

Internal and External Factors that Influence First-generation Rural Students in WV to Pursue a STEM Degree

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Introduction

Students who major in STEM and who come from families where they are in the first generation to pursue a college degree are growing in number. These students are an important and understudied population who can grow and diversify the STEM workforce. The First2Network, an NSF INCLUDES Alliance, is a statewide initiative to attract and retain first generation rural student in West Virginia to major and persist in a STEM field. The First2 Network purpose is to improve retention and success for rural, first-generation STEM students in the first two years of the undergraduate curriculum. Most research in the area of STEM retention concentrates on persistence and attainment among students who have already entered a STEM major. This research looks at factors relevant to interest in and entrance into STEM majors, the first critical step into the STEM pipeline. A decision to pursue a STEM major occurs over the course of student's secondary education. We examine curricular and extracurricular factors that may influence a student to enter college and study STEM. We also try to better define what it means to be a first generation student (FGS).

The federal government defines a FGS as “an individual both of whose parents did not complete a baccalaureate degree” or “in the case of any individual who regularly resided with and received support from only one parent, an individual whose only such parent did not complete a baccalaureate degree.” No consideration is given to whether other immediate and extended family members attended or completed college. In the first year of the project, it became clear to the researchers that not all FGS are the same in terms of their level of first generationness. It raised the question as to if what influenced a student's decision to attend college and pursue a degree in STEM might differ based on this level of first generationness.

If a student's parent(s) or guardian did not attend college, but a sibling or someone from their extended family did, would it make a difference in what might contribute to their decision to attend college and major in a STEM field? Interviews of students who participated in the pilot project for the First2Network indicated that external factors such as a sibling, relative, or friend who attended college influenced their decision. In addition, teachers, school counselors, religious leaders, and neighbors also influence their decision. FGS have indicated that family members often provide significant support and motivation to pursue college.

Other researchers have considered the factors that influence students to attend college. Vega (2016) found that many FGS' parents instilled a strong college-going expectation at an earlier age, despite parents not having attended college themselves. The educational attainment of other family members, such as brothers, sisters, aunts and uncles, is also associated with students' college plans. If a member of the student's family attended college, he or she is more likely to attend (Chenoweth & Galliher, 2004). It was shown that as students move throughout the secondary pipeline their reliance on family and peers for college information shifts to school personnel during the junior and senior years (Bell et al., 2009). Teachers, counselors, college

fairs and college representatives become critical sources of information. Teachers and counselors influence educational aspirations by helping students choose their high school curriculum and postsecondary plans. Counselors play a crucial role in students' educational aspirations, especially for those from disadvantaged groups. (Carbrera & LaNasa, 2000; McDonough, 2005, as cited in Hahn & Price, 2008) Students consistently rank friends as a major influence on the decision to attend college and which college to attend. Students whose friends enroll in college are more likely to enroll in college themselves (Engberg & Wolniak, 2009). Additionally, support from community members has been shown to have a positive influence on the decision to attend college. To determine the differences between students who planned to attend college and those who did not plan to attend college, researchers surveyed rural Vermont high school seniors. Support from community members, especially clergy and school personnel, was reported by students as having a positive influence on their decision to attend college (Knisley, 1993).

Since all of the students in our study were from Appalachia, a review of the literature in this area found that Appalachian students ranked peers as the second most influential group in their higher education decisions, just behind parents and ahead of teachers, counselors, relatives, siblings, and even self (Voinovich School of Leadership and Public Affairs Ohio University, 2009). Internal factors that influences students identified during the pilot interviews included a desire for a good income, career aspirations and positive associate with college. Again, the review of literature found support for this idea. Ayala and Stiplen (2002), found that for FGS, "the motivation to enroll in college is a deliberate attempt to improve their social, economic, and occupational standing" (Ayala & Striplen, 2002, p. 57).

Our research investigates whether these influences, both external and internal, were the same for all students in our study who are classified as FGS or whether there are variations based on who in the family attended college. We attempt to answer the following questions:

- Can we better define what is meant to be a first-generation student?
- What influences a first-generation student's decision to go to college? To study STEM?
- Are there differences in influences based on levels of first-generationness?

Methods

Participants

The participants for this study were students who attended an Immersive Experience during the summer prior to their entering college. All participants had interest in pursuing STEM majors in college. The Immersive Experience was designed to engage students in STEM research, introduce them to STEM professionals and help them get to know other STEM majors. Data collection took place after the participants had completed the Immersive Experience. The students attended these experiences at various locations around the state of West Virginia, including university settings, research sites, and companies. In the summer of 2020, participants attended these activities virtually due to the restrictions because of COVID-19. A total of 178 students were asked to participate in the research, 26 from year 2018, 27 from 2019, 69 from 2020, 56 from 2021 and 43 for 2022.

Measures

Interviews and a survey were used for this study. The interviews were loosely structured to allow freedom for both the interviewer and the interviewee to explore additional points and change direction, if necessary. The interviews were used to better understand factors that influenced students to attend college and study STEM. The interview questions also asked about family members who attended college. A survey was developed based on the coding of the in-depth interviews of participants. The survey was designed to capture ideas that were uncovered during interviews, i.e., factors that influenced the students to attend college and study STEM and information about family members who attended college.

Procedure

In early 2018, In-depth individual interviews were conducted with the eleven student participants from the summer Immersive Experiences Pilot. The interview questions included ones that asked about who in their immediate or extended family attended or graduated from college, if the family members majored in STEM, and the external and internal factors that influenced their decision to attend college and major in STEM. Classical content analysis was used to analyze interview data. The interviews were recorded and transcribed. After the transcription, the transcripts were broken down into smaller segments of the data and a code was assigned to each segment. Three coders were used to ensure consistency and cross-checking. Based on the information from the interviews, a survey was developed using the same questions but included responses given by the pilot students as influence choices with an option to specify other.

In October of 2019, the survey was emailed to all students who participated in the summer 2018 pilot, and those who participated in a summer 2019 Immersion Experience. Any student who was interviewed and also completed the survey was included only in the survey pool. The interview information was used only as a baseline to develop the survey. Table 1 shows the number of surveys sent, completed and the response rate. The same survey was sent out in September of 2020, 2021 and 2022 to student who participated in a summer Immersive Experience for those years.

Table 1: Respondents to the Student Survey

Year	Sent	Responded	Response Rate
2018 (Pilot)	26	7	27%
2019	27	14	52%
2020	69	34	49%
2021	56	21	38%
2022	43	24	56%
Total	221	100	45%

Findings

After interviewing students who are considered first-generation, it became obvious that they come from very different backgrounds. For example, they may have close relatives or friends that graduated from college, or their parents may have attended college and almost graduated but did not get a degree. This resulted in creating levels of degree of first generationness (Darrah, Humbert & Stewart, 2022). Data was reported from all participants, then all FGS were compared with non-first generation students (NFGS), and then NFGS compared with the levels of first generationness.

Based on the interview results, for purposes of our study, we have defined the following levels of student backgrounds. Level 0 students are NFGS, Level 1 through Level 4 are FGS, but have differing backgrounds.

