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How Do Engineering Attitudes of Learners Who Are Displaced Change after Exposure to a Relevant and Localized Engineering Curriculum?

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How do engineering attitudes of learners who are displaced change after exposure to a relevant and localized engineering curriculum?

Introduction

Engineering education, and STEM education more broadly, has long been recognized as a critical field for addressing global challenges and promoting economic development [1]. However, access to relevant engineering education remains a major barrier for many learners, particularly those who have been displaced due to conflict, poverty, or other factors. The Localized Engineering in Displacement (LED) program was created to address this issue by delivering engineering learning opportunities to learners in displaced settings. Multiple iterations of the LED program have been implemented in Kenya, Jordan, Zimbabwe, Senegal, and the U.S.

Previous research has shown that students in displaced settings often face unique challenges, such as limited access to resources and support, and may have limited prior exposure to engineering concepts. These factors can impact students' motivation and self-efficacy and may limit their ability to successfully engage with engineering coursework. While assessing the impact of a STEM program on students, it is important to understand their individual skills and motivations as they have various perspectives and backgrounds. By including asset language, which covers both the strengths and gaps in their abilities, we can gain a better understanding of the students and tailor the program to their unique needs [2]. This approach can lead to more effective and engaging learning experiences for the students. In the LED program, we use RPK (Recognition of Prior Knowledge) assessments which allow us to see the students' knowledge and thought process in terms of engineering before and after the course. With the help of the RPK assessment, the curriculum considers students' prior knowledge, skills, and attitudes towards STEM to contextualize the material. In this paper, we specifically investigate understanding the impact of the LED program on students' attitudes towards engineering to improve the effectiveness of this program and similar initiatives.

Purpose

This research aims to examine self-beliefs of students who are displaced to determine their self-determination, motivation, and self-efficacy, and growth over the course of our LED program using a pre- and post-class assessment design. By analyzing students' responses before and after participation in the program, we hope to gain insight on the potential relationship between students' attitudes and their likelihood of success in the field of engineering.

Self-efficacy is a critical factor to consider when exploring an individual's performance. The Social Cognitive Career Theory asserts that an individual's belief in their ability to successfully complete a task has a direct impact on their actual performance which we can analyze through our assessments [3]. In other words, an individual who has high self-efficacy - or confidence in their abilities - is more likely to pursue and succeed in tasks related to their career goals, and this has been shown for female engineering students [4], underrepresented racial/ethnic minority college students [5], and to be particularly important for engineers who are marginalized [6]. With this, we understand the importance of emphasizing engineering to bring out those who have not had the chance to express their engineering skills. We take this into account in our research because we use self-efficacy assessments in our courses to see students' attitudes toward engineering and analyze the engineering course progress.

As the assessment team (authors), we develop new learning models and assessment methods specifically tailored to the LED program. These methods allow us to measure the effectiveness of the program in promoting engineering understanding and attitudes among students. By analyzing the results of our assessments, we provide instructors and researchers with valuable insights into how the LED program can be improved and how it compares to other engineering education programs. We are particularly interested in examining the influence of the LED program on students' self-determination, motivation, and self-efficacy, as these factors have shown to be critical for success in engineering learning [7]. We use a pre- and post-assessment approach, administering tests to students before and after participating in the LED curriculum. By closely analyzing students' perceived confidence, aspirations, and attitudes towards technology, we hope to develop more inclusive and effective engineering curricula that can engage and support our learners [8].

Attitudinal factors are important to measure because they can influence an individual's behavior and success in a particular field or subject. In the case of STEM education, an individual's attitude towards STEM subjects can impact their interest, motivation, and persistence in pursuing STEM careers. Therefore, measuring the growth of these attitudinal factors in a tailored class can provide valuable insights into the effectiveness of the course and the potential impact on students' future pursuits.

In this study, we focus on the attitudinal factors of self-efficacy, self-determination, and intrinsic motivation towards science and technology. By measuring the growth of these attitudinal factors in our tailored course, we can determine the course's effectiveness in promoting positive attitudes towards science and technology fields [8]. This information can be valuable for educators and policymakers in developing effective science and technology education programs that promote diversity, equity, and inclusion in science and technology fields.

