

An Investigation of Degree Pathways for Students of Color with Transfer Credits

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Nationally, about 80% of two-year college (TYC) students intend to obtain a bachelor's degree; however, only 13% successfully do so. Recently, Governor Gretchen Whitmer joined the Complete College America movement to increase the completion rates of TYC students in the state of Michigan. Here, we use institutional data from Michigan State University (MSU) to explore TYC transfer students pathways through an undergraduate STEM program. We define TYC transfer students as one who transferred at least one credit from any TYC to MSU; 30% of students sitting in a STEM class are TYC transfer students at MSU. In this paper, we describe the assorted degree pathways that TYC transfer students take to complete a bachelor's degree in STEM programs. We will also investigate how these pathways change for different race/ethnicity markers.

I. INTRODUCTION

Historically, 80% of students who enroll in a two-year college (TYC) plan to continue with their education by pursuing a bachelor's degree at a four-year institution. However, only 13% actually obtain a bachelor's degree [1]. In 2009, the Obama administration proposed the American Graduation Initiative, an investment to increase resources within TYCs to graduate more students while "collaborating with other educational institutions to expand course offerings and promote the transfer of credit among colleges" [2]. Nationally, there has been a large push for TYCs to become part of the conversation in increasing student success while continuing to grow the economy.

As of October 2019, the Governor of Michigan, Gretchen Whitmer, announced Michigan's membership to the Complete College America alliance – an initiative committed to increasing college completion rates and paths to post-secondary success by providing scholarship opportunities (e.g. MI Opportunity Scholarship) for tuition-free pathways to TYCs within the state [3]. The state of Michigan is home to 28 public community colleges, which have been responsible for more than 50% of the post-secondary enrollment in the state [4]. This trend is representative of the national landscape with nearly half of all students who complete a bachelor's degree have enrolled at a TYC at some point in the previous 10 years [5]. Students who enroll in a TYC represent a variety of pathways including: vertical transfer from a TYC to a four-year college (FYC), lateral transfer between institutions of the same type, co-enrollment between multiple post-secondary institutions, and back-and-forth enrollment between TYCs and FYCs [6].

In this paper, we are interested in understanding the landscape for students who transferred from a TYC institution to pursue a bachelor's degree in Science, Technology, Engineering and Mathematics (STEM) at Michigan State University (MSU). MSU is a large, mid-western, land-grant university focused on educating the Michigan population. The Michigan Transfer Agreement (MTA) [7] outlines a process for MSU to support students who transfer from a TYC; however, limited research has been done to investigate the student transfer process. In order to begin to understand how to build successful and supportive programs for transfer students, we undertake the following research questions: (1) *What are the pathways to degrees at MSU for students who declare a STEM major upon enrollment and have any TYC transfer credit?* and (2) *For students of color with TYC transfer credit, what are the proportions of success for the STEM degree pathway?*

II. METHODS

The data analyzed in this study is drawn from the database collected by the Office of the Registrar at MSU [8]. MSU is a large institution, serving approximately 50,000 students. The overall population of students at MSU is comprised of 51%

women, 77% White, 14% International, 8% Black/African American, 6% Asian, 4% Hispanic/Latino, and fewer than 4% from other racial and ethnic categories [9]. At this "Very High Research Activity" institution, or R1 as classified by the Carnegie Classification of Institutions of Higher Education [10], ACT scores range from 23 to 29 (25th percentile to 75 percentile) for the undergraduate student population. Below, is a description of the analyzed sample, including the filters that were applied to the data, along with the definition (and coding) of "TYC Transfer Credit".

A. Sample

The sample analyzed in this research included students who began their studies at MSU between the fall of 1992 and the fall of 2012. The data collected over this 10 year window includes administrative decisions from MSU that is reflected in the analysis of the data. The Office of the Registrar collected data prior to 1992; however, since MSU was on a quarter system during that time period, this study did not include any data prior to 1992. The data was requested from the Office of the Registrar in 2017 and therefore, students that enrolled after the fall of 2012 may not have had adequate time to earn their degree (5 years) and were not included in this analysis. The total number of students in this sample pulled from the Office of the Registrar database was 190,998.