Level 0: One or both parents graduated from college (not considered first-generation)

Level 1: Parents or guardians attended some college.

Level 2: Siblings attended or completed college; parents did not attend.

Level 3: Extended family (grandparents, aunts/uncles, cousins) attended or completed college; parents or siblings did not.

Level 4: No one in immediate or extended family attended or completed college.

Figure 1 below indicate the first generation levels of the 100 survey respondents. Of the student respondents, 72 students would be considered FGS (Levels 1 through Level 4) by the conventional definition, only 11 of these students said that they *did not have anyone* in their immediate family that attended or graduated from college. As can be seen, 66 of the 100 students who completed the survey had a parent who either attended (Level 1) or graduated (NFG) from college (see Figure 1) and of those, 26 indicated at least one parent majored in a STEM field (see Figure 2). Interestingly, only one of the participants who had a sibling that attended college (level 2) said that they had a sibling that majored in a STEM field. Thirty percent of the respondents at Level 3 with an extended family member who attend college said that an extended family member majored in STEM. Since none of the Level 4 students had anyone in their immediate or extended family attended or completed college, there were no STEM majors.

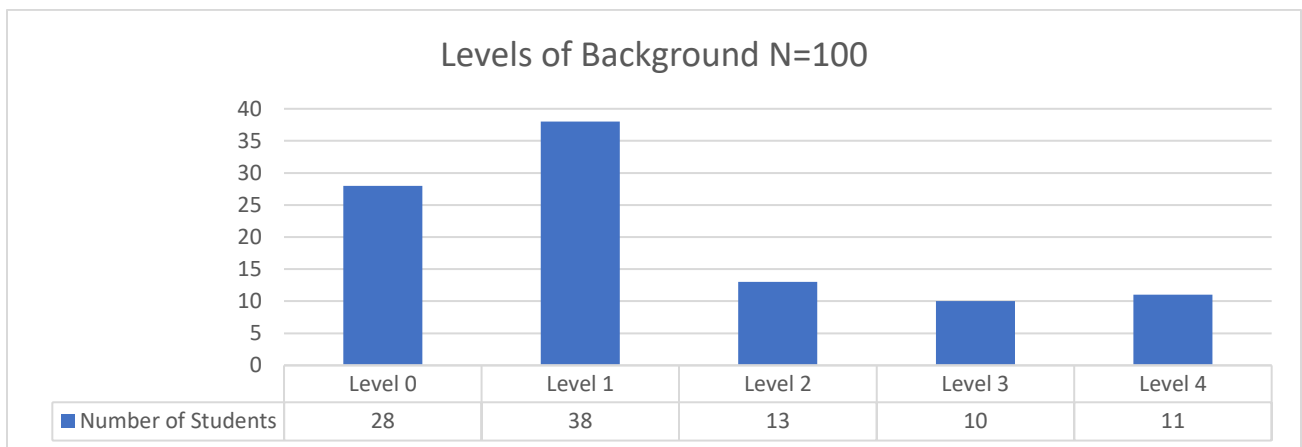


Figure 1: Respondents Background Levels

Figure 2 shows how many students at each level had a family member who majored in a STEM field.

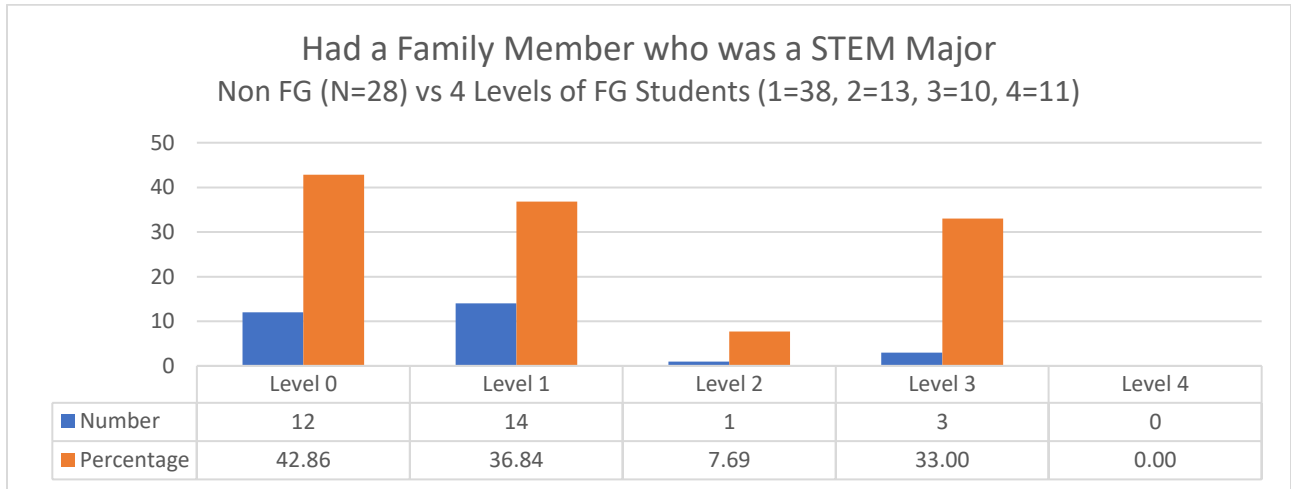


Figure 2: Participants who had a Family Member who was a STEM Major by FG Level

External and Internal Influences

In this study, we consider the external and internal influences related to a student’s decision to go to college and major in STEM by the student’s first generation level. We looked at this nominal data in two ways. We determined the number and percentage of students who selected each influence and then we looked at the mode to see which influence was selected the most for each group.

Factors that Influenced Students to go to College

We began by considering the influences to go to college for all students who responded to the survey. We then consider these influences for FGS (N=72) versus the NFGS (N=28) and then the same influences by level of first generationness. The respondents could choose all that applied. As seen in the Figure 3 below, when considering all responses, parents had the most influence when it came to the choice to go to college, followed by teachers and with classes and siblings slightly less.