Methods

In this research, we employ a quantitative approach to analyze the pre- and post-course assessments. The selection and implementation of instruments were carefully considered to ensure that meaningful data is collected for analysis. We chose to use quantitative measures to capture complex constructs such as attitudes, self-determination, motivation, and self-efficacy. While these constructs are inherently subjective, quantitative measures allow for quantification and statistical analysis, providing valuable insights into the impact of the LED program on students' attitudes and understanding.

The instruments used in this study were selected based on established scales and measures from the literature on engineering education and related fields. The scales chosen were deemed appropriate for capturing the targeted constructs of interest in our research questions. The instruments were administered to students as pre- and post-course assessments from Kakuma and Dadaab refugee camp in Kenya, capturing their attitudes and understanding before and after participating in the LED program.

After data collection, visual analysis and descriptive statistics were employed as important tools for data analysis. Visualizations such as graphs and charts were created to display the data and identify patterns and trends. Descriptive statistics, including means, were used to summarize the central tendency, and spread of the pre- and post-assessments overall, as well as specific sub-scales. Inferential statistics were also used to determine the likelihood of true differences between pre- and post-course performance. Furthermore, the reliability of the instruments was assessed using Cronbach's alpha values for the entire assessment as well as specific sub-groups.

Instruments

We measure students' attitudes for three key constructs that are related to students' engineering learning process and growth. We incorporated questions from three different well-established scales that measure the constructs of intrinsic motivation, self-efficacy, and self-determination. For self-efficacy, we adapted the well-established Motivated Strategies for Learning Questionnaire (MSLQ) and validated in engineering and STEM disciplines [9]. However, much of the reliability and validity testing was done in high-income secondary and tertiary formal learning contexts. We utilize the expectancy component of the MSLQ and its eight items that, together, form a self-efficacy scale for performance in each discipline.

For self-determination, we build on self-determination theory [10], recognizing that the perception that one belongs and can be agentic in their space is related to the retention of minority groups in engineering and STEM. We utilize four items that relate to students' perceived effort and agency in their learning process. Intrinsic motivation is another important construct that we measure in our study. We recognize that students who are intrinsically motivated have a genuine interest and enjoyment in the learning process and are more likely to persist in challenging tasks [10]. Our questions around intrinsic motivation focus on students' enjoyment of learning engineering concepts, as well as their aspirations to pursue a career in engineering. Finally, we utilize questions around broader motivation and aspirations.

Internal Consistency Validation

Cronbach's alpha was used to measure the internal consistency of the questions. Cronbach's alpha is a measure of internal consistency, which assesses how well a set of items or questions on a survey or test measure a single underlying construct or trait. The value ranges from 0 to 1, with higher values indicating greater internal consistency. We calculated Cronbach's alpha for the assessment but also found the Cronbach alpha values for the subgroups: self-efficacy, self-determination, and intrinsic motivation.

Table I
Cronbach's Alpha Coefficients for Internal Consistency

Cronbach Alpha	**Full Data**	**Self-Efficacy**	**Self-Determination**	**Intrinsic Motivation**	**Not Grouped**
Pre-Assessment	0.783	0.771	0.715	0.424	0.732
Post-	0.813	0.774	0.566	0.732	0.596

Assessment					

The raw alpha and standardized alpha values were calculated separately for each assessment. The results of Cronbach's alpha analysis indicate that the internal consistency of the questions used to measure the scales together are relatively consistent across both assessments. The raw alpha and standardized alpha values for the pre-assessment and post-assessment are relatively close to each other, suggesting that the questions on the pre-assessment and post-assessment are measuring the same underlying construct in a consistent manner. There seemed to be a negative correlation within questions 2, 5, and 14.

We analyze the data with the specified questions inverted. The values of Cronbach's alpha for the pre-assessment and post-assessment are .783 and .812 respectively. These values are significantly higher than the previous values provided, indicating that the internal consistency of the questions on the pre- and post-assessment tests is now even stronger. A value of .7 or above is generally considered to be a good indicator of internal consistency [11]. This suggests that by inverting the negatively correlated questions, the questions are measuring the same underlying construct of self-determination, self-efficacy, and self-motivation in an even more consistent manner. This is a good indication that the assessment is measuring the construct it is meant to be measuring. Through this analysis, we gain a deeper understanding of the changes in the students' attitudes towards the engineering content by closely examining the responses to each question and its subgroups.

