Northeastern
Center for Inclusive Computing

On the BPC Importance of Advising

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Introduction

The Center for Inclusive Computing (CIC) partners with colleges and universities to increase the representation of computing graduates who identify as women. These partnerships focus on removing the institutional barriers that exclude women of all races and ethnicities from discovering, thriving, and persisting in computing programs. In other papers we have discussed the following interventions to build inclusive computing environments essential to retaining all students: common assessment,[1] handling the distribution of prior experience in the intro sequence,[2] removing GPA-based enrollment caps for internal transfers,[3] centralized recruitment and training of teaching assistants (TAs),[4] right-sizing degree requirements,[5] and analyzing intersectional pass/drop/fail/withdraw rates. In this paper we: 1) describe the linkages between student advising and support tools like mentoring, tutoring programs, and companion instruction), and retention in computing; and 2) outline best practices based on our experience working with schools across the country. These opinions are based on the CIC's in-depth work with 29 universities and observations from 76 all-day site visits at 46 different universities across the U.S.

Please note that, while support structures are an important driver of retention in computing, this work must be done in conjunction with the other interventions listed above.

Student Advising

Advising is essential to attracting and retaining students from populations historically marginalized in tech. Black, Hispanic and Native students have less access to computer science classes in high school, and women students of all races and ethnicities take CS classes in high school at a much lower rate than men.[6] Additionally, women—and especially Black, Hispanic and Native women—face a less welcoming climate when they arrive in college computing programs.[7],[8] Students transferring from community college face further challenges: interpreting articulation agreements, mapping credits already obtained to degree requirements at the new institution; and determining how to do all of this without adding

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[1] Brodley, C. E. and Gill, C., "The BPC Relevance of common assessment in the introductory sequence," *Communications of the ACM*, 67(7), July 2024.
[2] Brodley, C. E., 2022, "Expanding the pipeline: Addressing the distribution of prior experience in CS," *Computing Research News*, 34(6), June 2022.
[3] Brodley, C. E., 2022, "Why universities must resist GPA-based enrollment caps in the case of surging enrollments," *Communications of the ACM*, 65(8), August, 2022.
[4] Brodley, C. E., and Muzny, F., 2023, "On the BPC importance of centralizing TA training, recruitment and evaluation," https://cic.northeastern.edu/resources/
[5] Lionelle, A., Quam, M., Gill, C., and Brodley, C. E. "Does curricular complexity in computer science influence the representation of women CS graduates?" Proceedings of the 55th ACM Tech. Symp. on Computer Science Education, ACM, 2024.
[6] https://services.google.com/fh/files/misc/diversity-gaps-in-computer-science-report.pdf
[7] Yolanda A. Rankin and Jakita O. Thomas. 2020. The Intersectional Experiences of Black Women in Computing. In The 51st ACM Technical Symposium on Computer Science Education (SIGCSE '20), March 11–14, 2020, Portland, OR, USA. ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3328778. 3366873; Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others?. *Psychological bulletin*, *143*(1), 1.
[8] While we maintain that fixing structural issues is critical and will improve climate, it is naïve to think we could address the broader barriers that women, Black, Latina and Native students will continue to face in society.

unnecessary time to graduation. In these situations, advising is the primary means by which students can close these knowledge gaps and make informed decisions.

Common Challenges and Best Practice Solutions

In our work at the CIC, we have heard advisors and other student success professionals talk about navigating common scenarios such as:

1) Students share they are having challenges in computing classes and wonder whether they should pursue another degree or pathway.
2) Students are unclear on the additional layers of support that are available to them and when/where/how they can avail themselves of those resources.
3) Transfer students have satisfied their general education requirements in the first two years, which can result in needing to take 3 or more CS courses in a semester to graduate on time.
4) Students in other majors are disinclined/dissuaded from taking an intro computing class because of rumors about the level of difficulty and who is welcome/not welcome.
5) Students lack understanding of pre-requisite chain(s) and end up facing overloaded semesters and/or adding time to degree.
6) In places where more than one computing degree is offered (e.g., BA and BS), students express concerns that one is "inferior" to the other.

In light of these scenarios, we have seen a number of advising best practices emerge:

1) Department leadership meets regularly with advisors to ensure there is a consistent message about all aspects of the degree(s) and on the rationale/thinking behind different paths.
2) Departments revisit degree maps regularly to make updates and provide multiple, publicly available, example plans of study for: a) transfer students, b) first year students who are/are not calculus ready and, c) first year students with/without prior coding experience. This helps students find the plan of study most relevant to their situation.
3) Advisors are trained on how to present the differences among different pathways (e.g., CS, Data Science, Cyber, BA/BS, etc). This training is regularly updated and offered to ensure the correct message is getting to the students, even if there is turnover among advisors.
4) Advisors work with faculty to revisit pre-req chains and determine if they are creating degrees so complex that it is difficult for students to graduate in the required timeline.
5) As a university puts in new practices to address retention issues, computing leadership lets advisors in other departments know that "CS is under new management" and it is safe for students from other disciplines to try CS0 or CS1.

Who the Adviser is Matters…But Not Much

Our point of view is that who does the advising informs but does not radically change the best practices. Across the schools with which the CIC has worked, we observe no consistent rhyme or reason for who does the advising. In many schools, it is done by faculty; in many it is done by professional staff. And there are others that take a hybrid approach, with, say professional advisors assigned for the first two years (at a 4-year institution) and faculty for the last two years. Further, we don't have a strong point of view on whether any one of these staffing decisions is better than any other. What we think matters to BPC is content and training of advisors as discussed in the best practices above.