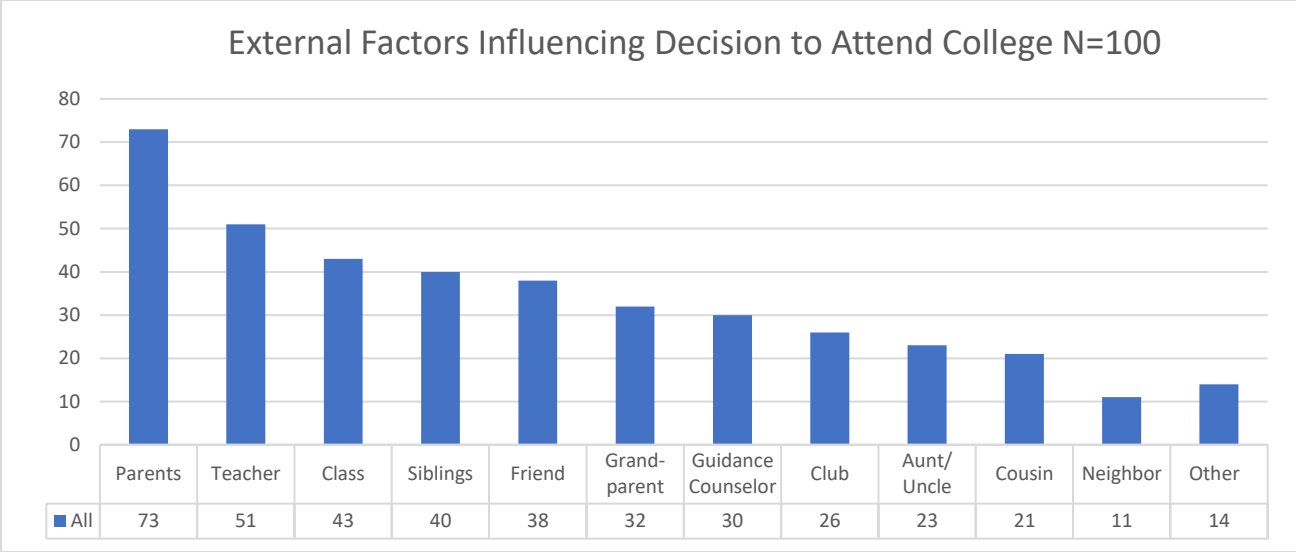


Figure 3: External Factors Influencing Decision to Attend College – All Students

In Figure 4 we compare the percentages of NFGS (N=28) to FGS (N = 72) with respect to the factors influencing them to attend college. Parents and teachers played a big role for both groups. However, for FGS, classes and friends played a larger role than for their non-first-generation counterparts.

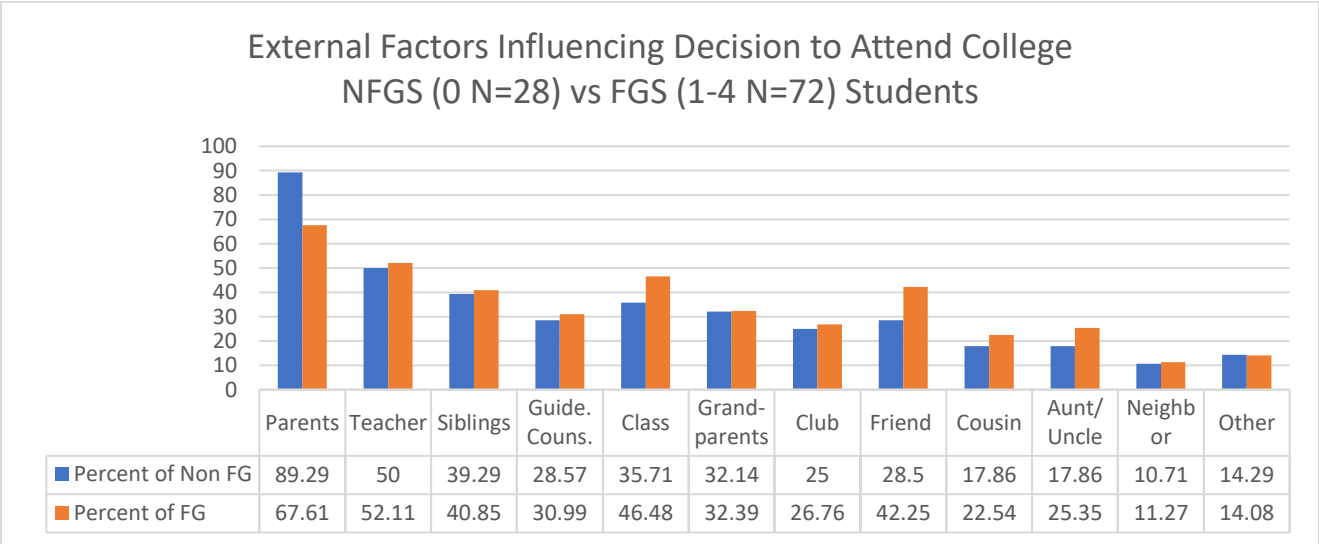


Figure 4: External Factors Influencing the Decision to Attend College, FG vs. NFG

Based on our premise that not all levels of FGS have the same influences, we looked to see if there was a difference in academic and non-academic related external influences to attend college, by level of first generationness. When considering all the FGS (Figure 4), parents (67.61%) had the biggest non-academic influence. In Figure 5 it can be see that when the FGS are divided by level, siblings and friends were very influential for level 2 students whereas parent were by far the most influential for the other three levels.

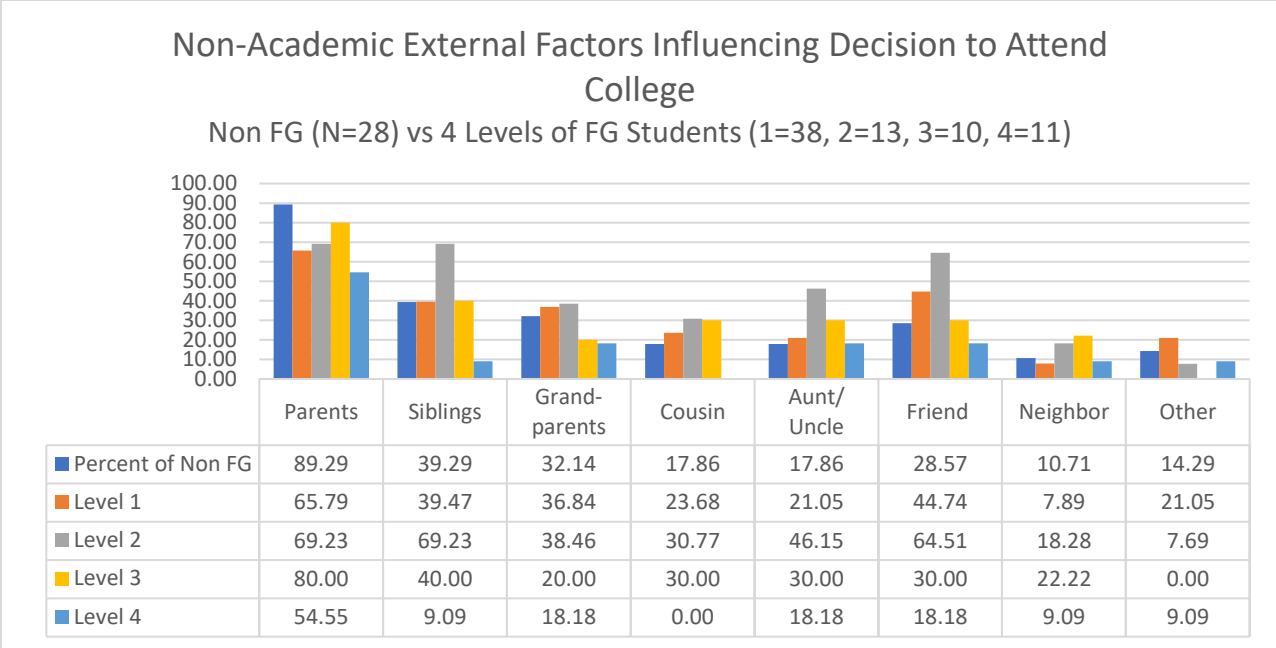


Figure 5. Non-Academic External Factors Influencing Decision to Attend College by FG Level

When considering all the FGSs (Figure 4), teachers (52.11%) had the biggest academic influence. When the group is separated into levels (Figure 6), teacher was identified as having the most influence on Levels, 2, 3, and 4, however, class had the biggest influence on Level 1 (44.74) students.