According to the data provided, in the pre-assessment, the Cronbach's alpha value for self-efficacy was .771, indicating a good level of internal consistency among the items in the scale. This suggests that the questions in the self-efficacy scale are measuring a consistent construct. It appears that the students' self-determination towards learning science and technology has increased individually within each question after participating in the program. However, it is worth noting that Cronbach's alpha value for the self-determination scale in the post-assessment is below the commonly accepted threshold of .7. Therefore, it is important to take this into consideration when interpreting the results of this scale. Looking at intrinsic motivation, we see the alpha value below threshold in the pre assessment but spike up at the post assessment depicting how students' responses have begun to look similar. The not grouped questions were not found to have a strong relationship with any of the other questions in the assessment, and therefore were not included in the self-efficacy, self-determination, or intrinsic motivation scales. In the pre-assessment, Cronbach's alpha value for this group of questions was .732 indicating a good level of internal consistency among the items in the scale. However, in the post-assessment, the Cronbach's alpha value decreased to .596, which is below the commonly accepted threshold.

Results

In order to ensure that the questions on the pre- and post-assessment tests were consistently measuring the key sub-constructs of self-determination, self-efficacy, and self-motivation in a reliable and valid manner, the researchers grouped the questions using the "Science Motivation Questionnaire II: Validation With Science Majors and Nonscience Majors" [12]. The grouping of questions using an established and validated questionnaire helps to increase the internal consistency of the questions on the assessment.

Self-Efficacy

Table II
Self-Efficacy Questionnaire Items

Question #	**Questions**
3	I can help my friends who have difficulties in understanding science and technology matters
4	I have skills required for being successful in science and technology lesson
6	I can accomplish science and technology projects successfully
7	I believe that I will have high scores in science and technology examinations
9	I am sure that I can accomplish all skills given in science and technology lesson successfully
15	I can cope with difficulties by myself in science and technology lesson whenever I encounter

We grouped questions 3, 4, 6, 7, 9 and 15 (shown in Table III) as measuring self-efficacy. These questions are asking about the students' confidence in their abilities and their belief in their ability to successfully complete science and technology tasks and projects. Each of these questions tap into different facets of confidence, including students' confidence in working through challenges and assessment performance.

Table III
Descriptive Statistics for Self-Efficacy Questionnaire Scores

Self Efficacy Description
Pre Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q3	20.000	**4.150**	1.040	0.233	1.000	**−1.888**
Q4	20.000	**4.100**	1.119	0.250	1.250	**−0.966**
Q6	20.000	**4.250**	1.020	0.228	1.000	**−1.221**
Q7	20.000	**4.400**	0.754	0.169	1.000	**−1.670**
Q9	20.000	**3.950**	1.146	0.256	1.000	**−1.292**
Q15	20.000	**3.350**	1.226	0.274	2.000	**0.005**

This table shows the full description of the data.

Self Efficacy Description
Post Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q3	15.000	**4.267**	1.387	0.358	1.000	**−2.033**
Q4	15.000	**4.000**	1.000	0.258	0.500	**−1.978**
Q6	15.000	**4.200**	1.207	0.312	1.000	**−1.844**
Q7	15.000	**4.067**	0.799	0.206	0.500	**−1.098**
Q9	15.000	**4.000**	1.309	0.338	1.000	**−1.322**
Q15	15.000	**3.133**	1.457	0.376	2.000	**−0.424**

This table shows the full description of the data.

