming features and methodologies, making comparison across studies difficult.

The question of how academic-support environments themselves might perpetuate oppression, and of fruitful avenues for mitigation, is largely absent in the research. Interventions that can be embedded within academic support programming warrant investigation. For instance, Jordt et al. (2017) showed that a values affirmation exercise can reduce stereotype threat and improve performance of students underrepresented in STEM — particularly those who held more stereotyped beliefs about gender differences — in a biology class. This exercise has also been shown to improve women's performance on cognitive tasks (Martens et al., 2006; Miyake et al., 2010). In a similar vein, Christopher (2015) found that reframing the perception of the purpose of a test, teaching students to celebrate struggles, and creating positive stereotypes were effective in reducing the impact of stereotype threat and improving performance in law students. Translating interventions that have proved fruitful in the classroom or other domains to academic-support programming — including training on inclusive pedagogy for staff and peer tutors — is a promising area for future research.

Critical Research Question 2: How does the institutional positioning of academic support programming relate to usage and outcomes for students from different identity groups?

Subquestion a: Does placement of services in community-specific environments (e.g., within multicultural houses) result in greater usage, or different outcomes?

Subquestion b: What marketing approaches are most effective in increasing support-service usage by students from a variety of identity groups?

Research suggests that in general, students whose identities are marginalized in STEM show low willingness to seek help, compared to those with other identities. Asking for help can feel like exposing oneself as academically inferior, which can pose a threat to one's self-esteem (Karabenick & Gonida, 2018a; Karabenick & Knapp, 1991a; Pokorny & Pickford, 2010; A. M.

Ryan & Pintrich, 1997; Sánchez Rosas & Pérez, 2015). Students with lower levels of prior academic achievement tend to be, ironically, less likely to ask for help than those with greater academic preparation (A. M. Ryan et al., 2001). Students who may already feel marginalized in the academic environment — for instance, students of color, low-income students, and first-generation college students (Sánchez Rosas & Pérez, 2015) — are often especially concerned about the stigma of help-seeking. (See the Psychosocial section for detail on this.) Particularly in more selective institutions, stigma can be intertwined with impostor phenomenon, in which students harbor a worry that they might not, after all, merit the place they have earned in the institution (Bertelsen et al., 2013; Fischer, 2010; Lee & Kramer, 2013; Patel et al., 2015; Sonnak & Towell, 2001).

One approach that a number of institutions have taken to reducing this sense of stigma, and the consequent avoidance of help-seeking, is to create support spaces specifically for particular identity groups. Multicultural student centers and LGBTQ+ resource centers, for instance, can provide an anchor for many students who might otherwise lack a strong sense of belonging on campus. Moreover, offering services in locations that are convenient for students is one of the common strategies used to increase usage (Rennar-Potacco & DeYoung, 2007). However, the degree to which placement of academic-support programming within these spaces will impact outcomes remains unknown.

Critical Research Question 3: How does intergroup diversity play out in group learning situations within academic support environments?

Subquestion a: Does the identity of a tutor/coach impact outcomes for different groups of students (e.g., based on race, gender, prior achievement, etc.)?

Subquestion b: How does the demographic makeup of a learning group impact outcomes for different students?

There is substantial research supporting the notion that demographic diversity creates a general benefit for groups, for instance leading to less conformity in decision-making (Gaither et al., 2018), higher-quality product outcomes (Watson et al., 2002), and greater learning gains (Saleh et al., 2005) than in homogenous groups, although diverse groups can face additional challenges as well (Shemla et al., 2016; Watson et al., 1998). However, research on the experiences of individual students in homogenous vs. diverse groups is more limited. Studies on the impact of teacher/mentor identity suggest that same-race teachers may positively impact academic outcomes (Egalite et al., 2015; Redding, 2019), that female mentors have a positive impact on female students in the STEM disciplines (Stout et al., 2011), and that role models who are members of underrepresented or marginalized groups create a welcoming academic culture for students who identify similarly (Blake-Beard et al., 2011, p.; Cole et al., 1999; Marx et al., 2009). There is also evidence that when groups are gender-balanced or female-majority, women in STEM experience less anxiety and greater confidence, and engage more fully (Dasgupta et al., 2015); that majority-group students tend to dominate discussion in mixed-ethnicity groups (Wilkinson & Fung, 2002); and that male students can tend to speak more and be perceived as more STEM-competent in groups (Due, 2014; N. A. Lewis et al., 2019; Underwood et al., 2000). Interestingly, the ethnic/racial makeup of a group appears to influence gender dynamics, with women speaking more in more racially diverse groups than in homogenous groups (Toosi et al., 2012). It is also clear that intersecting social identities impact students' responses to any given environment, so that what might be true for one female Black student, for example, might not be true for another (Torres & Massey, 2012). More research is needed to better understand the impact of intergroup characteristics on student experience and performance in academic support settings.