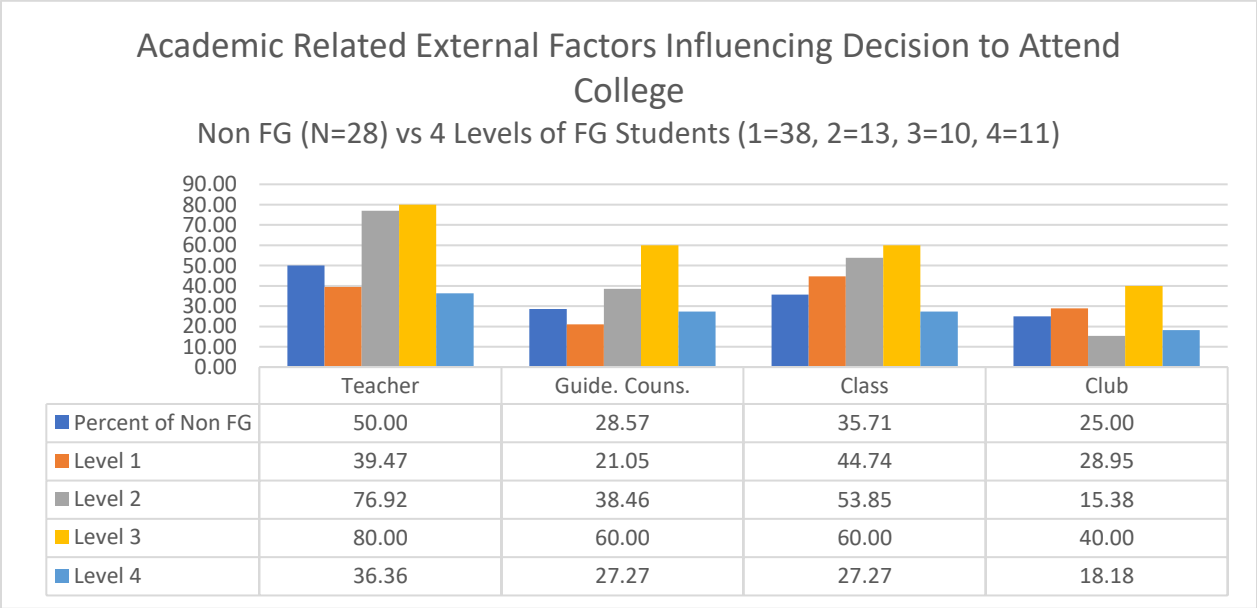


Figure 6. Academic Related External Factors Influencing Decision to Attend College by FG Level

We next looked at internal factors such as desire for good income, career aspiration and positive association with college. As seen in the Figure 7 below, they were all very common influences, but desire for a good income was the most common driving factor for this group.

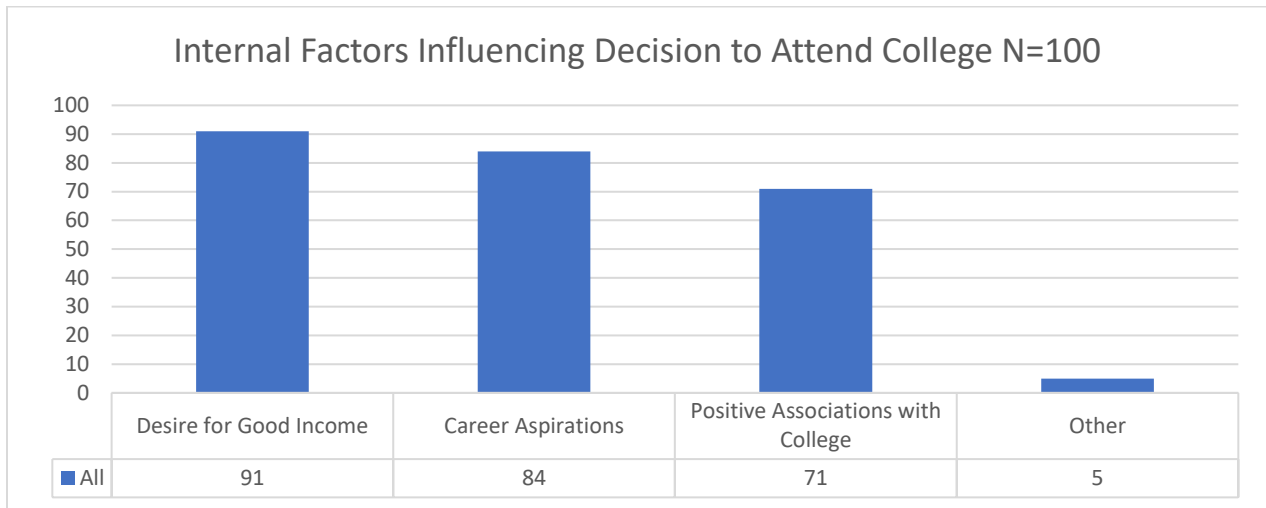


Figure 7: Internal Factors Influencing Decision to Attend College – All Students

Looking at this data in another way, Figure 8 shows the percentage of NFGS versus FGS. We found that a greater percentage of both groups indicated that a desire for a good income was the largest influence.