The mean values for all questions in the self-efficacy scale in the pre-assessment are moderately high, indicating that students have a moderate level of self-efficacy towards their ability to learn and succeed in science and technology before participating in the program. Question 3 has a mean of 4.15 in the pre-assessment, indicating that students moderately agree that they can help their friends who have difficulties in understanding science and technology matters before participating in the program. Question 4 has a mean of 4.1 in the pre-assessment, indicating that students moderately agree that they have the skills required for being successful in science and technology lessons before participating in the program. Question 6 has a mean of 4.250 in the pre-assessment, indicating that students moderately agree that they can accomplish science and technology projects successfully before participating in the program. Question 7 has a mean of 4.400 in the pre-assessment, indicating that students strongly agree that they believe that they will have high scores in science and technology examinations before participating in the program. Question 9 has a mean of 3.950 in the pre-assessment, indicating that students moderately disagree that they are sure that they can accomplish all skills given in science and technology lessons successfully before participating in the program.

Specifically looking into the mean curve (Fig. 1), the dotted black line in both graphs, we can see that in the pre-assessment the curve was higher at students agreeing (4) than the curve for the post assessment. We can further look at individual question curves and their dynamics to see why that would have occurred. As we look at the graph for Question 6, we see that students began to have scattered feelings about successfully completing a science and technology project after taking the class. It is clear that there are several bumps in this question in the post assessments as students might have struggled with the projects in this class. We also look at Question 15. Initially, most students did not agree that they could cope with difficulties in science and technology topics. Our students come in with little confidence and a strong feeling that they would not be able to cope with challenges, but they had a variety of experiences and levels of growth in confidence. As this would be their first time taking such a unique class it can be difficult to adapt and learn the material. With this, it has not been enough time for them to feel fully confident that they can complete difficult engineering content.

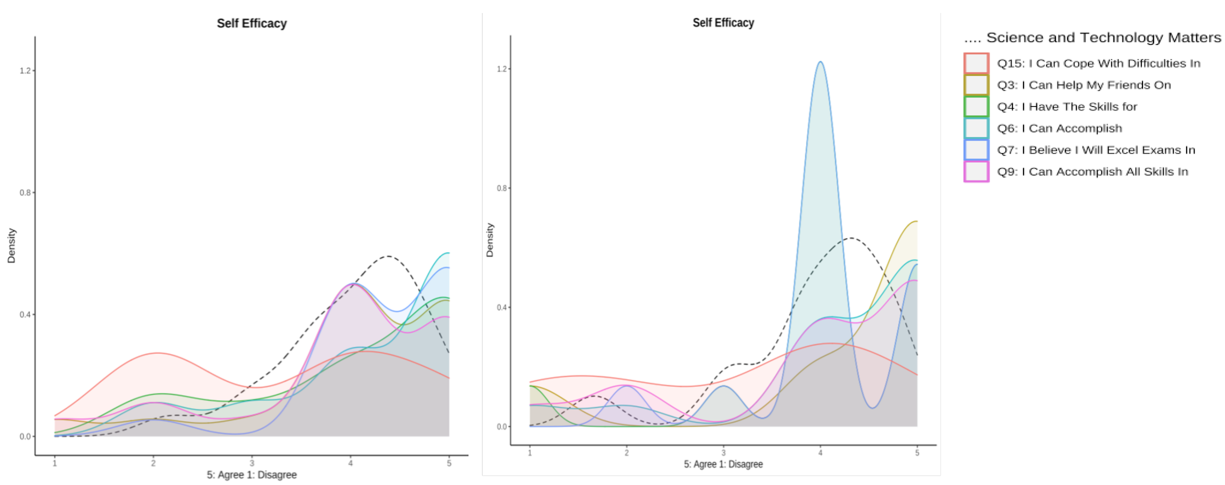

Fig 1. Density Plot of Self-Efficacy Scores

Self-Determination

Table IV
Self Determination Questionnaire Items

Question #	**Questions**
10	I can develop myself on science and technology matters
11	I spend a lot of time learning science and technology

12	I use strategies to learn science and technology well
13	I put a lot of effort into learning science and technology problems

We grouped questions 10, 11, 12, and 13 as measuring self-determination. These questions are asking about the students' ability to regulate their own learning, their effort and time spent on learning science and technology, and their use of strategies to learn science and technology well.

Comparing the pre and post assessment values for self-determination, we can see that in general, the mean values for the questions in the self-determination scale have remained the same in the post-assessment. However, the Cronbach alpha did significantly drop, depicting that the question responses were not very close together in the post assessment.

