RESEARCH ARTICLE

Factors affecting first, second and third year undergraduate engineering students' perception of their mathematics modules

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Abstract

It is well documented in the literature that students entering their first year of university struggle with adapting to the new teaching style and environment. This is particularly evident in the literature among students enrolled in STEM courses at university, including those enrolled in engineering courses. One of the primary concerns around students entering engineering courses in university is their level of mathematics and its subsequent effect on their learning. The issues identified in the literature focus on students in their first year of university but this neglects students in later years who may also experience issues. Therefore, in this paper, we investigate, through survey responses, if issues which cause students difficulty are present for students beyond their first year of university. Specifically, we report factors that first, second- and third-year undergraduate engineering students at an Irish university have identified as causing them difficulty when studying mathematics. Moreover, we investigate what, if any, impact these issues may have on students' perception of mathematics and their stress levels due to mathematics.

Keywords: Engineering Mathematics, mathematics problem, higher education

1. Introduction

Students around the world who are entering universities and studying service mathematics (e.g., engineering, technology, business, science students) have exhibited a declining mathematical ability with this phenomenon being referred to as the *Mathematics Problem* (Lawson, 2003). The *Mathematics Problem* was first identified in the United Kingdom (Society, 1995) where, in the 1980s, academics across the UK noted higher drop-out rates from universities and lowering academic performances among university students. This idea remained speculative until the Engineering Council published a report in 2000 confirming the academics' suspicions (Hawkes and Savage, 2000). Further research solidified the idea that students' mathematical standards were dropping and furthermore, the *Mathematics Problem* was identified in other countries such as Ireland (O'Donoghue, 1999), Australia (Matthews Kelly et al., 2012) and across Europe (Alpers, 2008).

One key aspect of the *Mathematics Problem* is shallow content knowledge, which can lead students to struggle with learning mathematics in university - where the mathematics is generally more difficult than in secondary school and often requires more abstract thinking. This "abstraction shock" (Hefendehl-Hebeker, Ableitinger and Hermann, 2010) can cause significant strife for students, even those considered to be mathematically strong in secondary school (Di Martino and Gregorio, 2019).

Aside from lacking mathematical fortitude, students report facing other issues - namely those under the theme of "teaching style". There is a distinct disconnect between the way teaching is carried out at second-level and at third-level (Brandell, Hemmi and Thunberg, 2008). Moreover, students usually receive more guidance at second-level and may struggle to become autonomous learners (Wingate,

2007). There is also evidence that teachers at third-level lack knowledge of good pedagogical practice (Murtonen and Vilppu, 2020) which may lead to poor teaching strategies (Knight, 2002). This can manifest in teachers covering material too quickly or not properly assessing their students' prior knowledge. Moreover, teachers often do not emphasise the relevance of the material they are teaching, leading to low student motivation (Taleyarkhan, Lucietto and Azevedo, 2021). In recent years, students have also had to contend with the impact of the COVID-19 pandemic on education. In particular, students who were at the end of their second-level education (so students who graduated from second-level in 2020 and 2021) during the pandemic were impacted negatively in several countries, including Ireland (Thorn and Vincent-Lancrin, 2022).

The issues students face when they enter university from secondary school have been described in the literature by the secondary-tertiary transition (STT), which includes not only the cognitive and didactical issues mentioned above but also those that are socio-cultural in nature (Gueudet, 2008), i.e., those which derive from the difference in culture at university and secondary school. Naturally, the STT has been studied in the context of students in their first year of university, however in this paper, we investigate if these issues are present in students beyond the first year of university. Furthermore, we report on how these issues impact the students' perception of their mathematics modules.

The research question addressed in this paper is as follows: *What are the factors affecting undergraduate engineering students': (i) confidence in, (ii) perception of difficulty of, and (iii) stress levels relating to, their mathematics modules in first year of university and beyond?*

2. Methodology

2.1. Sample

The sample for the study in this paper consisted of $n = 100$ undergraduate engineering students enrolled in first, second and third year (of a four-year degree) at an Irish university. The students range in age from 19 to 22 years old and are spread across eight different courses (all variants of engineering courses). Students complete either four or five (depending on their specific course) Engineering Mathematics modules within the first three years of their undergraduate degrees. We note that the Engineering Mathematics modules completed by the students of engineering degrees in this study are recognised as containing core mathematics topics for undergraduate engineers worldwide (SEFI mathematics working group, 2002).