Research Area 3: Psychosocial Factors in STEM Academic Support

Psychosocial factors — those related to the interplay between one's own psychology and the social environment — play a critical role in academic success. The academic psychosocial landscape is complex; individual factors do not operate in isolation but interact with other features of a student's experience. One important set of factors relates to how students understand themselves as learners, for example the degree of self-efficacy they feel in a particular endeavor, the attributions they make for their own academic success or failure, and the degree to which they hold a "growth mindset." Self-efficacy (the belief that one has the ability to perform and succeed at a given task [Bandura, 1982, 1997]) has repeatedly been found to predict outcomes such as academic success, student retention, and GPA (Bandura, 1997; Bouffard-Bouchard et al., 1991; Lane et al., 2004; Linnenbrink & Pintrich, 2003; Pajares & Miller, 1994; Zimmerman & Bandura, 1994). Attributional style (Seligman et al., 1979) refers to the ways in which individuals tend to explain events in their own lives, particularly success or failure experiences. Attribution theory (Weiner, 1985, 2010) identifies four dimensions of the attributions people make for events they experience: internal vs. external, controllable vs. uncontrollable, stable or enduring vs. unstable, and global, or generalizable across events, vs. particular events. Recent research suggests that making internal, stable, and global attributions for positive events is related to positive academic outcomes (Gordeeva et al., 2020; Houston, 2016). Mindset, or implicit theory of intelligence (Dweck, 2006; Dweck et al., 1993) refers to a person's tendency to view intelligence as malleable or as fixed. A good deal of research provides evidence that a growth mindset (i.e., a malleable view of intelligence) is predictive of academic success (Aronson et al., 2002; Claro et al., 2016; Dweck, 2006; Spitzer & Aronson, 2015; Yeager & Walton, 2011), although other research provides less evidence (Sisk et al., 2018). It should be noted that both growth mindset and the related concept of "grit" — a tendency to

persevere and maintain passion for one's goals through challenges (Duckworth, 2016; Duckworth et al., 2007) — have received criticism for ignoring the institutional and structural factors that can impede success for students with marginalized identities (Denby, 2016; Kohn, 2015; Mehta, 2015; Ris, 2015).

Another set of psychosocial factors relates to students' direct engagement with the environment, for example the degree to which and ways in which they seek academic help, the degree to which they are impacted by stereotype threat, or the degree to which they feel they merit a place in the institution or program. Help-seeking behaviors are positively correlated with academic performance (R. Hodges & White Jr, 2001; Karabenick, 1998; Karabenick & Gonida, 2018b; Karabenick & Knapp, 1991b; Kitsantas, 2002; Newman, 2000; Williams & Takaku, 2011). However, students who feel concerned that seeking help may threaten their identity in some way are less likely to seek academic help (N. L. Cabrera et al., 2016; Karabenick & Knapp, 1991b; Patel et al., 2015; Rodriguez et al., 2016; Winograd & Rust, 2014). Stereotype threat (Steele, 1997) occurs when awareness of a stereotype — one about a social group with which one identifies — negatively affects one's performance on an important task. A substantial body of literature has demonstrated the negative impact of stereotype threat on academic performance, as well as performance in a variety of other domains (Beasley & Fischer, 2012; Bell et al., 2003; Hess et al., 2003; K. E. Ryan & Ryan, 2005; Stone et al., 2012). Stereotype threat most dramatically impacts individuals high in ability for the relevant domain and those who strongly identify with the relevant domain (Aronson et al., 1999; Osborne & Walker, 2006). Imposter phenomenon (Clance & Imes, 1978) — we avoid the term *imposter syndrome*, which suggests a pathology (Feenstra et al., 2020) — occurs when an individual maintains a strong belief that they are not sufficiently intelligent or talented to belong in a given environment. Imposter phenomenon has been positively correlated with anxiety, depression, and psychological distress,

and appears to have differential impacts based on social identity (Bernard et al., 2017; Clance & Imes, 1978; Cokley et al., 2013; Harvey & Katz, 1985; Henning et al., 1998; Peteet et al., 2015; Wang et al., 2019).