Table V
Descriptive Statistics for Self Determination Questionnaire Scores

Self Determination Description
Pre Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q10	20.000	**4.211**	1.055	0.236	1.000	**−1.968**
Q11	20.000	**3.700**	1.081	0.242	1.250	**−0.439**
Q12	20.000	**4.211**	0.766	0.171	1.000	**−1.199**
Q13	20.000	**3.950**	1.146	0.256	1.250	**−0.826**

This table shows the full description of the data.

Self Determination Description
Post Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q10	15.000	**4.333**	0.617	0.159	1.000	**−0.312**
Q11	15.000	**3.600**	1.183	0.306	1.000	**−0.872**
Q12	15.000	**3.733**	1.223	0.316	1.000	**−1.035**
Q13	15.000	**4.400**	0.737	0.190	1.000	**−0.841**

This table shows the full description of the data.

In the pre-course assessment, Question 10 had a mean of 4.211 indicating that students moderately agree that they can apply science and technology matters before participating in the LED program. In the post-course assessment, the mean for Question 10 increased to 4.33 indicating that students more strongly believe they can develop themselves on science and technology matters after participating in the program. Question 10 remained relatively the same as the means were still similar. Question 11 in pre-assessment had a mean of 3.7 indicating that students moderately disagree that they spend a lot of time learning science and technology before participating in the program. In the post-assessment, the mean for Question 11 decreased to 3.6 indicating that students moderately disagree that they spend a lot of time learning science and technology after participating in the program. It is noteworthy that the students spent more time learning course material as they progressed in the course, which is surprising given the assumption that students would spend more time learning during the course. Question 12 in pre-assessment had a mean of 4.211 indicating that students moderately agree that they use strategies to learn science and technology well before participating in the program. In the post-assessment, the mean for question 12 decreased to 3.733 indicating that students moderately disagree that they use strategies to learn science and technology well after participating in the program. Question 13 in pre-assessment had a mean of 3.950 indicating that students moderately disagree that they put a lot of effort into learning science and technology problems before participating in the program. In the post-assessment, the mean for Question 13 increased to 4.4 indicating that students moderately agree that they put a lot of effort into learning science and technology problems after participating in the program.