In order to answer the research questions above, several filters were applied to the overall sample. First, only students who earned zero, one, or two degrees from MSU were included – the number of students who earned more than two degrees was less than 3% of the overall sample which reduced the sample size to $n = 185,789$ students. Second, the sample only included students who were enrolled in courses at MSU for no more than 18 total semesters – approximately 3,500 students ($< 2\%$ of the total population) were enrolled in at least one course for longer than 18 semesters – further reducing the sample size to $n = 182,413$. Furthermore, students who had transfer credit from more than one TYC (see Sec. II B) – less than 2% of the sample – were not included in this study leaving a total of $n = 178,796$ students. We do not know which of the enrollment paths the students may be following (see Sec. I); however, this filter minimizes the students who would be following a back-and-forth enrollment path between TYCs and MSU. Lastly, to specifically address the research questions in regards to students who enrolled as a STEM major, we applied the NSF definition of STEM [11] to categorize students' majors and degrees; the size of the final data set analyzed below consists of 60,193 students.

In order to answer our two research questions, we coded a "Conferred Degree" and "Race/Ethnicity" variables in the sample to facilitate the analysis. We categorized "Conferred Degree" into three types: (1) a STEM degree, (2) a Non-STEM degree, and (3) No degree, which was coded as None. We also coded the "Race/Ethnicity" variable to analyze across historical differences in data collection. Over

the period of the study, MSU has historically collected the student's "Race/Ethnicity" using the following categories: "American Indian/Alaskan Native" ($n = 287$), "Asian" ($n = 1,189$), "Asian/Pacific Islander" ($n = 2,576$), "Black (non-Hispanic)" ($n = 5,167$), "Caucasian (non-Hispanic)" ($n = 45,939$), "Hawaiian/Pacific Islander" ($n = 13$), "Hispanic" ($n = 1,683$), and "Multi-Race" ($n = 581$). Around 2009, "Asian/Pacific Islander" was split into "Asian" and "Hawaiian/Pacific Islander"; as a result, our analysis combined these into one category labeled "Asian/Hawaiian/Pacific Islander". In addition, the students who either did not report their race/ethnicity ($n = 566$) or it was not requested by MSU ($n = 2,192$) were combined into one "Not Reported/Not Requested" category. For the purposes of this study we define students of color as an overarching category for students who are listed in the registrar data as: "American Indian/Alaskan Native," "Asian/Hawaiian/Pacific Islander," "Black (non-Hispanic)," "Hispanic," or "Multi-Race." We note that the MSU registrar does not allow student to select both "Hispanic" and a racial category. In general, the sample analyzed in this study has similar racial/ethnic composition to the overall demographics of MSU outlined above.

B. Defining TYC Transfer Credit

Students within the sample could have transferred credit from Advanced Placement (AP) courses in high school, from another institution of higher education, or have no transfer credit. The research questions focus on students who have transfer credits from a TYC. We identified a TYC by using a cross-reference with institutions from the most recent Carnegie Classification of Institutions of Higher Education [10]. Students who did not have transfer credit from a TYC were labeled as having "No TYC Transfer Credits" ($n = 41,919$). Students who came to MSU and had at least one transfer credit from any TYC were labeled as having "Any TYC Transfer Credits" ($n = 18,274$). We made a further distinction based on the 2014 Michigan Transfer Agreement (MTA) which allows students to transfer 30 general education credit hours from a TYC toward earning a bachelor's degree [7]. These students were a sub-sample of the "Any TYC Transfer Credits" and were labeled as having "30 or more TYC Transfer Credits" ($n = 7,257$).

III. RESULTS

We observed from a Sankey plot (Fig. 1) the pathways of students from enrollment, as STEM majors, to graduation. The left side of Sankey plot has the two categorization of students with Any TYC Transfer Credits (path colored in red) and No Transfer Credits (path colored in blue). The right side of the plot indicates the degree which MSU conferred upon these students: STEM ($n=34,970$), Non-STEM ($n=10,102$), and None ($n=15,121$). From this plot, 75% of the students