Working within Constraints

The National Academic Advising Association (NACADA) recommends a ratio of students to advisors of 296 students to one.[9] However, most computing departments the CIC works with far exceed this ratio. This too-high student-to-advisor ratio is due to university funding models that set a higher caseload by design, but also due to the high level of turnover that is frequent in advising positions. In most CIC schools, advisors feel understaffed and overwhelmed. These feelings are particularly acute for less well-resourced universities that have trouble attracting candidates to fill open positions. At one large public university, the ratio was 700:1 and students often wait 2-3 weeks to get an appointment. Insufficient advising means that students may not find the support they need to persist in the face of challenges.

Fortunately, we have observed strategies to address understaffing and make advising resources go further, include these:

1) Formal peer advising: Several CIC schools employ student "peer-advisors" who sit in the advising office and triage drop-in students for quick questions (they are typically paid the same rate as TAs). Students at these universities report that peer advisors are particularly helpful in thinking through which courses to take and how to plan semesters for a reasonable workload.
2) Group advising: Some universities hold information sessions on specific topics in a many-to-one advising format. This contrasts with having group advising without a specified topic, a scenario that, according to advisors, can devolve into each student trying to have one-on-one advising despite the group setting. The group approach requires identifying the set of narrow, high-demand topics, setting the schedule, and then advertising these sessions well.
3) Course-integrated advising: One CIC school ran a successful pilot in which students built a plan of study as a required assignment in CS2. The hundreds of plans were then "graded" by an advisor who met with students as needed to ensure each student had a viable path to graduation.
4) Retention advisors: At one CIC school, our grant funded a specialized "retention advisor." Similarly, another school created advisor positions that work with transfer students across the 4-year university and its primary community college partner, actively building the computing pathway.

Near-Peer Tutoring and Mentoring Support

While we stand behind the advising best practices listed above, we recognize that no amount of advising can retain a struggling student if there isn't strong academic support, for example through tutoring. Tutoring programs provide course-level support that is more fine-grained and accessible than office hours. Tutors are typically undergraduate students who assist students with system setup, questions about assignments, or bugs in open lab hours. Sessions with tutors are typically short (5-10 minutes), but opportunities for help are frequent (e.g., several hours each day). Because tutors are typically less expensive to hire than graduate TAs, it is usually possible to hire more undergraduate tutors and thus provide more hours of support for students.

Peer mentoring is another form support that provides academic support in a more informal and accessible format. Typically, students are assigned a mentor (mentors might have more than one mentee) with whom they meet via structured meetings several times per term. The structured meetings might be themed (e.g., how to get an internship) or open-ended.

While these supports sound straightforward, there are subtleties to running them successfully:

1) **Scheduling.**

[9] https://nacada.ksu.edu/Resources/Clearinghouse/View-Articles/Advisor-to-Student-Ratio-Caseload-Resources.aspx

a. For tutors, it is crucial that there are sufficient tutors staffed during hours that students are likely to be working on assignments (e.g., in the evenings and days leading up to an exam/assignment deadline). In large enrollment classes, scheduling is also very much enabled by common assessment structures.[10] When course sections are synced, the department can pool tutoring resources and offer a larger range of hours.
b. For mentors, meetings must coordinate with student class schedules.

2) **Training.** Both mentors and tutors must be trained on inclusivity. The suggestions for TA training for inclusivity provided in a separate position paper also apply for mentor and tutor training.[11]
3) **Compensation:** Tutors and mentors need to be compensated. Typically, this is structured as pay for tutors and as pay/course credit for mentors.
4) **Motivation**: Students need to be guided and motivated as they may not immediately understand the benefits of the resources a department offers. Approaches include having the instructor discuss the resources in class and having professors and/or TAs reach out directly to individual students who might benefit from the support. For mentoring, approaches include making attendance in the program mandatory, and/or giving students academic/co-curricular credit for their participation.

Companion Courses

Finally, some CIC schools have developed companion courses that help students learn or practice knowledge and skills that are needed by a particular class but are not explicitly taught or given much space in the class (sometimes referred to as the "hidden curriculum"). For example, a companion course may let students practice coding/algorithm development or might teach other content such as command-line navigation or using program development tools like IDEs or git. We find these courses are most successful when they are tightly integrated with the course(s) they are designed to support, perhaps even taught by the same instructor. Again, students need to see the value of this "extra" work and be compensated in some way (usually with a small amount of academic credit).

This does beg the question as to why an extra course might be needed and why the content would not just be part of the main course. This is a fair question, and it relates to the extremely uneven distribution of prior experience that students bring to the intro sequence (and that is largely correlated with the affluence of the zip code in which the student went to high school). Given this uneven distribution of knowledge, "companion" courses can be a good way to help students who are truly new to computing to practice the concepts they are learning without being evaluated or feeling judged for not knowing.

Conclusion

In this paper, we have laid out the student support strategies that – in our experience – are effective in retaining students from populations that have been historically marginalized in computing. We hasten to add that these strategies complement one another, and institutions would do well by implementing as many as possible. Finally, as stated at the beginning of this paper, we also believe that no amount of student support can make up for structural barriers – unsynced sections, GPA-based enrollment caps, no TA training, high curricular complexity, etc. As such, these student supports should also be implemented

[10] Brodley, C. E. and Gill, C., "The BPC Relevance of common assessment in the introductory sequence," *Communications of the ACM*, 67(7), July 2024.

[11] Please see: Brodley, C. E., and Muzny, F., 2023, "On the BPC importance of centralizing TA training, recruitment and evaluation," https://cic.northeastern.edu/resources/

as part of a broader effort, beginning with structural changes that lay the foundation for student success.