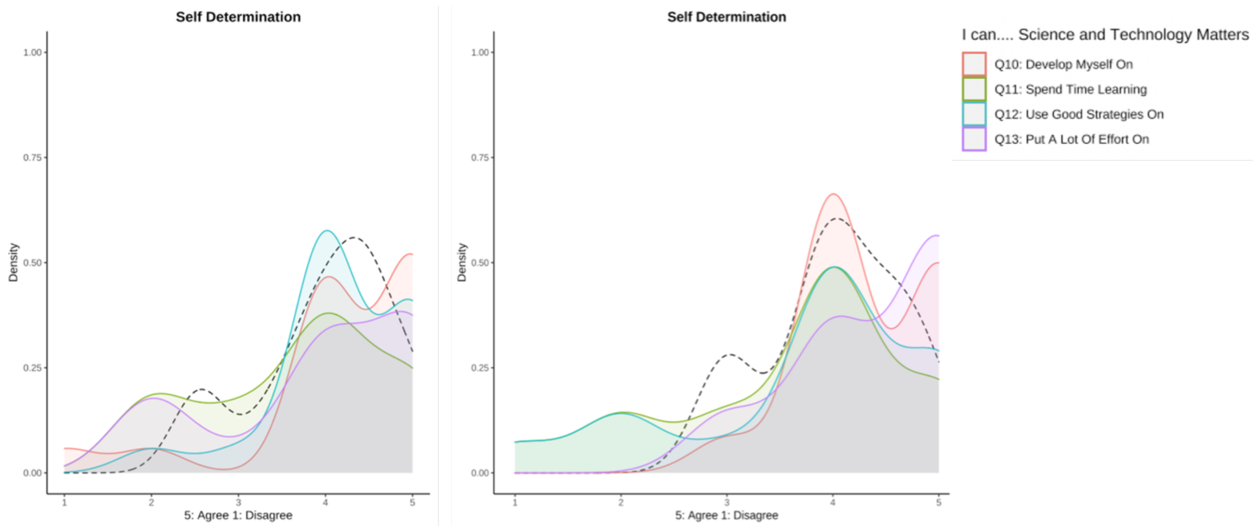

Figure 2. Density Plot of Self Determination Scores

Looking at the mean scale and item curves for the pre and post assessment responses, we analyze the mean curve for the construct of self-determination (the black dotted line) that students tended to be a lot more undecided (3) than previously overall. The median of Question 13 responses was shifted more to the right, largely driven by the responses of disagreement decreasing. We determined that after taking the class, the students were putting more effort into science and technology problems as they learned how to solve and understand better in class. From the post assessment graph, we can see Question 10 spiked at Agree (4) as students began to realize that they can understand and learn more about science and technology. Students could have been less confident about the material as engineering can be considered a “hard” subject and have them feel less confident about the content. After being exposed to the material, they have the ability to understand what it’s like to be in an engineering class and the content that is taught in them. This brings out more confidence and after taking more classes on this or learning to create more projects, they could potentially feel strong about being able to understand the material.

Another important scale item to look at in the graph is Question 12. This is important because prior to taking the class, the students did not seem to worry about knowing strategies to learn well in science and technology. After taking the class, as seen in the post assessment graph, there seems to be more students who strongly disagree that they do not use strategies to learn well. Engineering is a broad field that can be difficult to learn at first. Learning a new subject can be difficult and finding the ways to understand the material can be even harder. After taking the class, students have learned that they do not have strategies to do well, but after taking more engineering courses, students will begin to adapt to the subject and learn the way they understand engineering concepts best. When trying out a new class, hobby, or learning a new concept, it can take some time for an individual to determine the most effective strategies for their learning style. We can anticipate that the students will begin feeling more confident once they take more engineering classes and have adapted to the class environment.

Intrinsic Motivation

Table VI
Intrinsic Motivation Questionnaire Items

Intrinsic Motivation Question #	**Questions**
16	Learning science and technology is interesting
17	I am curious about discoveries in science and technology
18	The science I learn is relevant in my life
19	Learning science makes my life more meaningful

We have grouped questions 16, 17, 18, and 19 as measuring intrinsic motivation. These questions are asking about the students' interest and motivation in learning science and technology.

Table VII
Descriptive Statistics for Intrinsic Motivation Questionnaire Scores

Intrinsic Motivation Description
Pre Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q16	20.000	**4.000**	1.124	0.251	1.000	**−0.989**
Q17	20.000	**3.750**	1.293	0.289	2.250	**−0.782**
Q18	20.000	**4.200**	1.005	0.225	1.000	**−1.824**
Q19	20.000	**4.600**	0.503	0.112	1.000	**−0.442**

This table shows the full description of the data.

Intrinsic Motivation Description
Post Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q16	15.000	**4.667**	0.816	0.211	0.000	**−2.894**
Q17	15.000	**3.933**	1.223	0.316	1.500	**−1.208**
Q18	15.000	**4.400**	0.828	0.214	1.000	**−1.811**
Q19	15.000	**4.600**	0.828	0.214	0.500	**−2.543**

This table shows the full description of the data.

Based on the mean values and skewness of the intrinsic motivation questions in the pre- and post-assessment, we can see that there is an overall increase in intrinsic motivation from pre- to post-assessment. The mean values for all questions in the intrinsic motivation scale in the post-assessment are higher than in the pre-assessment. This suggests that students have a higher level of intrinsic motivation towards science and technology after participating in the program.

Question 16 has a mean of 4.0 in the pre-assessment and 4.667 in the post-assessment, indicating that students find learning science and technology more interesting after participating in the program. With this, we can see that after being exposed to the engineering content, the students learn that they enjoy this topic. Question 17 has a mean of 3.75 in the pre-assessment and 3.933 in the post-assessment, indicating that students have a stronger curiosity about science and technology after participating in the program. Looking into this question, after students were introduced to the content, they wanted to learn more about it as well. Question 18 has a mean of 4.2 in the pre-assessment and 4.4 in the post-assessment, indicating that students find the science they learn more relevant to their lives after participating in the program showing that the students believe it is important to learn such content. Question 19 has a mean of 4.6 in both pre- and post-assessment, indicating that students already find learning science meaningful before and after participating in the program.