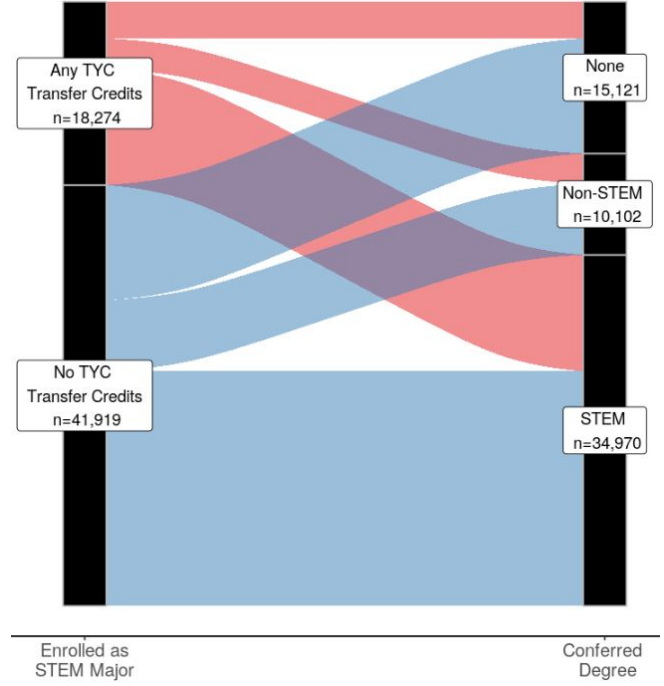


FIG. 1. A Sankey plot showing the pathways to a STEM, Non-STEM or No degree (right side) for students who initially enrolled as a STEM Major (left side). The red (top) paths present students who have Any TYC Transfer Credits while the blue (bottom) paths present students who have No TYC Transfer Credits. The proportion of students for earned degrees are in Table I.

who enrolled as a STEM major earned a degree in either STEM or Non-STEM; this is comparable to the overall graduation rate at MSU (80% in 2018) [12].

A. Pathways to Degrees for TYC Transfer Credit Students

To explore the pathways of our sample, we calculated the percentages of students with No TYC Transfer Credits, Any TYC Transfer Credits and 30 or more TYC Transfer Credits who earned a STEM degree, a non-STEM degree, and no degree. We were interested in comparing the percentages of the degrees earned between the students who were categorized into the two types of transfer credit groups – Any Transfer Credits and 30 or More Transfer Credits – and the students with No Transfer Credits. Table I presents the percentages of students who enrolled as a STEM major and earned a degree in either STEM, non-STEM degree, or no degree. We also report the absolute percentage difference between the Any TYC Transfer Credits group and the No TYC Transfer Credits group (D_{Any-No}) and the 30 or More TYC Transfer Credits group and the No TYC Transfer Credits group (D_{30-No}). Statistical significance of these differences were determined using the z -statistic for a two-sample test of proportion. To correct for the Type I error rate, a Bonferroni correction was

TABLE I. The percentages of the conferred degrees (STEM, Non-STEM, and None) for students with No TYC Transfer Credits, Any TYC Transfer Credits, and 30 or more TYC Transfer Credits. D_{Any-No} represents the absolute difference of percentages between students with Any TYC Transfer Credits and students with No TYC Transfer Credits. D_{30-No} represents the absolute difference of percentages between students with 30 or more TYC Transfer Credits and students with No TYC Transfer Credits. The statistical significance levels have been Bonferroni corrected and noted with superscripts: "a" denotes $p < 0.017$, "b" denotes $p < 0.003$, and "c" denotes $p < 0.0003$. If left without a superscript it is not statistically significant

Conferred Degree	No TYC Transfer Credits	Any TYC Transfer Credits	30 or more TYC Transfer Credits	D_{Any-No}	D_{30-No}
STEM	55.77%	63.44%	68.09%	7.67 ^c	12.32 ^c
Non-STEM	16.89%	16.54%	10.50%	0.35	6.39 ^c
None	27.34%	20.02%	21.41%	7.32 ^c	5.93 ^c
<i>N</i>	41919	18274	7257		

applied to the pairwise statistical tests [13].

The first pathway describes students who enrolled as a STEM major and obtained a STEM degree. For students who initially enrolled as a STEM major with No TYC Transfer Credit, 55.77% graduated with a STEM degree within at least 5 years. In comparison, students who initially enrolled as a STEM major and had either Any TYC Transfer Credits or 30 or More TYC Transfer Credits, 63.44% and 68.09%, graduated with a STEM degree, respectively. Overall, the students who enrolled as a STEM major and had Any TYC Transfer Credits earned a STEM degree at a greater proportion than students with No TYC Transfer Credits ($D_{Any-No} = 7.67\%$, $p < 0.001$). We also observed a similar trend for students who initially enrolled as a STEM major and had 30 or More TYC Transfer Credits ($D_{30-No} = 12.32\%$, $p < 0.001$). The difference between these students and those with No TYC Transfer Credits was 4.65% greater than the difference between students with Any TYC Transfer Credit and those with No TYC Transfer Credit.