Finally, affective experience is an increasing concern across college campuses (Center for Collegiate Mental Health, 2021); mental health struggles both stem from and feed into academic difficulties, and are correlated with lower academic achievement and retention rates (Kitzrow, 2003; Thompson et al., 2013).

Critical Research Question 1: How can institutions most effectively encourage students' use of academic support services?

Subquestion a: How does effectiveness of messaging approaches differ across subgroups of students?

Subquestion b: What is the impact of targeted outreach to students who are earning low grades in their courses?

There is a large body of research examining the use of persuasion in messaging, with numerous studies investigating the impact of various approaches to messaging on people's inclination to seek help for mental health and health-related problems (M. S. Christopher et al., 2006; Joyce & Weibelzahl, 2011; Siegel et al., 2015; Suka et al., 2020)**.** Messaging can make a difference in people's behavior, and getting the message right should be particularly important for encouraging students who are more reluctant to seek help to take part in academic-support programming. However, there is little research specifically addressing methods of persuasion for academic help-seeking (notable exceptions include Covarrubias et al., 2019; Deacon et al., 2017). Using a psychosocial lens to investigate messaging could create fruitful groundwork for future research. For example, what approaches to messaging about academic support services

can both persuade students to seek help and encourage growth-oriented self-assessments as students encounter academic challenges? Do marketing messages that emphasize correction promote deficit thinking — assuming that the student is "deficient" and needs to be "fixed" — whereas messages that emphasize the difficulty of the task might normalize and promote the struggle inherent to productive learning? Investigation into the impact of type, tone, and content of a message, as well as the source and medium of the message (e.g., flyers, social media, classroom announcements, email from faculty, communication with peers or parents), could provide insight into the most effective approaches to messaging, as well as for whom particular messages work best. Impact may vary, for example, across demographic groups, personality traits, or abilities. In particular, targeted messaging or services to students who are struggling academically (e.g., students who are at risk for failing courses or probation) might have a beneficial effect, or they could trigger stereotype threat, prompt defensive reactions, or further harm students' self-esteem and motivation. Research into these relationships would provide guidance for faculty, advisors, and learning centers hoping to reach the most at-risk students.

Critical Research Question 2: Within an academic-support environment, what curricular and programmatic approaches most effectively promote inclusion, specifically through increased sense of belongingness, reduced imposter phenomenon, and/or reduced impact of stereotype threat?

Students whose identities are marginalized, or are underrepresented within their disciplines, are particularly susceptible to a reduced sense of belonging, to imposter phenomenon, and to the impact of stereotype threat — all of which can have a negative effect on learning, performance, and retention in STEM. Although effectiveness of interventions targeting these factors has been examined (Alter et al., 2010; Cisco, 2020; Cohen et al., 2006; Walton & Cohen, 2011; Zanchetta et al., 2020), the use and impact of such interventions within an

academic-support setting has been far less researched. Studies incorporating interventions such as those described in the section above (e.g., values affirmation) into support programming would provide guidelines for student learning centers and other support providers in developing services that both welcome students and extend broader institutional efforts to provide inclusive learning environments.

Critical Research Question 3: What curricular and programmatic approaches within STEM academic-support services promote self-efficacy, encourage productive attributions and mindset orientations, and reduce academic anxiety for students?