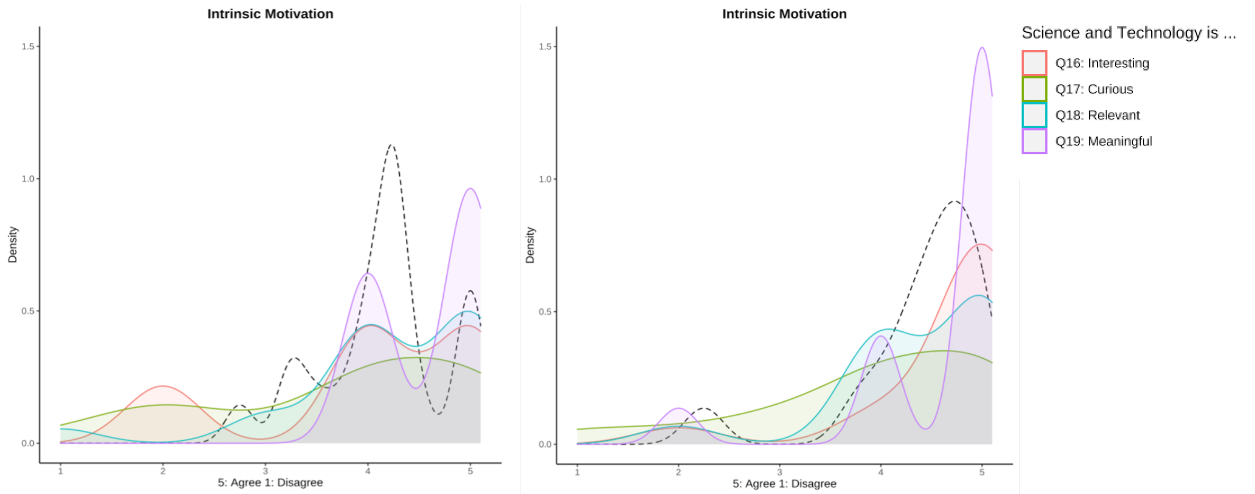

Figure 3. Density Plot of Intrinsic Motivation Scores

Looking into the mean graphs for both pre and post assessment, we see that the black dotted line, the mean curve, has shifted to the right depicting an increase in overall Intrinsic Motivation. The mean curve peak at Agree (4) in the pre-assessment shifted to the right more towards strongly agree (5) in the post assessment. We can also see that this was largely driven by a shift in responses in Questions 16 and 17 as they agreed to the questions more than they did in the pre-assessment. The results of this analysis suggest that the students developed a greater appreciation for the importance and relevance of engineering after being exposed to the content through the LED program.

Overall, the data suggests that participating in the LED program had a positive impact on students' intrinsic motivation towards science and technology. The results provide evidence that the program is effective in increasing students' interest and motivation in science and technology.

Not Grouped

Table VIII
Not Grouped Questionnaire Items

Question #	Questions
1	Problems in class relevant to science and technology lesson disconcert me
2	I cannot learn matters of science and technology no matter how I spend effort
5	If it was optional, I would not want to learn science and technology lesson whenever I encounter
14	I cannot do my science and technology homework by myself

Questions 1, 2, 5 and 14 may be more difficult to group as they appear to measure a different construct than the self-efficacy, self-determination, and intrinsic motivation. They have currently been grouped as non-grouped questions because they were negatively correlated with the other scales. They may be measuring students' attitude towards science and technology in general and may not fit neatly into one of the previously established groups. One way to group them is as a negative attitude towards science and technology. By grouping these questions in this way, we can get a more specific understanding of how students perceive their attitude towards science and technology in general.

Upon further analysis, it appears that the means for questions 1, 2, 5, and 14 decreased in the post-assessment, which may indicate that the students were less likely to agree with these statements after participating in the program. For example, Question 1 has to do with problems in class relevant to science and technology lessons disconcerting the student, Question 2 is related to the student feeling they can't learn matters or science and technology no matter how much effort they put in, Question 5 is about not wanting to learn science and technology lessons if it was optional, and Question 14 is about not being able to make science and technology homework by oneself. These questions are indicating that students may have more confidence in their abilities and more motivation to learn science and technology after participating in the program.

