Can a Student Organization Decrease Introductory CS Course Withdrawals among Students of Color?

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Abstract—DePauw has sponsored a Women in Computing student organization since the early 1990s. Over the years the sponsors noticed that the club did not serve our female students of color (SoC) as well as it might and that it did not serve male SoC at all. In 2016 we conducted a survey and a focus group to assess student enthusiasm for initiating a student organization for all students of color in computing (SoCiC) and found uniform support for such a club. The researchers also collected data about SoCiC and found that this population persists to graduation at the same robust rate that all students follow, once the two introductory courses are completed. SoCiC withdrew from the two introductory courses at higher rates (and therefore dropped the computer science major) than students from other racial/ethnic groups. We applied for and received grants from both the Mellon Foundation and the Ball Brothers Foundation. Our grant proposal goals lay in recruiting, retaining, and celebrating SoCiC. The three sponsors of our student organization, Computing Opportunities for Students of Color (COSOC), now find ourselves in the last year of grant funding. We recently collected data concerning the withdrawal rates for each of our two introductory courses for Black, Hispanic, and All students – both prior to COSOC and after COSOC. Our data show that the withdrawal rates for SoCiC are lower in post-COSOC semesters than in pre-COSOC semesters. In future work we want to pursue a qualitative study of COSOC.

Keywords—recruitment, retention, broadening participa-tion, students of color, student organizations, course withdrawal

I. INTRODUCTION

Black students received only 8.6% of computing bachelor's degrees – Hispanic students, 10.2% – in 2017-18 [8]. "With the decreasing number of CS graduates entering the IT industry, the workforce is missing out on the wealth and breadth of innate student ability and skills that are instead being channeled into non-CS, and most probably non-STEM, fields" [3]. Researchers investigate projects (such as COSOC) to recruit, retain, and celebrate SoCiC.

II. REVIEW OF THE LITERATURE

A. Statement of the Problem

Is there evidence that the numbers of withdrawals from DePauw's two introductory computer science classes by SoC have decreased since the creation of COSOC?

B. Withdrawals from Computer Science, STEM, and Other Courses by SoC, Female, Male and/or All Students

Several researchers explored course withdrawals and published these conclusions: "[S]ome already at-risk students (e.g., [Black]) are more likely to engage in excessive course dropping." [1]; "the largest dropout point occurs in the first two years of [STEM students'] studies" [2]; and "The extent to which the individual becomes academically and socially integrated into the academic and social systems of an institution determines the individual's departure decision" [4].

C. Promising Practices for Lowering Withdrawal Rates

Additional researchers investigated ways to address high withdrawal rates. The following list ties the literature to COSOC components: a) talks by role models; b) lunch with role models; c) mentors; d) graduate school visits; e) trips to industry sites; f) workshops; g) social events including celebrations of students' achievements (i.e., graduation, awards, recognitions); h) tutoring; i) proactive (previously referred to in the literature as intrusive) advising by sponsors.

- A reason Black and Hispanic students are not successfully integrated into the academic and social life of college is the lack of a critical mass of students with similar ethnic characteristics [5]. Connects to COSOC items a) – g).
- Significant faculty interaction with students improves retention [6] – as does respect from instructors [3]. Connects to COSOC component i).
- Students withdraw from computer science classes because they may lack information about future careers [7]. Connects to COSOC components a), b), e).
- Women and minorities who integrate social and academic activities drop classes less often [3]. All COSOC items.

III. METHODS

The authors analyzed withdrawal rates for Black, Hispanic, and All students from the two introductory Computer Science courses: Computer Science I (CS1) and Data Structures (DS). RStudio was used to performed mean, standard deviation, and variance calculations on all three groups. In addition, the researchers performed t-test analyses to assess the statistical

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Ball Brothers and Mellon Foundations.

significance of the results. The analyses were conducted on data from fall 2016 to fall 2019 (7 total semesters: 3 semesters before a prototyping seventh semester, which counts as a before COSOC semester, and 3 semesters after the launch of COSOC). Statistical analyses were performed in three phases: 1) comparing each group's (All, Black, and Hispanic) rates before and after COSOC for both introductory courses; 2) for CS1 only; and 3) for DS only. Results and analysis follow.