A number of studies have examined the effectiveness of psychosocial interventions designed to impact outcomes such as growth mindset, self-efficacy, and academic anxiety (Bartsch et al., 2012; Broda et al., 2018; DeBacker et al., 2018; Hulleman & Harackiewicz, 2009; T. F. Smith & Capuzzi, 2019; Yeager & Walton, 2011). However, these have generally been carried out in laboratory or classroom settings. Research is needed on the impact of targeted psychosocial interventions within support programming. For example, how do particular tutoring policies and practices impact sense of belonging or a growth mindset? How does a tutor's use of particular forms of language affect students' academic help-seeking behavior? And does this differ across students with particular characteristics? How might interventions aimed at metacognition and self-regulation help to improve psychological wellness as well as academic difficulties (Kim & Hodges, 2012; Legg & Locker, 2009)? How does the timing of psychosocial interventions (e.g., during orientation, after midterms, between the first and second semesters, or after the first year) impact both psychosocial and academic outcomes? Is a single-session intervention enough to change a student's behavior, or are multi-session interventions necessary in order to impact behavior? And finally, are targeted interventions necessary to change behavior, or is simply incorporating practices informed by knowledge of psychosocial factors

enough to influence student behavior? Complicating this issue is the fact that, as suggested by some researchers (e.g., Yeager & Walton, 2011), the most effective format might differ from institution to institution.

Research Area 4: Metacognition and Self-Regulation in STEM Academic Support

Metacognition and self-regulation are interrelated concepts describing the processes of recognizing and understanding what one knows and does not know, and knowing which steps to take as a result of such recognition and understanding (Flavell, 1979; Newman, 2002). Metacognition and self-regulation are essential for effective studying and learning (Cook et al., 2013; McGuire, 2015; Schneider & Artelt, 2010; Winne & Hadwin, 2013; Zimmerman, 1989, 2002, 2008). Undergraduate students who make greater use of metacognitive strategies (for example, planning one's study strategies, monitoring effectiveness of strategies used, etc.) tend to have higher grades (Cook et al., 2013; Hacker et al., 2009; L. C. Hodges et al., 2020; McGuire, 2015; Schleifer & Dull, 2009; Young & Fry, 2008) and other desirable academic outcomes (Bol et al., 2016; Gettinger & Seibert, 2002; Kitsantas, 2002; Mega et al., 2014). Self-regulation is also highly correlated with help-seeking behaviors; students who self-regulate well are more likely to seek help when needed (Dunn et al., 2014; Pintrich et al., 1993; Zimmerman & Pons, 1986). However, research indicates that college students often lack awareness of the most beneficial study and metacognitive strategies (Kornell & Bjork, 2008; McCabe, 2018; Roediger III & Karpicke, 2006; Yan et al., 2017). Strategies with the clearest evidence of improving learning and retention of knowledge include distributing study sessions, also known as spacing (Kornell & Bjork, 2007); switching between topics while studying, also known as interleaving (Kornell & Bjork, 2008); retrieval practice or testing (Roediger III & Karpicke, 2006; Rowland, 2014); elaboration techniques such as elaborative interrogation (B. L. Smith et al., 2010), self-explanation (Wong et al., 2002), and dual coding (Fernandes et al., 2018); and preparing to teach

others (Dunlosky et al., 2013; Ley et al., 1995; Roediger III & Karpicke, 2006). Calibration, or the ability to accurately gauge one's own knowledge or ability level, is also considered to be an important metacognitive skill (Alexander, 2013).

Critical Research Question 1: What intervention approaches within academic-support settings lead to students' adoption of productive metacognitive strategies, in both the short and long term?

Subquestion a: How does the effectiveness of such approaches differ among different populations of students?

Various approaches to teaching metacognition and self-regulation have been described in the literature, and as noted earlier, some studies have found such training to have positive effects. However, much less is known about the particular characteristics of training — the way training is framed, the nature of the activities used, its length and structure, etc. — that make it more or less effective in promoting behavior change in students. It is unclear, for instance, whether students would be more likely to put metacognitive skills to use when they are learned within the context of a disciplinary course (e.g., taught by faculty as a unit within a chemistry class), within a program offered by staff at a college learning center, or within programming conducted by trained peers. Metacognitive training can also take different forms, for example stand-alone workshops on study skills, or as a full credit-bearing course. We know of no study that directly compares the efficacy of different instructor types or structural formats. There is also room for research on the efficacy of various approaches to virtual metacognition training: Several studies (e.g., Cardinale & Johnson, 2017; Pryjmachuk et al., 2012; Tuckman, 2002) have found positive effects of online metacognitive interventions, but the optimal structure for such interventions is not clear.