Table IX
Descriptive Statistics for Not Grouped Questionnaire Scores

Not Grouped Description
Pre Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q1	20.000	**2.600**	1.392	0.311	3.000	**0.161**
Q2	20.000	**2.100**	1.165	0.261	1.250	**1.118**
Q5	20.000	**2.050**	1.234	0.276	1.000	**1.202**
Q14	20.000	**2.400**	1.188	0.266	1.250	**0.578**

This table shows the full description of the data.

Not Grouped Description
Post Assessment Analysis

described_variables	n	mean	sd	se_mean	IQR	skewness
Q1	15.000	**2.333**	1.345	0.347	2.500	**0.715**
Q2	15.000	**1.600**	0.737	0.190	1.000	**0.841**
Q5	15.000	**1.267**	0.458	0.118	0.500	**1.176**
Q14	15.000	**2.533**	1.407	0.363	2.000	**0.631**

This table shows the full description of the data.

Question 1 has a mean of 2.6 in the pre-assessment, indicating that students do not agree that the science and technology content disconcerts them. After taking the class, the mean changed to 2.33 which was still similar to the pre-assessment. Question 2 has a mean of 2.1 in the pre-assessment, indicating that students believe they can learn science and technology when putting in the effort. Question 5 has a mean of 2.05 indicating that they do want to learn science and technology. Lastly, Question 14 has a mean of 2.4 indicating that they believe they would be able to do their engineering homework by themselves. All these questions were negatively asked which is why all the responses were reversed. Looking at the post assessment means, all of the means dropped except for Question 14. This is good because it shows that the students have confidence they can learn and complete engineering content. Question 14 went higher, but some students take time understanding material and doing homework alone at home can be difficult when there is no help from a professor.

Discussion and Conclusion

In addition to the importance of these attitudinal factors, our study provides a unique context in which to measure their growth. The tailored LED curriculum provided a focused and supportive environment for our students to engage with engineering content and develop their attitudes towards the field. Our study thus makes an important contribution to the literature on engineering education, as it offers insights into the effectiveness of this approach for promoting positive attitudes towards engineering among a specific population of learners.

Moving forward, our study sets the stage for future inferential work to determine the statistical significance of the observed changes in students' attitudes towards engineering. Such work could involve hypothesis testing to determine whether the changes we observed are statistically significant or examining the impact of individual factors on attitude growth. Overall, our study offers valuable insights into the factors that influence attitudes towards engineering and provides a foundation for further research in this important area.

In conclusion, the pre and post assessment results of the LED program indicate that the program has seen a growth of the students' self-efficacy, self-determination, and intrinsic motivation towards learning science and technology. The Cronbach's alpha values for the self-efficacy and intrinsic motivation scale in the pre-assessment indicate good internal consistency among the items in the scale, suggesting that the questions are measuring a consistent construct. In the post-assessment, Cronbach's alpha values suggests that after participating in the program, the students have a higher level of self-efficacy and intrinsic motivation towards learning science and technology. The self-determination scale in the pre-assessment had a Cronbach's alpha value of .715, indicating a good level of internal consistency among the items in the scale. However, in the post-assessment, the Cronbach's alpha value decreased to .566, which is below the commonly accepted threshold of .7. This suggests that the students' self-determination towards learning science and technology may have decreased slightly after participating in the program. However, the mean values for all questions in the self-determination scale increased in the post-assessment, indicating that overall, the students may have become more self-determined towards learning science and technology after participating in the program.

The results of this study have implications for research and practice. It highlights the importance of designing and implementing localized engineering programs to increase students' self-efficacy, self-determination, and intrinsic motivation towards learning science and technology. These findings also have implications for curriculum design and assessment in displaced communities, as they provide insight into the attitudes and perceptions of students towards science and technology and can inform the development of more effective and engaging curricula. Further research would be needed to examine the link between attitude and performance outcomes.

References

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