IV. Findings and Analysis

TABLE I
Mean, Standard Deviation and Variances for Widthrawals

Groups	Before COSOC			After COSOC		
	Mean	SD	Var	Mean	SD	Var
All	0.052	0.036	0.001	0.072	0.051	0.002
Black	0.102	0.151	0.023	0.050	0.100	0.010
Hispanic	0.123	0.176	0.031	0.085	0.101	0.010

TABLE II
Mean, Standard Deviation and Variances for Widthrawals for CS1

Groups	Before COSOC			After COSOC		
	Mean	SD	Var	Mean	SD	Var
All	0.051	0.015	0.0002	0.085	0.016	0.0002
Black	0.018	0.040	0.0016	0.000	0.000	0.000
Hispanic	0.107	0.147	0.0217	0.100	0.141	0.0200

TABLE III
Mean, Standard Deviation and Variances for Widthrawals For Data Structures

Groups	Before COSOC			After COSOC		
	Mean	SD	Var	Mean	SD	Var
All	0.053	0.052	0.0027	0.058	0.082	0.006
Black	0.187	0.179	0.0322	0.100	0.141	0.020
Hispanic	0.140	0.219	0.0480	0.071	0.101	0.0010

Tables I, II, and III show the results of the analysis discussed in Section III. Table I gives the results when comparing withdrawal rates for all groups for both introductory courses, while Tables II and III compare the rates for CS1 and DS, respectively. T-test analyses for all three cases show no statistical significance due to the small number of data points (7 data points). Table I shows that, while the mean withdrawal rate increased slightly for all students after COSOC, the mean was considerably lower for Black students (half the rate before COSOC) and Hispanic students (about 30% lower than the pre- COSOC rate). The low values in standard deviation and variances post-COSOC show that the reductions in the rates were consistent over the semesters studied and demonstrate the absence of large swings that would indicate outliers in the data. When separating the data for each course (CS1 and DS), Table II shows that despite the increase in overall withdrawal rates for all students in CS1 (65% increase), there was a very small reduction in the withdrawal rates for Black students and no increase in withdrawal rates for Hispanic students. Table III shows the same data for the DS course. In this course, there was a marginal increase in the overall withdrawal rate of all students and a noticeable decrease of that rate for Black students (46%) and about a 50% decrease in withdrawal rate

for Hispanic students post-COSOC. Standard deviations and variances remain much lower post-COSOC compared to pre-COSOC values for tables II and III, which indicates data consistency and lack of outliers.

V. Discussion

Our analysis shows that despite increases in overall withdrawals, the withdrawal rates for SoC served by COSOC have not increased. In fact, the withdrawal rate for Black students was cut in half post-COSOC for both courses and the rate for Hispanic students was reduced by 30%. Further data gathering and analysis are required to assert the statistical significance of the results presented here.

VI. Limitations

Limitations to the study: 1) DePauw is a selective national-level small liberal arts school; 2) SoC account for 20% of the student body; 3) Each semester has a small number (less than 8) withdrawals; 4) Students declare majors as sophomores.

VII. Future Work

Clearly, the authors must pursue further evaluation of COSOC and its effect on retention of SoCiC at the introductory course level. The small number of SoCiC in the study indicates the need for a qualitative study. Furthermore, other researchers call for these kinds of qualitative studies: "The clear majority of course withdrawal studies are quantitative, but qualitative research that provides a more nuanced understanding of how students rationalize course dropping would advance knowledge in this area" [1]. Along with the appropriateness of qualitative studies, additional researchers request these studies, because "little is known about what influences individuals to complete their CS studies and follow a CS career" [3].

References

[1] L. McKinney, H. Novak, L. S. Hagedorn, and M. Luna-Torres, "Giving up on a course: An analysis of course dropping behaviors among community college students," Res. High Educ., vol. 60, pp. 184–202, 2019.

[2] P. M. Huang and S. G. Brainard, "Identifying determinants of academic self-confidence among science, math, engineering, and technology students. " J. Women Minorities Sci. Eng., vol. 7, pp. 315-338, 2001.

[3] M. N. Giannakos, I. O. Pappas, L. Jaccheri, and D. G. Sampson, "Understanding student retention in computer science education: The role of environment, gains, barriers and usefulness," Educ. Inf. Tech., vol. 22, 2365-2382, 2017.

[4] V. Tinto, "Dropouts from higher education: A theoretical synthesis of the recent literature," Rev. Educ. Res., vol. 45, 89–125, 1975.

[5] A. Seidman, "Minority student retention: Resources for practitioners." New Dir. Inst. Res., vol. 2005, pp. 7-24, 2005.

[6] L. Barker, C. L. Hovey, and L. D. Thompson, "Results of a large-scale, multi-institutional study of undergraduate retention in computing," 2014

[7] L. Carter, "Why students with an apparent aptitude for computer science don't choose to major in computer science," ACM SIGCSE Bull., vol. 38, pp. 27-31, 2006.

[8] National Center for Educational Statistics. Bachelor's Degrees Conferred by Postsecondary Institutions, by Race/Ethnicity and Field of Study: 2017-18, Oct. 2019. Accessed on: Mar. 21, 2021. [Online]. Available: https://nces.ed.gov/programs/digest/d19/tables/dt19$_3$21.30.asp