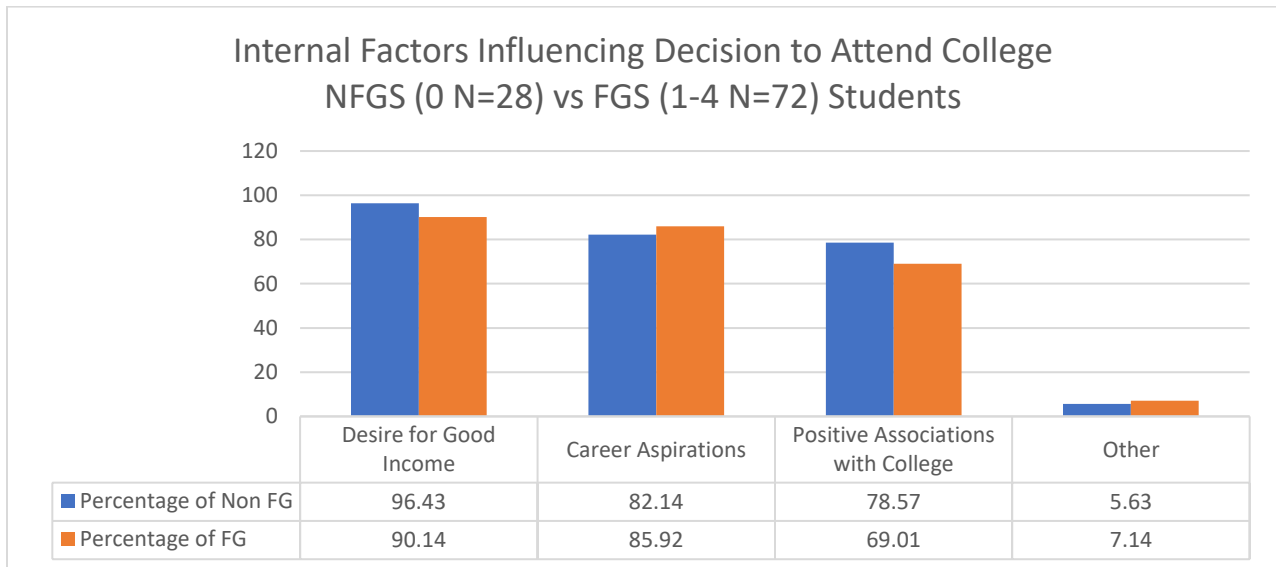


Figure 8: Internal Factors Influencing Decision to Attend College, FG vs. NFG

When considering all the FGSs (Figure 8), a desire of good income (90.14) was the internal influence selected most, but when looking at FGS by level (Figure 9), career aspirations was highest for Level 2 (100%)

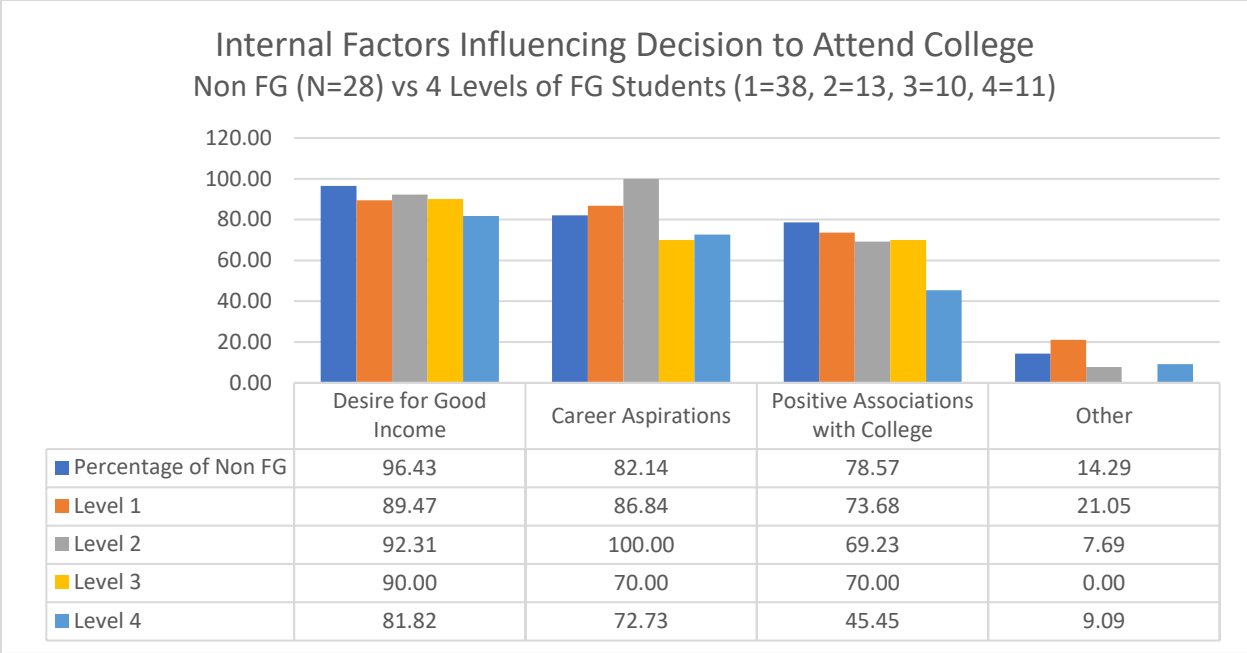


Figure 9: Internal Factors Influencing Decision to Attend College by Levels

Factors that Influenced Students to Study STEM

Next, we looked at these external and internal factors that influenced students to enter a STEM major (see Figure 10). While parents had the biggest influence on these students’ decision to attend college, more students indicated that teachers and classes influenced their decision to major in a STEM field.

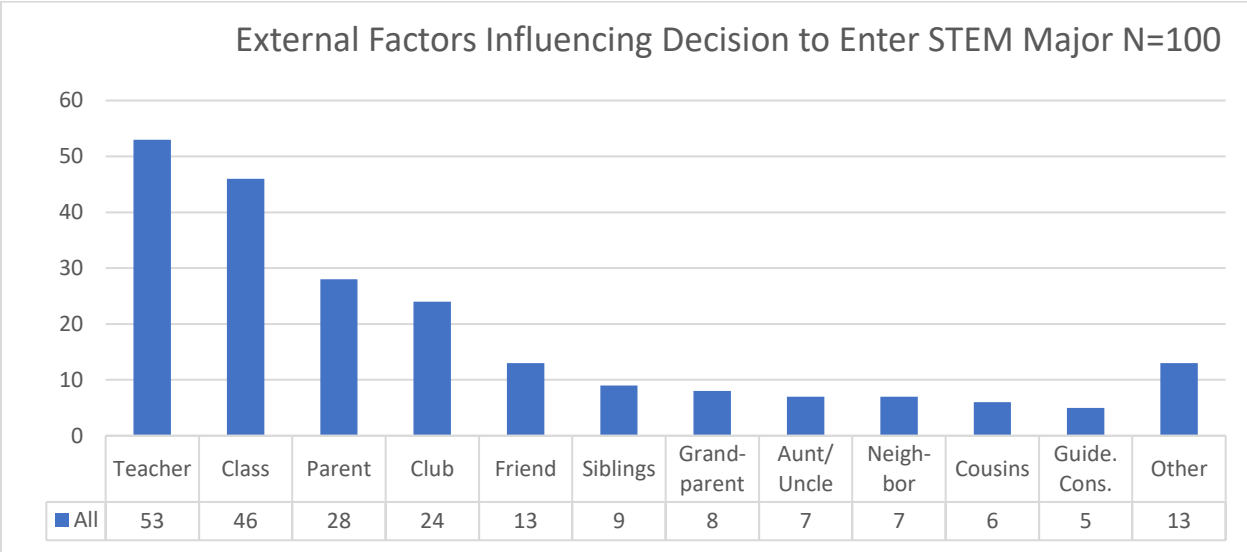


Figure 10: External Factors Influencing Decisions to Enter a STEM Major – All Students

When considering external influences related to a student’s decision to enter a STEM major, Figure 11 shows the percentage of NFGS versus FGS. It is clear that teachers and clubs played a much larger role for FGS compared to NFGS. Parents were the biggest influence on NFGS and almost half of both groups selected class as an influence.