The second pathway describes students who initially enrolled as a STEM major but obtained a non-STEM degree. Students who enrolled as a STEM major with either No TYC Transfer Credit or Any TYC Transfer Credits graduated with a non-STEM degree at similar proportions: 16.89% and 16.54%, respectively. However, students with 30 or More TYC Transfer Credits – earned a non-STEM degree at a lesser proportion than students with No TYC Transfer Credits, 10.50%. This difference, $D_{30-No} = 6.39\%$ ($p < 0.001$), suggests that a TYC transfer student who has satisfied the MTA [7] is less likely to switch from seeking a STEM degree at MSU to earning a non-STEM degree at MSU.

The third pathway describes students who enrolled as a STEM major however, obtained no degree within at least 5

years. Of the students who initially enrolled as a STEM major with No TYC Transfer Credit, 27.34% did not obtain a degree from MSU. However, initially enrolled STEM majors who had Any TYC Transfer Credits or 30 or more TYC Transfer Credits did not obtain a degree at a lesser proportion than students who had No TYC Transfer Credit: $D_{Any-No} = 7.32\%$ ($p < 0.001$) and $D_{30-No} = 5.39\%$ ($p < 0.001$). This result supports the analysis done for the first pathway, students with Any TYC Transfer Credits graduate at a higher proportion than students with No TYC Transfer Credits.

B. Pathways to a STEM Degree by Racial/Ethnic Groups

In general, it has been shown that the overall student population at TYCs is more diverse than the student population at FYCs [14, 15]. With that being said, we would like to investigate the pathways presented above for each of the racial/ethnic groups as reported by the Office of the Registrar. In this section, we will only report the percentages of students who earned a STEM degree; the results from the students who earned a non-STEM degree or students that did not graduate supported the claims of those presented in Section A. Table II summarizes the percentages of students who earned a STEM degree within 5 years by the MSU racial/ethnic categories. These results are disaggregated by the three types of TYC transfer credits – No TYC Transfer Credits, Any TYC Transfer Credits and 30 or more TYC Transfer Credits. The overall results are presented from the largest differences (between students with TYC transfer credits and No TYC Transfer Credits) to the smallest differences.

For the students who reported Black (non-Hispanic) and initially enrolled as a STEM major with No TYC Transfer Credits, 36.13% of them graduated with a STEM degree. In comparison, Black (non-Hispanic) students who initially enrolled as a STEM major and had either Any TYC Transfer Credits or 30 or More TYC Transfer Credits, 53.34% and 65.10%, graduated with a STEM degree, respectively. The differences between students with TYC transfer credit and students with No TYC transfer credit were the largest for students who self-identified as Black (non-Hispanic). Specifically, there was a statistically significant difference between students with Any TYC Transfer Credits and students with No TYC Transfer Credits ($D_{Any-No} = 17.21\%$, $p < 0.001$) as well as between students with 30 or more TYC Transfer Credits and students with No TYC Transfer Credits ($D_{30-No} = 28.97\%$, $p < 0.001$).

We observed similar trends for students who reported Hispanic. Overall, 43.95% of the Hispanic students who enrolled as STEM majors and had No TYC Transfer Credits earned a STEM degree within 5 years. In contrast, the Hispanic students that had Any TYC Transfer Credits or 30 or more TYC Transfer Credits graduated with a STEM degree at a greater proportion: $D_{Any-No} = 10.92\%$ ($p < 0.001$) and $D_{30-No} = 17.91\%$ ($p < 0.001$). These trends between Hispanic students with any transfer credits and those with No

TABLE II. The table sample summarizes the percentages of a conferred STEM degree for students with No TYC Transfer Credits, Any TYC Transfer Credits, and 30 or more TYC Transfer Credits, disaggregated by race/ethnicity. D_{Any-No} represents the absolute difference of percentages between students with Any TYC Transfer Credits and students with No TYC Transfer Credits. D_{30-No} represents the absolute difference of percentages between students with 30 or more TYC Transfer Credits and students with No TYC Transfer Credits. The statistical significance levels have been Bonferroni corrected and noted with superscripts: "a" denotes $p < 0.017$, "b" denotes $p < 0.003$, and "c" denotes $p < 0.0003$. If left without a superscript it is not statistically significant.

