

The Impact of Financial Aid on STEM Graduation Rates

1 Student Graduation and STEM Classification Criteria

We first determine the student's graduation status by evaluating four degree date fields **degreedate1** to **degreedate4**. If at least one of these fields contains a valid date, the student is classified as **Graduated**. If none of the fields have a date, the student is labeled as **Not Graduated**.

Additionally, we categorize students into **STEM majors** based on the **Higher Education General Information Survey (HEGIS)** classification system, a widely recognized standard in higher education. After discussing with UMBC IRADS, specific **HEGIS codes** were identified as representing STEM disciplines. A student is classified as a **STEM major** if their **Entry Major Code** begins with one of the following HEGIS prefixes:

- **04** – Biological Sciences
- **07** – Computer and Information Sciences
- **09** – Engineering
- **17** – Mathematics
- **19** – Physical Sciences

If a student's **major code** does not begin with any of these prefixes, they are classified as **Non-STEM**.

To ensure our analysis focuses on **degree-seeking students**, we exclude those identified as **Non-Degree undergrad**, as they are not enrolled in a formal degree program.

2 Understanding the Student Distribution

Now that we have categorized students based on their **graduation status and field of study**, we have examined the overall distribution of students in our dataset. The breakdown is shown below:

- **Total Number of Students Degree Seeking Students:** 28,960
- **Total Number of Students who Graduated:** 17,645
- **Total Number of Students who Entered in the STEM Major:** 12,509
- **Number of STEM Entry Students Who Graduated (Any Major):** 7,660

3 STEM Graduation Analysis

After examining the **overall student distribution**, we now focus on **STEM graduation trends**, identifying how many students successfully earned a **STEM degree**, whether they initially enrolled in a **STEM field** or transitioned into one later. The breakdown is as follows:

- **Total Number of Students who Graduated as a STEM Major (Regardless of Entry Major):** 5,485
- **Total Number of Students Who Started and Graduated in STEM:** 4,923

3.1 Key Insights

From this data, we have derive key insights:

- **31.08 percent of all graduates** (5,485 out of 17,645) earned a **STEM degree**.
- **39.36 percent of students** who initially pursued STEM (4,923 out of 12,509) successfully completed a **STEM degree**.
- **18.94 percent of students who enrolled** (5,485 out of 28,960) have earned a **STEM degree**, regardless of their starting major.

4 Financial Support Metrics and Distribution

A new metric, **Total Support**, was computed by summing financial support amounts across multiple years. This calculation was performed only if the relevant financial aid columns, ranging from **GrantAmountFY2014** to **MeritAmountFY2022**, were available in the dataset.

4.1 Financial Support Indicators

To further analyze the distribution of financial aid, two key indicators were introduced:

- **First-Year Support Indicator (supportedY1):** Flags whether a student received any financial support in their first academic year (**FY2014**). A student is considered to have received first-year support if their **GrantAmountFY2014** or **MeritAmountFY2014** is greater than zero.
- **Overall Support Indicator (supported):** Identifies whether a student ever received financial support at any point during their academic journey. This is determined by checking if the **Total Support** amount is greater than zero.

4.2 Financial Support Categorization

To systematically categorize students based on financial support, predefined support bins were created:

- **No Support (NoSup):** $\text{NoSup} = \{0\} \cup \{\text{missing values}\}$

- **Less than 5,000 (<5K):** Less than 5K = $[1, 4, 999]$
- **5,000 - 10,000 (5K-10K):** 5K-10K = $[5, 000, 9, 999]$
- **10,000 - 15,000 (10K-15K):** 10K-15K = $[10, 000, 14, 999]$
- **15,000 - 20,000 (15K-20K):** 15K-20K = $[15, 000, 19, 999]$
- **More than 20,000 (>20K):** GT20K = $[20, 000, \infty)$

Using these bins, students were grouped based on their total support, and the distribution was analyzed. The number of students in each category is as follows:

