

Does Self Efficacy in Mathematical Ability Have an Effect on The Number of Women Pursuing STEM Careers?

Summary

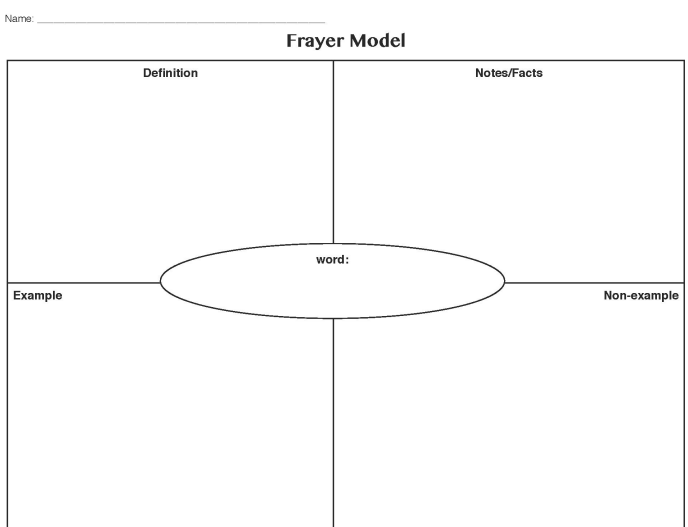
- As three girls who are very interested in pursuing careers in the STEM field, we were very disappointed to learn that out of the 120,000 people working in STEM jobs in Ireland, only ¼ of them are Women.
- This is thought to be due to the lack of confidence among girls in their own abilities in areas such as maths and also the stereotypes of boys being better suited to careers in the STEM field.
- To investigate this, we gathered 4 maths classes in our year (transition year) and used 2 for the experiment and 2 as a control. This ensured our results were accurate and allowed us to clearly observe the effects of our experiment and see if there were any changes to the attitude of the class towards STEM jobs after completing the experiment.
- We gave each class three separate tests, a survey to see the levels of interest in STEM jobs in the groups, a self-efficacy test to measure the amount of confidence the girls had in their own mathematical abilities and a standardised maths test to measure objective numeracy and view the average level of maths ability in the class.
- After six weeks of lessons involving techniques like the KWL method, Thunk question and the Frayer Model to aid the teaching of problem solving, we tested both classes again and found a significant increase in confidence, interest in STEM careers and general maths ability in the classes we taught.

Introduction

- Although the number of people working in STEM fields (science, technology, engineering and maths) has been greatly increasing in recent years, most of these jobs are occupied by Men (Almost ¾).
- We are all very interested in STEM jobs and found it disappointing that so little females would share this interest. We wondered why although there is a big current initiative for gender equality, this is not being reflected in STEM.
- We wanted to investigate to see if we could find a way to encourage girls to give a future career in STEM greater consideration and generate more interest among girls surrounding the idea of a STEM job.
- We were interested to see if we could encourage girls to become more outspoken and vocal in class and to improve their confidence.
- We wondered would they find themselves being more drawn to the idea of a STEM job.

Method

- We gathered four Transition Year higher level maths classes (100 students in total), two to conduct the experiment on (46 students) and two to use as a control to ensure accurate results (45 students).
- We gave each class three separate tests, a STEM career survey to measure interest in STEM, which we created using inspiration from an article written by Barnum Monegain for Healthcare IT News called 'Survey reveals growing lack of interest in STEM careers among young people, especially girls.' We included questions such as 'Have you ever considered a career in STEM?' and 'Do you think STEM jobs are hard to understand?'
- We gave the girls a self-efficacy test to measure self confidence in mathematical ability, which was developed using the 'Mathematics Self-Efficacy and Anxiety questionnaire' written by Diana K May at Oakland University.
- Finally a standardised maths test to measure objective numeracy, the questions included in this test were taken from the 'Less Stress More Success Junior Cert Maths' books written by Brendan Guildae and Louise Boylan.
- We then completed problem solving sessions with two of the classes over six weeks, throughout these classes we used 'think' questions to improve confidence and participation in class, the KWL method to simplify the questions and give students more confidence when attempting them and we used the Frayer model to help the students to understand any difficult words in the question to also make it easier for them to attempt.
- At the end of the six weeks we asked all four classes to complete the three same previous tests from the start of the experiment. We then compared these results with the results from the first set of tests to see if this had resulted in a greater amount of girls interested in pursuing STEM careers.
- These results were also used to compare the control class to the classes we had taught.