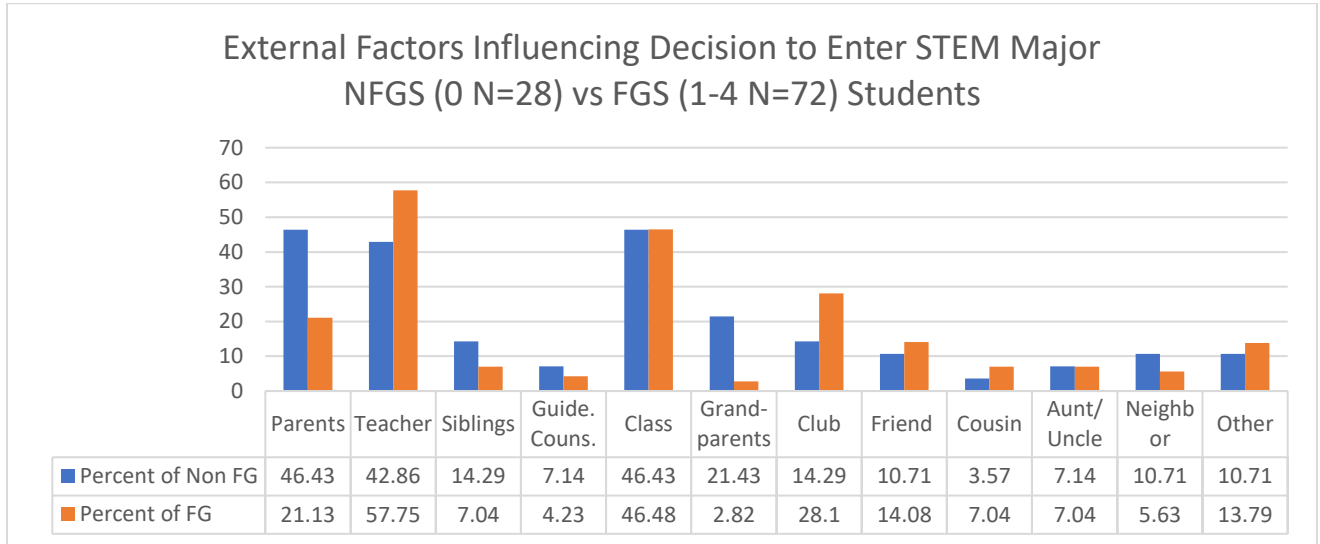


Figure 11: External Factors Influencing Decision to Enter a STEM Major, FG vs. NFG

When considering all the FGSs (Figure 11), teachers (57.75%) had the biggest influence in the academic realm. When looking at FGS by levels (Figure 11), classes were equally as influential as teachers for Level 2 students. However, teachers were the highest for Levels 1, 3, and 4.

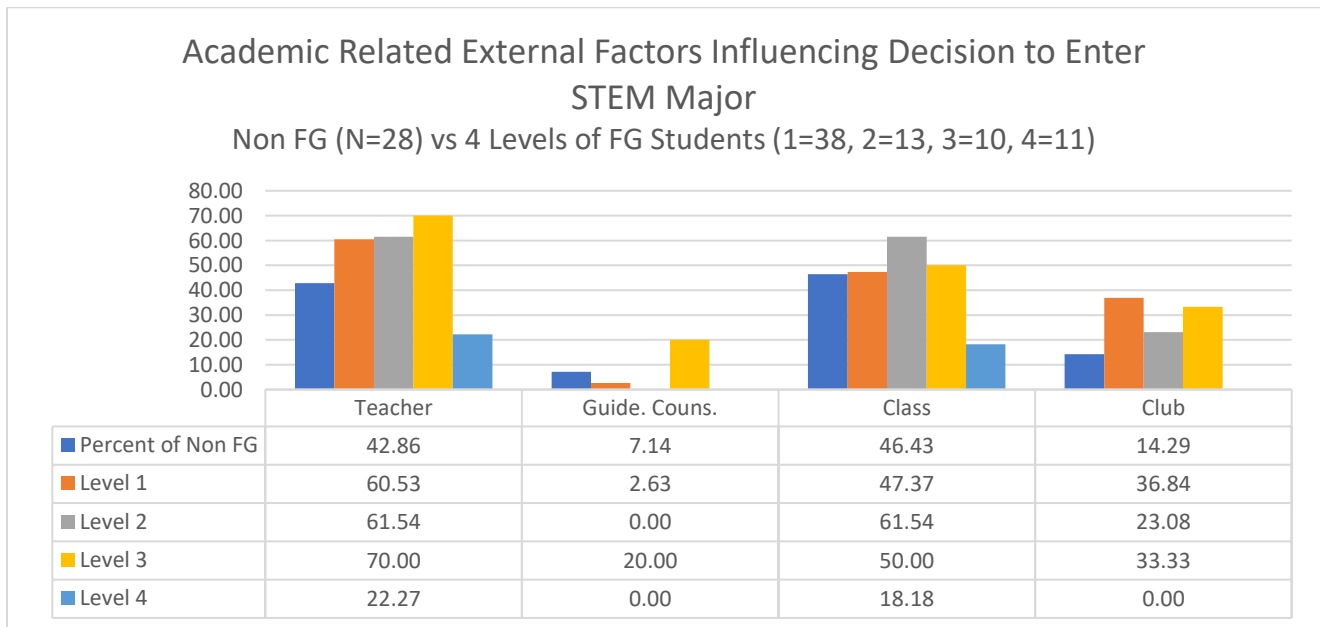


Figure 12. Academic Related External Factors Influencing Decision to Enter STEM Major by FG Level

When considering all the FGSs (Figure 11), parents (21.13%) had the biggest non-academic influence. However, when looking at them by level (Figure 13), friends were equally as influential as parents for Level 2 students and higher for Level 3, whereas parents were more influential for Levels 1 and 4.