- **No Support:** 12,096 students
- **Less than 5,000:** 4,514 students
- **5,000 - 10,000:** 2,794 students
- **10,000 - 15,000:** 1,888 students
- **15,000 - 20,000:** 1,547 students
- **More than 20,000:** 6,121 students

5 EFC Category and STEM Graduation Analysis

EFC Category	Total Students	STEM Entrants	Graduates (Any Major)	STEM Graduates	Entrant Graduation Rate (%)	Graduation Rate (%)
High	9,771	3,714	2,195	1,320	59.10	35.54
Low	7,579	3,568	2,660	1,808	74.55	50.67
Medium	2,563	1,059	735	458	69.41	43.25
Unknown	9,047	4,168	2,070	1,337	49.66	32.08

Table 1: Graduate Students Metrics who entered in STEM by EFC Category

5.1 Explanation of Columns

- **EFC Category:** The financial need classification of students based on Expected Family Contribution (EFC).
- **Total Students:** Total number of students in each EFC category.
- **STEM Entrants:** Number of students who entered in STEM major.
- **Graduates (Any Major):** Number of who entered in STEM major and graduated with any degree (including non-STEM).
- **STEM Graduates:** Number of students who started and graduated in STEM without switching majors.
- **Entrant Graduation Rate (%):** Percentage of STEM entrants who graduated in any major.

$$\left(\frac{\text{Graduates (Any Major)}}{\text{STEM Entrants}} \right) \times 100$$

- **Graduation Rate (%)**: Percentage of STEM entrants who remained in STEM and graduated.

$$\left(\frac{\text{STEM Graduates}}{\text{STEM Entrants}} \right) \times 100$$

5.2 Key Insights

5.2.1 Entrant Graduation Rate (%)

Low-need students have the highest graduation rate among STEM entrants at **74.55%**, reflecting strong persistence in completing their degrees. In contrast, **high-need students** graduate at a lower rate of **59.10%**, indicating that financial constraints may pose challenges to degree completion. **Medium-need students**, with a **69.41%** graduation rate, perform better than high-need students. The **unknown EFC** group records the lowest graduation rate at **49.66%**.

5.2.2 Graduation Rate (%)

Low-need students demonstrate the highest STEM graduation rate at **50.67%**, with more than half of those who entered STEM successfully completing a STEM degree. In contrast, **high-need students** have the lowest graduation rate at **35.54%**, suggesting that financial stress may contribute to students switching out of STEM fields. **Medium-need students** show a moderate graduation rate of **43.25%**, indicating that access to some financial support improves STEM persistence compared to those with high financial need. The **unknown EFC** group has the lowest recorded graduation rate at **32.08%**.

5.3 STEM degree completion % of Total Students

In a cohort study, **high-need students** had the **lowest STEM degree completion rate (13.51%)**, suggesting that **financial aid gaps may hinder students from successfully earning STEM degrees**. In contrast, **low-need students** had the **highest STEM degree completion rate (23.86%)**, meaning that **nearly 1 in 4 students** in this category ultimately earned a STEM degree. **Medium-need students** had a slightly higher completion rate (**17.87%**) than high-need students, while students in the **unknown financial need category** earned STEM degrees at a rate of **14.78%**.

6 STEM Graduation Based on Financial Support

EFC Category	Supported	Total Students	STEM Entrants	STEM To STEM Completed	STEM Entry Rate From Total (%)	STEM To STEM Completion Rate From Entrants (%)	STEM To STEM Completion Rate From Total (%)
High	0	272	87	12	31.99	13.79	4.41
High	1	9,499	3,627	1,308	38.18	36.06	13.77
Low	0	2,112	804	274	38.07	34.08	12.97
Low	1	5,467	2,764	1,534	50.56	55.50	28.06
Medium	0	665	238	62	35.79	26.05	9.32
Medium	1	1,898	821	396	43.26	48.23	20.86
Unknown	0	9,047	4,168	1,337	46.07	32.08	14.78

6.1 Explanation of Columns

- **EFC Category**: The financial need category based on Expected Family Contribution (High, Low, Medium, or Unknown).