We give some detail regarding the topics covered in each of the Engineering Mathematics modules taken by the students. We believe this will add some context to the discussion later.

- Engineering Mathematics 1 (EM1): Differential calculus, Series, Vector algebra
- Engineering Mathematics 2 (EM2): Integral calculus, Ordinary differential equations, Functions of several variables and partial differentiation, Matrices
- Engineering Mathematics 3 (EM3): Laplace and inverse Laplace transforms, Fourier series, Linear algebra
- Engineering Mathematics 4 (EM4): Probability and Statistics
- Engineering Mathematics 5 (EM5): Vector calculus, Partial differential equations, Numerical methods.

In Table 1, we provide relevant biographical information pertaining to the students in our sample. To interpret rows 4 and 5 of Table 1, we provide a short account of the Irish education system. Students take six years of second-level education in Ireland with fourth year, called transition year, often being

optional. At the end of second-level, students take the Leaving Certificate examinations, in which they sit examinations in a minimum of six subjects. Mathematics is taken by almost all of the students. Students receive grades in each subject with H1 being the highest attainable grade. Students' grades are converted into points (with 625 being the maximum achievable) and these points are used as entry determinants to third-level courses in Ireland. For the subject of mathematics, there are five strands that students cover throughout their second-level mathematics studies: Statistics and Probability, Geometry and Trigonometry, Number, Algebra and Functions.

Table 1. Biographical information regarding students in the sample for this study.

Year	First Year	Second Year	Third Year
Responses (Total number of students enrolled)	49 (200)	35 (323)	15 (130)
Male/Female/Non-Binary	30/19/0	23/13/0	10/4/1
Mean Leaving Certificate Points (max. 625)	577	543	589
Median grade in Mathematics in Leaving Certificate	H2	H2	H2

A limitation of the study that we identify immediately is that there is a relatively low response rate, particularly among the third years. This is something we aim to improve upon in subsequent studies on this topic.

In 2021 (when the third years would have completed the Leaving Certificate), a score of 589 points renders the third years in the top 6.4% of students nationally in the Leaving Certificate results that year (Central Applications Office, 2025a). In 2022 (when the second years would have completed the Leaving Certificate), a score of 543 points had the second years in the top 16.8% of students nationally in the Leaving Certificate results that year (Central Applications Office, 2025b). In 2023 (when the first years would have completed the Leaving Certificate), a score of 577 points put the first years in the top 8.7% of students nationally in the Leaving Certificate results that year (Central Applications Office, 2025c). Moreover, in 2021, 12.9% of students nationally received either a "H1" or "H2" (the highest and second highest results) in their mathematics examination in the Leaving Certificate and in 2022 and 2023, 13.7% of students and 9.8% of students respectively did likewise (CareersPortal Leaving Cert Results Grades Explorer, 2025). From these results, we can conclude that the students in this survey can be considered mathematically and academically strong students, at least from the perspective of the grade achieved in the end of second-level examinations in Ireland.

2.2. Data Collection and Analysis

The data for this study was collected through responses to a survey consisting of thirty questions[1]. Biographical, Likert and open-ended style questions were present in the survey leading to quantitative and qualitative results. Having been granted ethical approval, two of the authors, who both work in the Mathematics Support Centre in the university where this study took place, informed the students about the survey during one of their Engineering Mathematics lectures (with prior permission from the lecturers). The students received a link to the surveys (Microsoft Forms) via email around the midpoint of the second semester of the 2023/2024 academic year (approximately mid-February 2024). The surveys remained available for the students to complete for a period of approximately one month. After segregating the data into quantitative and qualitative data files, the

authors analysed the quantitative data using *R* and the qualitative data using inductive thematic analysis (Braun and Clarke, 2006). Due to the short nature of this paper, we only consider the responses to two of the open-ended style questions, the results of which are discussed in section 3.2.