The question of for whom particular interventional approaches are most effective also remains unanswered. How the timing, framing, and packaging of metacognitive training impact students with underrepresented identities, first-generation college students, and students with learning disabilities is of particular concern. Also relevant here are the training setting (e.g., in a learning center vs. within an affinity-group setting) and the ways in which the training is offered and promoted (e.g., offered to all vs. targeted, presented as help vs. part of the standard college academic experience).

The effectiveness of these kinds of interventions has generally been measured in one of two ways: 1) self-report measures of study or metacognitive skills, or 2) improvements in grades. For example, one might look for an improvement across pre- and post-tests on a metacognitive skills test such as the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) or a study skills test such as the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993). One drawback of self-report is that, by and large, students do not have particularly accurate insight into their study or metacognitive skill use (Miller & Geraci, 2011); self-report also introduces the risk of memory failure and social desirability bias. Behavioral measures can provide converging evidence of improvements.

Most interventions in the research literature incorporate multiple components. In other words, students might be trained to incorporate multiple study strategies such as retrieval practice, spacing, and elaboration, or multiple metacognitive strategies that address planning, monitoring, and evaluating, all in a single study. Although this increases the potential of finding an effect, it muddies the water in terms of determining which strategies are most effective. Some meta-analyses and reviews provide insight into this (e.g., Dunlosky et al., 2013; Hattie, 2011), for example suggesting that training in the planning components of metacognition are more effective than monitoring and evaluating. However, few controlled studies (one example is Saenz

et al., 2019) directly compare the effectiveness of different strategies, and those that do are limited to the laboratory. More field experiments and carefully controlled studies are needed to better understand the effectiveness of approaches to training in metacognition.

Critical Research Question 2: What is the ideal timing of metacognitive and self-regulation-oriented interventions?

There is little to no research on the ideal timing for academic-support interventions in STEM. However, the timing of educational interventions more broadly has been shown in the research to be a critical factor in their success (Cortes et al., 2019; Fernandez et al., 2015). In the term-based academic environment, in which students have just a matter of weeks to learn and then be assessed on course material, timing seems especially important, and this may be complicated by the potential reluctance of students to attend to information about useful study strategies until they are struggling in courses. Motivation and receptivity to metacognitive support may wax and wane over the course of a term, for instance increasing after students receive their first midterm grades, or decreasing in periods of particular stress, such as the pre-finals week. Research investigating the relative impact of interventions timed at different points in students' college paths could support institutional resource planning, enabling decision-makers to provide students metacognitive training at the points when it is most likely to make a difference.

Critical Research Question 3: Under what circumstances does metacognitive training transfer to other domains or environments?

Research on the impact of metacognition training within discipline-based courses (e.g., general chemistry) has proliferated in the past decade, with documented positive learning effects through teaching Bloom's taxonomy, the PLRS study cycle (Cook et al., 2013), reflection assistants (Gama, 2004), and the like. However, there has been very little investigation into

whether these skills, once learned, are transferable outside of the context of the course in which they are taught. As with critical thinking, there is also debate about whether metacognitive skills can be taught as general skills, independent of domain content, or whether they must be taught embedded within a subject-specific course (Gunn et al., 2011; Jones, 2007; McCardle & Hadwin, 2015; Moore, 2004; van der Stel & Veenman, 2010; Veenman & Verheij, 2003). It may be that particular approaches to metacognitive training are more or less likely to "stick" with students as they move through other courses. Research investigating the features of course-based metacognitive instruction that produce greater transfer to other settings, as well as the longevity of the effects and for which students impact is strongest, would improve both quality and efficiency of such training modules.

Critical Research Question 4: What is the relationship between students' psychological states on one hand and self-regulation of learning and metacognition on the other?

Subquestion a: How can psychosocial interventions best be leveraged to encourage effective self-regulation of learning?

A large body of research exists on the relationship between psychological states and learning (Linnenbrink, 2007), with substantial evidence for the deleterious effect of high levels of psychological stress on cognition (Calvo & Gutiérrez-García, 2016; Marin et al., 2011; Sandi, 2013). More limited research has established a connection between psychological states and students' use of metacognitive and self-regulation strategies. For instance, there are established links between anxiety and approach to study (Cipra & Müller-Hilke, 2019; Warr & Downing, 2000) between stereotype threat and metacognition (Fourquet et al., 2020), and between stereotype threat and self-regulation (Rydell & Boucher, 2017). These connections are thought to occur because of the additional tax on executive functioning processes caused by psychological stressors, although the relationship between these factors is complex and may be moderated by a

number of other variables (Plieger & Reuter, 2020). Additional research on the relationship between psychological states and both metacognition and executive functioning is needed. Moreover, only very limited research has evaluated the impact of psychosocial interventions (Yeager & Walton, 2011; see Research Area 3) on metacognition and academic self-regulation (e.g., Tajoldini et al., 2018).