Conferred degree	No TYC Transfer Credits		Any TYC Transfer Credits			30 or more TYC Transfer Credits		
	N	STEM	N	STEM	D_{Any-No}	N	STEM	D_{30-No}
Black (non Hispanic)	1358	36.13%	751	53.34%	17.21 ^c	194	65.10%	28.97 ^c
Hispanic	505	43.95%	293	54.87%	10.92 ^c	146	61.86%	17.91 ^c
Caucasian (non Hispanic)	18373	58.20%	9317	64.84 %	6.64 ^c	4147	68.62%	10.42 ^c
Asian/Hawaiian/Pacific Islander	1443	55.74%	736	61.90%	6.16 ^c	276	68.15%	12.41 ^c
American Indian/Alaskan Native	88	44.90%	43	47.25%	2.35	27	51.92%	7.02
Multi-Race	218	53.30%	108	62.79%	9.49	45	77.59%	24.29
Not Reported/Not Requested	1392	61.95%	345	67.51%	5.56	106	64.24%	2.29

TYC Transfer Credits are similar to those from the Black (non-Hispanic) student population.

For students who reported Caucasian (non-Hispanic) and Asian/Hawaiian/Pacific Islander, results showed similar trends. Yet, for these groups of students, the differences in percentages were smaller – additional research will be needed to understand these differences. As for the students who are reported as American Indian/Alaskan Native, Multi-Race or Not Reported/Not Requested, the absolute difference between the Any Transfer Credits group and No Transfer Credits group (D_{Any-No}) was not statistically significant. Similarly, the difference between the 30 or More Transfer Credits group and the No Transfer Credits group (D_{30-No}) was not statistically significant.

IV. DISCUSSION & FUTURE DIRECTIONS

We sought to investigate the three pathways to degrees at MSU for students who declared a STEM major upon enrollment and had transfer credits from a TYC. We also explored the proportions of success for these pathways for students of color. Given the national statistics about success rates for earning bachelor's degrees for TYC transfer students, we are pleasantly surprised to find that MSU students who have Any TYC Transfer Credit graduate at a greater proportion than those who have No TYC Transfer Credit. Our investigation into the Office of Registrar data does not explain what a flagship institution like MSU is doing for students with TYC transfer credits. However, we find it promising that larger proportions of Black (non-Hispanic) and Hispanic who have Any TYC Transfer Credit are succeeding at obtaining a bachelor's degree at a Predominately White Institution (PWI).

The reader may have noticed that we took care to not describe students of color in this paper by the common term "un-

derrepresented minority." Our decision was made in part by our own institutional results disaggregated by race/ethnicity. Our results indicated that Black (non-Hispanic) and Hispanic students benefit from having Any TYC Transfer Credit and succeed in greater proportions than their peers. We call the field to consider how to quantitatively establish what it would mean to label students as underrepresented. By what measure? We find, in the Any TYC Transfer Credit population, Black (non-Hispanic) and Hispanic students are enrolling in STEM majors at similar proportions to their peers with No TYC Transfer Credits. A focus on the administrative categorizations of these students will not capture the whole of their experiences as Black and Hispanic students at a PWI.

There are several limitations to this work. Since our analysis is limited to historical data from the Office of the Registrar, we cannot answer questions as to why Any TYC Transfer Credits or 30 or more TYC Transfer Credits students who registered as a STEM major graduated with a non-STEM degree or did not graduate at all. In our analysis, we did not consider when students obtained TYC transfer credits; students may have earned TYC transfer credits while in high school. We also acknowledge that students of color with TYC transfer credits face more barriers to graduate that are not accounted for by our data. Therefore, since MSU is a large research university and a PWI, we encourage similar work to be conducted at other institutions, including Historically Black Colleges and Universities as well as Hispanic Serving Institutions. Future work will explore what MSU is doing as an institution to support the success of TYC transfer students who seek a STEM degree.

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