3. Results

3.1. Quantitative Results

The students reported their level of agreement, on a scale from 1 (strongly disagree) to 5 (strongly agree), with the statements:

1. During my first year I was confident with mathematics.
2. I am confident with the mathematics I am studying now[2].
3. When I first started in university, I found maths difficult.
4. The maths I'm studying now is easy.
5. When I first started studying mathematics in university, it caused me significant stress.
6. My stress levels decreased after the first year.

We provide a master table of the results in Table 2.

Table 2: Master table showing the number and percentage of students who gave each type of response to each of the six statements.

Statement	Strongly Disagree Number (%)	Disagree Number (%)	Neutral Number (%)	Agree Number (%)	Strongly Agree Number (%)
1	1st Yr: 5 (10.2)	1st Yr: 12 (24.5)	1st Yr: 18 (36.7)	1st Yr: 10 (20.4)	1st Yr: 4 (8.2)
	2nd Yr: 6 (16.7)	2nd Yr: 14 (38.8)	2nd Yr: 9 (25.0)	2nd Yr: 6 (16.7)	2nd Yr: 1 (2.8)
	3rd Yr: 1 (6.7)	3rd Yr: 5 (33.3)	3rd Yr: 1 (6.7)	3rd Yr: 5 (33.3)	3rd Yr: 3 (20.0)
2	1st Yr: 6 (12.2)	1st Yr: 21 (42.9)	1st Yr: 12 (24.5)	1st Yr: 10 (20.4)	1st Yr: 0 (0.0)
	2nd Yr: 2 (5.6)	2nd Yr: 7 (19.4)	2nd Yr: 15 (41.7)	2nd Yr: 8 (22.2)	2nd Yr: 4 (11.1)
	3rd Yr: 3 (20.0)	3rd Yr: 5 (33.3)	3rd Yr: 3 (20.0)	3rd Yr: 3 (20.0)	3rd Yr: 1 (6.7)
3	1st Yr: 6 (12.2)	1st Yr: 13 (26.5)	1st Yr: 13 (26.5)	1st Yr: 13 (26.5)	1st Yr: 4 (8.2)
	2nd Yr: 2 (5.6)	2nd Yr: 3 (8.3)	2nd Yr: 10 (7.8)	2nd Yr: 12 (33.3)	2nd Yr: 9 (25.0)
	3rd Yr: 1 (6.7)	3rd Yr: 4 (26.7)	3rd Yr: 3 (20.0)	3rd Yr: 4 (26.7)	3rd Yr: 3 (20.0)
4	1st Yr: 18 (36.7)	1st Yr: 22 (44.9)	1st Yr: 8 (16.3)	1st Yr: 1 (2.1)	1st Yr: 0 (0.0)
	2nd Yr: 2 (5.6)	2nd Yr: 8 (22.2)	2nd Yr: 18 (50.0)	2nd Yr: 5 (13.9)	2nd Yr: 3 (8.3)
	3rd Yr: 7 (46.7)	3rd Yr: 5 (33.3)	3rd Yr: 2 (13.3)	3rd Yr: 1 (6.7)	3rd Yr: 0 (0.0)
5	1st Yr: 11 (22.4)	1st Yr: 17 (34.7)	1st Yr: 12 (24.5)	1st Yr: 4 (8.2)	1st Yr: 5 (10.2)
	2nd Yr: 1 (2.8)	2nd Yr: 10 (27.8)	2nd Yr: 5 (13.9)	2nd Yr: 12 (33.3)	2nd Yr: 8 (22.2)
	3rd Yr: 2 (13.3)	3rd Yr: 3 (20.0)	3rd Yr: 3 (20.0)	3rd Yr: 5 (33.4)	3rd Yr: 2 (13.3)
6	1st Yr: N/A	1st Yr: N/A	1st Yr: N/A	1st Yr: N/A	1st Yr: N/A
	2nd Yr: 7 (19.4)	2nd Yr: 8 (22.2)	2nd Yr: 8 (22.2)	2nd Yr: 9 (25.0)	2nd Yr: 4 (11.1)
	3rd Yr: 4 (26.7)	3rd Yr: 6 (40.0)	3rd Yr: 3 (20.0)	3rd Yr: 1 (6.7)	3rd Yr: 1 (6.7)

We now assign a numerical value to each response for the six statements above: “Strongly Disagree” was assigned 1, “Disagree” was assigned 2, “Neutral” was assigned 3, “Agree” was assigned 4 and “Strongly Agree” was assigned 5. By assigning each response a numerical value, we can provide the median and interquartile range response for each statement, for each year group. We provide this in Table 3 below.