Research Area 5: Institutional Factors and Partnerships in STEM Academic Support

Higher education institutions are by and large organized vertically, and comprise multiple divisions — schools, academic departments, administrative units — that operate with relative autonomy (Dufault, 2017; Keeling et al., 2007; Tony & Paul, 2001). The academic support function within a university might be especially sensitive to the potential organizational weaknesses caused by decentralization, given that it typically straddles the academic and student-services missions of the institution. How and where academic support is located within an institution, both organizationally and physically, will have an impact on its orientation, reputation, approach to programming, inter-unit relationships, and, ultimately, on the outcomes of student services. Few studies have systematically examined these issues; such examination would help university administrators make decisions about the structural organization of support programming (Patton et al., 2006; Tinto, 2006).

Critical Research Question 1: In what ways does the organization of an academic-support unit (or program) impact key outcomes?

Subquestion a: What is the impact of the organizational position and reporting line of the academic-support unit (or program) on the unit's operations and student outcomes?

Subquestion b: What is the impact of the physical location of an academic support unit (or program) on

- **student usage, both generally and by various student populations, e.g., students with disabilities, students with marginalized identities, international students?**
- **perceptions of academic support among students and faculty?**

Academic support in U.S. colleges and universities varies in its structure, with a number of different models existing across institutions (Toms, 2014; Truschel & Reedy, 2009). It may take the form of a centralized function — for instance, where a single entity is responsible for coordination, marketing, scheduling, training of tutors, and so forth across various disciplines — or it may be offered through individual STEM departments with or without coordination among them (D. R. Arendale, 2010; Dufault, 2017). The majority of academic support functions are affiliated with academic affairs departments, with a smaller proportion associated with a student affairs office or housed within a specific academic department or school (D. R. Arendale, 2010; Boylan, 2002; Toms, 2014). In general, centralizing academic support services within the functional organization of an institution, as well as centralizing them within a physical location, is viewed as more desirable than dispersed offerings and is assumed to more effectively promote student success (Cambridge, 2000; Engle & O'Brien, 2007; Engstrom & Tinto, 2000; Hossler et al., 2009; McGuire & Williams, 2002; N. Schmidt & Kaufman, 2005). Centralized organization, as compared to dispersed organization, could reduce barriers to accessing services, especially for students who are more reluctant to seek help, and may help consolidate resources (Balk, 2012; Kezar, 2006; Kezar et al., 2015; Toms, 2014).

Reporting lines also influence financial models. The division or unit within which the support function resides will impact budget allocation, access to institutional decision-makers, operational and philosophical approach, and ability to innovate. Student learning centers are often included in university-wide budgets as a line item, but support can also come from departments, student government, and private donations (Toms, 2014). Some academic-support

units are allocated independent budgets, while others draw funds from the budgets of the entities they fall under, as in an academic department with some allocation of funds for tutoring (Toms, 2014). Funding models drive the availability of resources for academic support, and in turn the quality and availability of support services. For example, when institutions allocate funds to schools and departments based on the number of students enrolled, they risk uneven allocation of academic support across disciplines when the academic support functions sit within the departments themselves (Ehrenberg, 2002). Of note, most centers do not charge for tutoring services (Truschel & Reedy, 2009); it is generally assumed that free services (or fees as part of tuition), rather than pay-for-service models, are correlated with higher attendance, especially among students with fewer resources.

Research is needed to guide institutional investment and decision-making around the organizational location, structure, and reporting lines of academic-support functions. For instance, how might a STEM support unit situated within a student affairs division differ in its approach, outreach, and student impact from a unit which sits within an academic department or an academic affairs unit? How does the reporting relationship of a unit impact its financial flexibility and ability to innovate, its reputation among key stakeholders, including students, and its reach?