Results and Statistical Analysis

Have you ever considered a career in STEM?

Classes Tested	Control Classes
Before: Yes - 43% No - 57% After: Yes - 67% No - 33% 24% increase P<0.05 therefore we can reject the null hypothesis.	Before: Yes - 45% No - 55% After: Yes 45% No - 55% 0% increase

How interested would you be in a career in STEM?



Above are some comparisons of results from the STEM career survey showing the increase in interest in a STEM career among girls before and after conducting our problem solving classes over the 6 week period. Below are some of the changes in results of the self-efficacy test and the average grades in the maths test over the 6 weeks.

Self-efficacy Test Results - Classes Tested

Question	Never	Seldom	Sometimes	Often	Always
I feel confident enough to ask questions in my maths class.	Before - 1 After - 0	Before - 6 After - 5	Before - 18 After - 13	Before - 10 After - 17	Before - 11 After - 11
I am afraid to give an incorrect answer in my maths class	Before - 7 After - 7	Before - 10 After - 16	Before - 7 After - 12	Before - 15 After - 9	Before - 7 After - 2

Standardised Maths Test Result

Classes Tested	Control Classes
Before: 61.62% After: 77.48% 15.86% increase	Before: 59.54% After: 63.9% 4.36% increase

It is shown above that over the course of the six weeks there has been an improvement in both self-efficacy and confidence among girls in class and also the average grade in the class. The average grade of the classes tested increased by 15.86% from the original testing to after the six weeks of problem solving sessions. A t-test was conducted on the results of the standardised maths test and we got a result of 4.91×10^{-8} . This proved that there was a significant difference between the before and after average grade of the classes being tested, showing that our problem solving sessions had a positive effect on mathematical ability and that the increase in their mathematical ability hadn't occurred due to any other reason apart from our problem-solving sessions. We also conducted the McNemar test on the results of the STEM survey questionnaire. We conducted this test as the data was categorical and paired data. In doing this test we wanted to be able to reject the null hypothesis which states that there is no significant difference between the two sets of data and that the data is not associative. As our p value was less than 0.05 we were able to reject the null hypothesis and say that the change in results was in fact down to our problem solving sessions and not due to random chance..

Conclusion

- The aim of our project was to find a way to increase confidence and self-efficacy in mathematical ability among girls and see if this would therefore increase interest in pursuing a career in STEM in girls.
- We decided the best way to do this was to give them six weeks of problem-solving sessions. A standardised maths test, a self-efficacy in maths test and a STEM interest survey were given to the girls before and after the the six weeks of problem-solving sessions.
- The teaching methods used during the problem-solving sessions were Thunk Questions, the Frayer Model and KWL. These boosted the girls' participation during the class.
- After comparing the before and after results we found that doing our problem solving sessions with the girls had helped to drastically increase not only their ability in problem-solving, but their self-efficacy in their mathematical ability and most importantly - their interest in pursuing a career in the STEM field.
- After conducting T-tests, using excel, for the standardised maths tests we got a result of 4.91×10^{-8} . This meant that there was a significant difference proving that our problem solving sessions had had an effect on their mathematical abilities.
- Using McNemar tests on the yes or no questions in the STEM career survey, we could reject the null hypothesis that the data was not associative and that the change in results was due to our classes and not random chance.
- The statistics above prove that our problem solving sessions had a positive effect on the girls' self-efficacy, mathematical ability and boosted interest in pursuing a STEM career.