Table 3: Median and Interquartile Ranges response for each statement for each year group.

Statement	Median (IQR) First Years	Median (IQR) Second Years	Median (IQR) Third Years
1	3(2)	2(1)	4(2)
2	2(1)	3(1.25)	2(1.5)
3	3(2)	4(1.25)	3(2)
4	4(1)	3(1)	4(1)
5	2(1)	4(2)	3(2)
6	N/A	3(2)	2(1.5)

A sign test showed that there was a statistically significant increase in the perceived difficulty of the mathematics module that the first year group were studying at the beginning of first year to the mathematics module they were studying at the time (in their first year) they completed the survey ($p < .001$). For the second year group, a Wilcoxon signed rank test showed that there was a statistically significant decrease in the perceived difficulty of the module from first year to the students’ point in time of their studies when they completed the survey ($Z = -2.520$, $p < .05$). For the third year group, a Wilcoxon signed rank test showed that there was a statistically significant increase in the perceived difficulty of the module from first year to the students’ point in time of their studies when they completed the survey ($Z = -2.801$, $p < .01$).

A sign test showed that there was a statistically significant decrease in the confidence level of the mathematics that the first year students were studying at the beginning of their first year to the mathematics they are studying now ($p < .01$). A sign test, and a Wilcoxon signed rank test showed that there was no statistically significant change in confidence in mathematics reported by the second or third years between the start of university and the time they completed the survey ($p=0.064$; $Z=-1.874$ $p=0.061$ respectively).

3.2. Qualitative Results

In order to address the research question, we only focused on the responses to two of the open-ended questions from the survey:

- Question A: For the module you selected as the most difficult in Question 22[3], was/were there any factor(s) that you feel significantly contributed to the level of difficulty and/or the level of stress that you experienced?
- Question B: Is there anything else you found challenging about studying mathematics in university?

We provide the results of our analysis of the responses to Question A in Table 4 and the analysis of the responses to Question B in Table 5.

Table 4. Major themes identified in responses to Question A.

As stated previously, EM1 refers to Engineering Mathematics 1, EM2 refers to Engineering Mathematics 2, etc. For example, in the first row 0/100/NA/NA/NA shows that of the 38.7% of the first-year students who mentioned something about 'problem with lecturer', 0% mentioned EM1, 100% mentioned EM2 and as these students are in first year, it is not possible for them to mention EM3 – EM5 so these are marked as NA.

Major Theme (% of students from sample who mentioned something under this theme)	Subtheme	Year groups reporting subtheme (% of each year group)	Percentage of students reporting each subthemes who mention each module: EM1/EM2/EM3/EM4/EM5* as the most difficult NA: Not Applicable
Teaching Style (67.0)	Problems with Lecturer (Lecturer speaking too quietly, hard to communicate with, etc.)	Yr 1 (38.7)	0/100/NA/NA/NA
		Yr 2 (32.3)	10/30/60/0/NA
		Yr 3: (15.4)	0/0/50/0/50
	General Mention of Teaching Style	Yr 1 (16.0)	0/100/NA/NA/NA
		Yr 3 (38.5)	0/40/60/0/0
	Poor/Confusing explanations given of material	Yr 1 (25.0)	0/100/NA/NA/NA
		Yr 2 (12.9)	0/25/75/0/NA
		Yr 3 (23.1)	0/0/67/0/33
Content (42.0)	Novelty of the material covered	Yr 1 (11.4)	0/100/NA/NA/NA
		Yr 2 (12.9)	25/0/75/0/NA
		Yr 3 (23.1)	0/67/33/0/0
	Quantity of material covered	Yr 1 (11.4)	20/80/NA/NA/NA
		Yr 2 (12.9)	25/25/50/0/NA
	Difficulty of the material covered	Yr 1 (18.2)	0/100/NA/NA/NA
	Lack of Application/Usefulness shown for material	Yr 2 (25.8)	0/25/75/0/NA