When the academic support function takes the form of a unit or center, its physical location on campus and the material resources it has at its disposal are part of what gives it personality and may or may not define it as an accessible and comfortable space for students. Such entities are often located within a larger student center, a library, or an academic building. Some do not have a designated space for programming but rather utilize classrooms or utilize residential spaces (Toms, 2014). The location of support services sends messages about their value and about those who utilize those services, and should be expected to bear some

relationship to student usage. For example, an inviting student center might create a sense of normalcy around help-seeking, in contrast to a dedicated tutoring space within a STEM department, which might cause students to worry that they would be viewed as deficient if seen accessing services there. Convenience of location would also be expected to impact usage (Rennar-Potacco & DeYoung, 2007), as might co-location of services. For example, the learning commons model — a large, central space housing multiple learning support functions — has in some instances demonstrated increased student attendance (Berkopes & Abshire, 2016; B. Davis & Sumara, 2008; V. Davis, 2009). For students with marginalized identities, services located within a "counterspace" (Ong et al., 2018) — a space which creates a welcoming, inclusive climate, such as a multicultural house, or an affinity-linked student organization space — might be expected to increase usage, and to produce a greater sense of belonging in STEM and better overall student outcomes (S. Chen et al., 2020; Dika & D'Amico, 2016; Ong et al., 2018). Research is needed to guide institutional decision-making about where to situate STEM learning support services, in terms of proximity to other buildings or offices frequented by students, co-location with other support or academic services, and location as it relates to social identity.

Critical Research Question 2: What is the impact of the quality of the academic support unit's (or program's) relationships with key campus partners, including faculty, on students' perceptions and use of services?

STEM academic support units (or programs) typically provide support for faculty-taught courses, making faculty buy-in critical to student engagement. While some academic support programs are led by course faculty, most support units are overseen by full-time professional staff dedicated entirely to the learning center. Additionally, most units use undergraduate peers or graduate students, rather than faculty members, to support students directly (Toms, 2014).

Faculty may provide valuable input into decisions about program type, structure, and content, as well as tutor recruitment and training, and may also provide student referrals. Moreover, faculty play a vital role in students' decisions to seek academic help. Encouragement and normalization of academic help-seeking is critical to student help-seeking behavior, given that many students — especially those who may benefit most — avoid seeking academic help for a variety of reasons, including stigma, fear of consequences, and belief in self-reliance (Karabenick, 2003; Patel et al., 2015; A. M. Ryan et al., 2001). Faculty, often more than others within a university, can influence students' help-seeking behaviors (Micari & Calkins, 2019). Thus, building relationships with faculty would seem to be critical to connecting and publicizing services to students, as well as optimizing services. The existence of an advisory board that includes faculty, and the manner in which an advisory board is used, might also be expected to impact key relationships and potentially influence access to funding and other resources. However, institutional pressures and reward structures may not encourage faculty to expend energy on supporting student development beyond their own courses. Indeed, some have suggested a need for a cultural shift to reward faculty to participate in advising, broadly speaking (Dillon & Fisher, 2000; Karr-Lilienthal et al., 2013; Levy & Polnariev, 2016). Faculty may also be reluctant to send students to tutoring or other academic support that operates independently of their own courses, out of concern that material will be taught incorrectly or in a manner inconsistent with their own approach (Rudland & Rennie, 2014).

Other student-facing campus partners, such as student affairs units, libraries, residential life departments, and multicultural student support units, can play a critical role in disseminating messages and influencing student attitudes and behaviors around academic help-seeking. Academic support units typically rely on such partners to advertise programming, refer students, and encourage usage. These partners also sometimes provide physical spaces for support

activities (Dufault, 2017; Truschel & Reedy, 2009). Because partner units often hold sway with large segments of the student population, the quality of the relationship between these campus partners and an academic support unit or program would be expected to impact students' impressions of academic support and their willingness to utilize services. Research into the relationship between inter-unit partnership models and student perceptions, usage, and outcomes would provide guidance on which kinds of collaborations are most fruitful and how best to nurture those. Particular areas for investigation might include the effectiveness of formal partnership models, the impact of physically situating an academic support unit with other student support units, the impact of formal and informal messaging about academic support through other student support units, and the impact of academic support services offered within other student-facing units' spaces.

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