- **Supported:** Indicates whether the student received financial support (0 = Not supported, 1 = Supported).
- **Total Students:** The total number of students in each EFC category, further divided by support status.
- **STEM Entrants:** The number of students who entered a STEM program in each EFC category.
- **STEM To STEM Completed:** The number of students who both entered and completed a STEM degree.
- **STEM Entry Rate From Total (%):** Measures how many students from the total population entered a STEM program.

$$\left(\frac{\text{STEM Entrants}}{\text{Total Students}} \right) \times 100$$

- **STEM To STEM Completion Rate From Entrants (%):** Measures how many students who entered STEM successfully completed a STEM degree.

$$\left(\frac{\text{STEM To STEM Completed}}{\text{STEM Entrants}} \right) \times 100$$

- **STEM To STEM Completion Rate From Total (%):** The percentage of all students who both entered and completed STEM.

$$\left(\frac{\text{STEM To STEM Completed}}{\text{Total Students}} \right) \times 100$$

6.2 Key Observations

6.2.1 STEM Entry Rate from Total Students (STEM_Entry_Rate_From_Total)

High EFC:

- Supported students (38.18%) have a higher STEM entry rate than non-supported students (31.99%).
- Support increases STEM entry by 6 percentage points, showing its impact on STEM participation.

Low EFC:

- Supported students (50.56%) have the highest STEM entry rate among all groups.
- Non-supported students (38.07%) also have strong STEM participation, but support boosts it by over 12 percentage points.

Medium EFC:

- Supported students (43.26%) enter STEM at a higher rate than non-supported students (35.79%).
- Support provides an 8% advantage in STEM participation, though overall Medium EFC numbers remain low.

Key Insight: Support significantly increases STEM entry rates in all EFC categories, especially for Low EFC students. Medium EFC students enter STEM the least, even with support.

6.2.2 STEM Completion Rate from STEM Entrants (STEM_To_Stem_Completion_

High EFC:

- Supported students (36.06%) complete STEM at much higher rates than non-supported students (13.79%).
- Support nearly triples STEM completion rates in this category.

Low EFC:

- Supported students (55.50%) have the highest completion rate of all groups.
- Non-supported students (34.08%) still perform well, but support increases their STEM persistence by over 21 percentage points.

Medium EFC:

- Supported students (48.23%) complete STEM at nearly double the rate of non-supported students (26.05%).

Key Insight: Support has the strongest impact on STEM completion for Low and Medium EFC students. High EFC non-supported students struggle the most, with the lowest completion rate (13.79%).

6.2.3 STEM Completion Rate from Total Students (STEM_To_Stem_Completion_

High EFC:

- Supported students (13.77%) complete STEM at much higher rates than non-supported students (4.41%).
- Support triples the overall STEM completion rate.

Low EFC:

- Supported students (28.06%) have the highest STEM completion rate across all groups.
- Non-supported students (12.97%) still perform well, but support more than doubles their STEM persistence.

Medium EFC:

- Supported students (20.86%) complete STEM at more than twice the rate of non-supported students (9.32%).
- Support significantly boosts their STEM graduation rate, but overall numbers remain low.

Key Insight: Low EFC supported students dominate STEM completions (28.06%), reinforcing the importance of support. Medium EFC non-supported students contribute the least to STEM graduates (9.32%), showing they struggle the most.

Group	STEM-to-STEM % of STEM Entry	STEM-to-STEM % of Total students
Supported	44.90%	19.20%
Not Supported	30.82%	11.41%

Table 2: Graduation Rates Based on Financial Support

6.3 Higher Graduation with Support

- Students who received financial support (**Supported group**) have a STEM graduation rate of **44.90%** when measured against their STEM entry numbers, compared to only **30.82%** for those who did not receive support.

6.4 Overall STEM Graduation

- When considering the entire population, **19.20%** of the supported group remain in STEM, whereas the graduation for the not supported group is only **11.41%**.

6.5 Implication

- These results indicate that financial support is associated with **better STEM graduation outcomes**, both among those who initially choose STEM and across the overall student body.