The two major themes identified in responses to Question A were teaching style and content, with subthemes under the former being reported by over two-thirds of respondents. The main factors reported by first-year students were the lecturer and poor/confusing explanations. The main factors reported by second-year students were the lecturer and a lack of application of the material. The main factors reported by the third-year students were poor/confusing explanations of the material and the novelty of the material. Aside from the novelty of the material, all three year groups report a

factor relating to the teaching style employed by the lecturer as being the two main factors that contributed to the difficulty they experienced in the mathematics modules that they found most difficult.

Aside from this, we can see that the first-year students find EM2 more difficult than EM1, with all but one of the subthemes mentioned by the first-year students being unanimously made in relation to EM2. The quantity of the material was the only subtheme that was not unanimous with an 80-20 split in favour of EM2 being more difficult. The second-years report EM3 as being the most difficult with it garnering at least 50% of the vote for every subtheme. The third-years are more split among EM2, EM3 and EM5, with EM3 being mentioned in all subthemes and novelty being the only subtheme for which EM3 was not stated as the most difficult.

The main theme identified in the responses for Question B (see Table 5) for all three years was the change in teaching style when compared to secondary school. The first- and second-years also mention the abstraction of the material as something they found challenging, while the second-years identify the lack of examination material (such as previous examination papers and solutions) as an additional issue.

Table 5. Major themes identified in responses to Question B.

Theme	Year groups reporting subtheme (% of each year group)	Further Description
Teaching style change compared to secondary school	Yr 1 (41.7)	● A lot of learning is now self-directed ● Lecturer doesn't communicate as effectively ● Hard to ask questions in class since it is a bigger group
	Yr 2 (33.3)	● Learning is now self-directed ● Poor/Confusing teaching style ● Every lecturer has a different teaching style ● Lecture notes provided are poor
	Yr 3: (66.7)	● Poor teaching style ● Lack of an explanation ● Poor learning material
Lack of Exam Preparation Material	Yr 2 (20.0)	● Not being provided exam solutions ● Not being provided previous examinations ● Material in lectures being different to the exam
Abstraction of Material	Yr 1 (33.3)	● Material is more abstract than in secondary school ● Hard to get a full understanding of the reasoning behind the methods taught in the lectures
	Yr 2 (13.3)	● Mathematics is very abstract and doesn't correlate with other modules

4. Discussion

Throughout the rest of this paper, we provide quotes from the students. The quotes are in the form $XNTT$, where $X = \{A, B\}$ and indicates which question the quote corresponds to, $N = \{1,2,3\}$ and indicates the year the student who made the quote is in and TT is a unique two-digit ID number, randomly given to each student.

From Table 4 it is clear that teaching style is the main factor identified by the students in this study which causes them difficulty in their mathematics modules. The first-years report problems with the lecturer and poor/confusing explanations as the main two subfactors within "teaching style" which cause them difficulty. A114: *The professor explains relatively simple topics in a very difficult way*. The second-years report problems with the lecturer and the lack of application for the material covered as the main subfactors for why they find their Engineering Mathematics modules difficult: A212: *There was a lot of content I will never use again as an engineer.* In contrast with the first-years, the second-years report these factors as applying primarily to EM3, while the first-years report their issues applying solely to EM2. Despite referring to different modules, the sentiment expressed in the quotes was similar - the lecturer did not explain things well - A232: *I found the lecturer very hard to follow*. The third-years report that the general teaching style and the poor explanation of the material were the main subfactors which caused them to find their mathematics modules difficult. A310: *Teaching may have been better with more explanation*. This student put EM3 down as the subject they found most difficult, but we can see that EM2, EM3 and EM5 all appeared as modules that the students in third-year found at least somewhat difficult with regards to the teaching style. Through these results, we can see that there is preliminary evidence that the students in this study report factors which fall into the didactical aspect of the STT (Gueudet, 2008). Also, we can see evidence that educators in the university in which this study takes place are perhaps not employing effective pedagogical techniques, which is consistent with the literature (Knight, 2002; Murtonen and Vilppu, 2020).