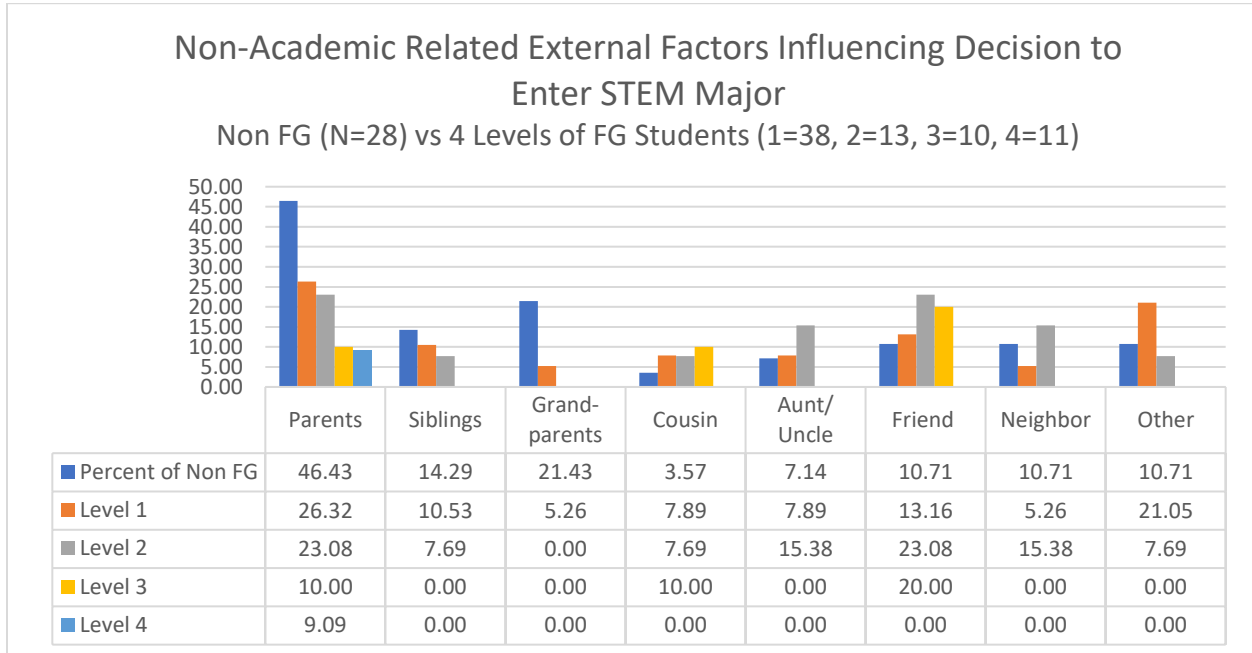


Figure 13. Non Academic Related External Factors Influencing Decision to Enter STEM Major by FG Level

When looking at internal factors that influenced students to major in STEM (Figure 14), career aspirations was selected most often. Interestingly, the same number of students selected a desire for good income and positive association with college as influences.

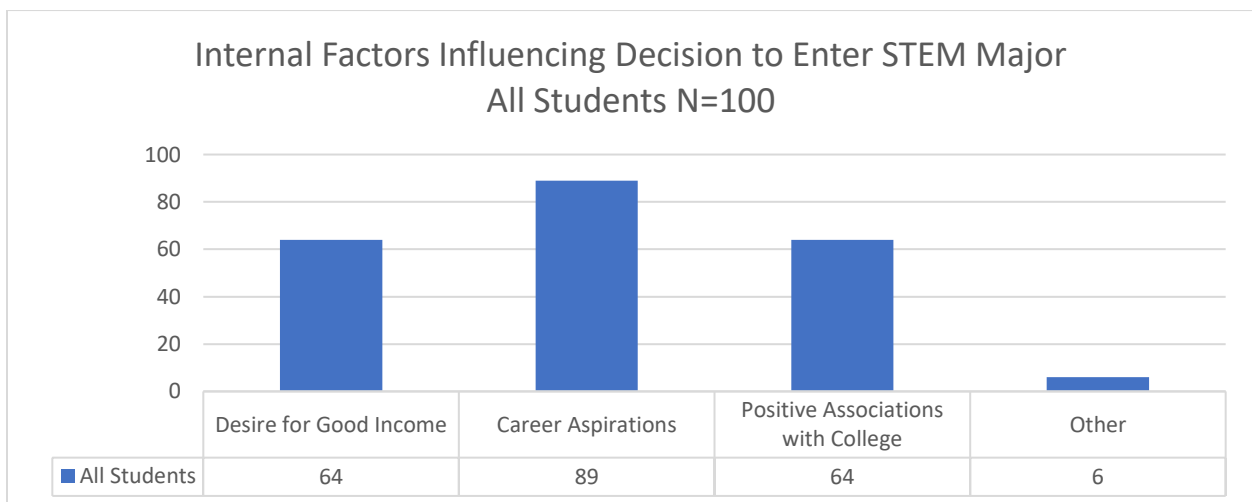


Figure 14. Internal Factors Influencing Decision to Enter a STEM Major – All Students

When dividing the group into FGS and NFGS and looking at internal influences, both groups selected career aspirations as having the biggest influence on their decision to major in STEM (Figure 15). Almost 15% more NFGS selected desire for good income than did FGS. For the FGS, positive associations with college was the second highest internal factor.

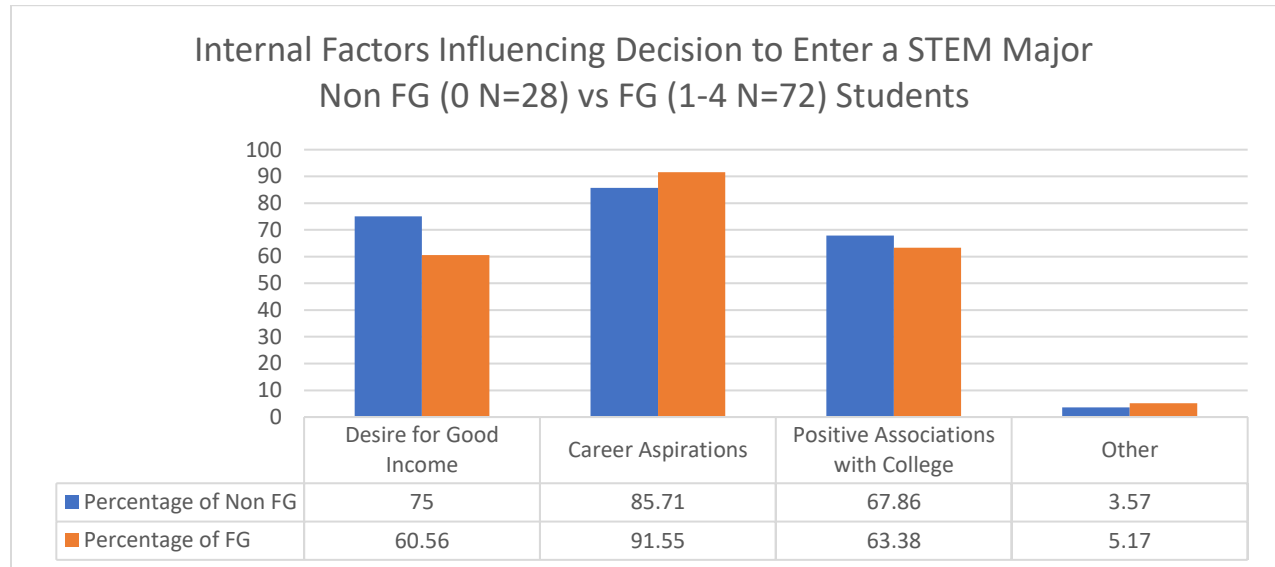


Figure 15: Internal Factors Influencing Decisions to Study STEM, FG vs. NFG

When considering all the FGS (Figure 15), career aspirations (91.55%) had the biggest influences. When looking at FGS by level (Figure 16), career aspirations and positive associations with college are both 80% for Level 3 students.