We can further analyse the data by looking at the responses to Question B: *Is there anything else you found challenging about studying maths in university?,* given in Table 5. Here, all students report that the change in teaching style between secondary school and university is a major challenge that they faced while studying mathematics at university. This indicates that it is the change in structure, coupled with the lecturers' style of teaching that is contributing to the students' plight in their mathematics module. In the responses to Question B, we see responses like: B227: *Everything is self-directed learning, unlike secondary school when we were given homework every night that had to be done that night* and B301: *Generally, the change of structure from secondary school to college.* We note that universities in Ireland are often referred to as 'colleges'. It appears that the students are reporting that the change in environment is also something they have had to contend with, which is an issue commonly cited in the socio-cultural aspect of the STT (Gueudet, 2008). While this is true, we cannot be certain whether these students' quotes, who are in second- and third-year, are referring to their experiences in their current year, or to their experiences in previous years. One other insight from the responses to Question B is that the first-years report that the material is often "abstract". This echoes the so-called "abstraction shock" (Hefendehl-Hebeker, Ableitinger and Hermann, 2010), and it indicates that perhaps the first-year students in the university in this study also report issues which fall into the epistemological/cognitive aspect of the STT (Gueudet, 2008). This contrasts the second years, who report that the material is "abstract", but not as avidly as the first-years. The third-years do not report this at all, indicating that perhaps the third-years have become more accustomed to the type of mathematics students are expected to deal with at university. Moreover, students also report struggling when the lecturer does not provide all the details of a solution, which could indicate a weak understanding of the material. This shows that the

Mathematics Problem (Lawson, 2003) may also be a factor for the students here, A118: *the lecturer skipping over smaller details assuming everyone should know them but no one ever does from the people I talk to.* In the discussion so far, we have shown preliminary evidence that the students of all years in this study report facing issues that are contained within the three aspects of the STT as compiled by Gueudet (2008). However, now we will compare these findings to the students' confidence in mathematics, their perception of the difficulty of mathematics and their stress levels due to mathematics.

Firstly, from Table 2, we observe that a plurality of the first-year students responded "Neutral" to Statement 1: *During my first year I was confident with mathematics.* This contrasts with the majority of the first-years who disagreed in some way with Statement 2: *I am confident with the mathematics I am studying now*. The apparent drop in confidence is observed in the statistically significant drop in median confidence level from 3(2) to 2(1), reported by the first-years. There is evidence of a drop in confidence reported among the third-years also with the median confidence dropping from 4(2) to 2(1.5), although this was not statistically significant. Perhaps a more convincing argument of this drop in confidence is the majority (53.3%) of third-years that agreed to any degree with Statement 1 compared to the majority (53.3%) of third-years that disagreed with Statement 2. The second-years report an increase in confidence between their first-year and the time of the survey with their reported median going from 2(1) to 3(1.25), although this is not statistically significant. There is still evidence of an increase in confidence however with a majority (55.5%) disagreeing to any degree with Statement 1, but only 25% disagreeing to any degree with Statement 2.

From Table 2, we observe that the first- and third-years are relatively split on whether they found mathematics difficult in first year. 34.7% of the first years and 46.7% of the third years agreed in some way with Statement 3: *When I first started in university, I found maths difficult*, while 38.7% of the first years and 33.4% of the third years disagreed in some way. This indecisiveness is not observed regarding their perceived difficulty with mathematics now. 81.6% of the first-years and 80% of the third years disagreed in some way with Statement 4: *The maths I'm studying now is easy.* This dramatic increase in perceived difficulty of their mathematics modules between first-year and the time of the survey is reflected by the statistically significant increases in medians from 3(2) to 4(1) for both year groups. These observations are reversed with the second years with 58.3% agreeing in some way with Statement 3 and only 13.9% disagreeing in some way. This contrasts with the 50% of students who reported a neutral response, and the relatively even split between the number of students agreeing and disagreeing observed in response to Statement 4 (22.2% versus 27.8%). The reason for this is perhaps due to the modules that each year group is enrolled in at the time of completing the survey. The first- and third-years are enrolled in EM2 and EM5, both of which are represented in Table 4 as modules that the students find difficult. The decrease in confidence reported by the first- and third-years also mirror this increase in perceived difficulty although we do not have a direct causation. The second-years are currently enrolled in EM4, which was not reported by a single student as being the most difficult. Moreover, the increase in confidence reported by the second-years mirrors the decrease in perceived difficulty, although similar to the first- and third-years, there is no direct causation. Regardless of the cause, the increase in the perceived difficulty and the drop in confidence are common among students who experience symptoms of the *Mathematics Problem* (Lawson, 2003) and as elucidated by Di Martino and Gregorio (2019), even academically stronger students (such as the students in this study) are not immune from experiencing a loss in confidence when they experience an increase in perceived difficulty.

The responses to Statement 5: *When I first started studying mathematics in university, it caused me significant stress* and statement 6: *My stress levels decreased after first year*, generally continuing the current narrative painted by the previous responses. Firstly, the first-years do not seem

particularly stressed with 57.1% of them disagreeing to some degree that mathematics caused them stress at the beginning of first-year. This is in contrast with 55.5% and 46.7% of the second- and third-years respectively, who agree to some degree with Statements 5 and 6. A potential explanation here could be that the first-years are comparing their experience with EM1 to that of their current module EM2, which they find significantly more difficult. They may be viewing this through rose-tinted glasses and do not recall any stress caused by EM1. The second- and third-years both report an increase in stress due to mathematics after first-year with 41.6% and 66.7% of second- and third-years disagreeing somewhat with Statement 6. These results corroborate with the results in Table 4 as EM3 and EM5 (both non-first year modules) are the most common modules listed as most difficult.

5. Conclusion

In this paper, we have shown preliminary results that three years of undergraduate engineering students in an Irish university experience issues when studying mathematics modules which are reflective of issues experienced in the STT (Gueudet, 2008). More specifically, the students reported didactical issues as a major factor affecting their perceived difficulty of mathematics in university – A129: *I feel your lecture can either make you or break you*. There is evidence that these didactical issues are not year dependent, and this is a novel result in the research on STT, where the focus has been solely on students in their first-year of university. There is evidence that the students also experience issues that can be classed under the epistemological/cognitive and socio-cultural aspects of the STT, however these are not as clear since students could be referring to previous experiences, rather than their current ones. These issues are associated with a relative drop in confidence, an increase in perceived difficulty of mathematics and an increase in stress levels among the second- and third-years. The only aberrations to these associations can be explained by looking at the modules the students are currently doing and the results in Table 4.

There are three main limitations to this study. The first was already mentioned: the sample size, particularly for the third years, is low. The second limitation is that we do not have a direct causation between the factors the students identified and their confidence, stress and perceived difficulty levels – we only have association. The third limitation is that we have not accounted for external factors such as the COVID-19 pandemic, which could have impacted the third-years (who would have completed their last year of secondary school and their first-year of university during 2020 and 2021) more than the first- and second-years. Another interesting question that is unanswered in this paper is whether the first-years in this study will report the same or similar factors as the second- and third-years did as they continue through university. To address these concerns, the authors are currently conducting a longitudinal study in which we investigate if the factors reported by the students in this study are constant or if other factors such as the COVID-19 pandemic have had a larger impact.

6. References

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[1] Only the responses from some questions were considered in the analysis carried out in this paper.

[2] "Now" refers to the time at which the survey took place. For the first years, "now" is the middle of their second semester of university, for the second years, "now" is the middle of their fourth semester of university and for third years, "now" is the middle of their sixth semester of university.

[3] In the question prior to Question A, the students were asked to rank the Engineering Mathematics modules they had completed in order of difficulty. Some modules were omitted in the first and second years' surveys as they had not yet completed these modules.