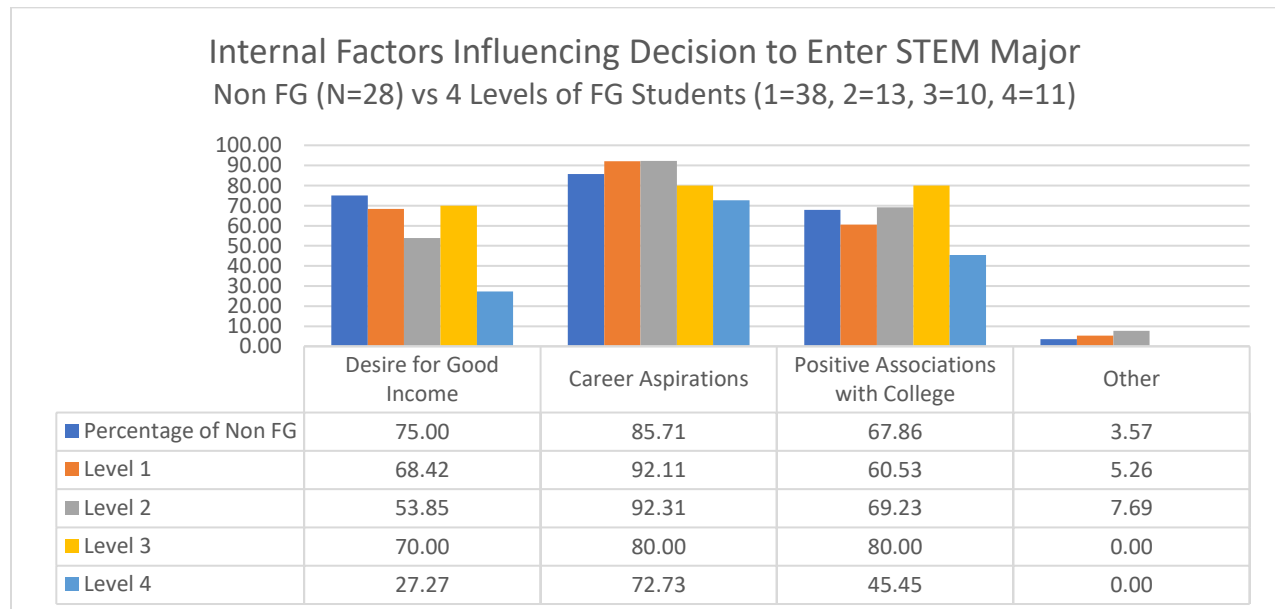


Figure 16. Internal Factors Influencing Decision to Enter STEM Major by FG Level

Alternative Look at the Data

Decision to Attend College

Since nominal data cannot be ordered or summed, the mode, the most frequently appearing value, is the most appropriate central tendency to report. As is seen in Table 2, for all the students who completed the survey (column 1) the influence selected by most participants was parents. This was also true for all the NFGS and all the FGS as a group, and the FGS Level 1 and Level 4 students. However, Level 2 students selected teacher as the person who had the most influence in their decision to attend college and Level 3 selected teachers and parents equally.

Table 2. Eternal Influences to Attend College

Sample	All	All NFG	All FG	Level 1	Level 2	Level 3	Level 4
<i>N</i>	100	28	72	38	13	10	11
Teacher	51	14	37	15	10	8	4
Guidance Counselor	30	8	22	8	5	6	3
Class	43	10	19	17	7	6	3
Club	26	7	33	11	2	4	2
Parent	73	25	48	25	9	8	6
Sibling	40	11	29	15	9	4	1
Cousin	21	5	16	9	4	3	0
Grandpa	32	9	23	14	5	2	2
Aunt/Uncle	23	5	18	8	6	3	1
Friend	38	8	30	17	8	3	2
Neighbor	11	3	8	3	2	2	1
Other	14	4	10	8	1	0	1

For all the students who completed the survey (column 1) the internal influence that most participants selected was income (Table 3). This was also true for all the NFGS as well as the FGS Level 1, 3 and 4. However, more of the Level 2 students selected career as having the most influence in their decision to attend college.

Table 3. Internal Factors the Influenced Decision to Attend College

Sample	All	All NFG	All FG	Level 1	Level 2	Level 3	Level 4
<i>N</i>	100	28	72	38	13	10	11
Income	91	27	64	34	12	9	9
Career	84	23	61	33	13	7	8
College	71	22	49	28	9	7	5
Other	6	2	4	3	1	0	0

Decision to Enter a STEM Major

As seen in Table 4, for all the students who completed the survey (column 1) the influence that most participants attributed to their decision to study STEM was teachers. This was also true for the combined FGS as well as Levels 1, 3, and 4. All NFGS and Level 2 were bi-modal NFGS having class and parents receiving the same number and Level 2 having both teachers and class receiving the same number.

Table 4. External Influences to Enter a STEM Major

Sample	All	All NFG	All FG	Level 1	Level 2	Level 3	Level 4
<i>N</i>	100	28	72	38	13	10	11
Teacher	53	12	41	23	8	7	3
Guidance Counselor	5	2	3	1	0	2	0
Class	24	13	33	18	8	5	2
Club	46	4	20	14	3	3	0
Parent	28	13	15	10	3	1	1
Sibling	9	4	5	4	1	0	0
Cousin	6	1	5	3	1	1	0
Grandpa	8	6	2	2	0	0	0
Aunt/Uncle	7	2	5	3	2	0	0
Friend	13	3	10	5	3	2	0
Neighbor	7	3	4	2	2	0	0
Other	13	3	10	8	1	0	1

For all the students who completed the survey (column 1) the internal influence that most participants attributed to their decision to study STEM was career aspirations. This was also true for all the NFGS as well as the FGS Levels 1, 2, 3 and 4.

Table 5. Internal Influences to Enter STEM Major

Sample	All	All NFG	All FG	Level 1	Level 2	Level 3	Level 4
<i>N</i>	100	28	72	38	13	10	11
Income	64	21	43	26	7	7	3
Career	89	24	65	35	12	10	8
College	64	19	45	23	9	8	5
Other	4	1	3	2	1	0	0

Discussion

Based on our research, we did see differences in the internal and external influences by level versus FGS as a whole. Most notably, teachers were a bigger influence on Level 2 and 3 FGS decision to attend college. However, when it came to choosing to major in STEM, teachers and class were weighed the same for Level 2.

When considering internal factors to enter college, again we saw a difference with Level 2 FGS. While other levels selected income as being most influential, every Level 2 participants selected career aspirations as having the most influence. For influence to enter a STEM major, all levels selected career aspirations as the biggest influence.

Research conducted by the Voinovich School of Leadership and Public Affairs at Ohio University found that Appalachian students ranked parents as the most influential group in their higher education decisions. Our research found that teachers had the greatest influence on FGS decision to attend college and this was true for all level of first generationness.

Research conducted by Ayala and Stiplen (2002) found that for FGS, “the motivation to enroll in college is a deliberate attempt to improve their social, economic, and occupational standing (pg. 57).” Our findings align with this research; the greatest influence identified by the FGS in our study was desire to have a good income.

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