

MIDDLE SCHOOL STUDENTS: SCIENCE OUTREACH, MATH ANXIETY, AND RESILIENCE

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Abstract

When students reach Middle School level academics, it is observed that their interest in STEM decreases. There are many theories that have been tested to discover why this shift occurs, however, it is thought that Math anxiety is the main contributor to this decline. Furthermore, there have been indications suggesting that Math anxiety is closely related to Resiliency. In this study, we are interested in looking at the relationship between Math anxiety and Resiliency in Middle School students. In doing so, a science outreach day was designed to both increase Middle school student's interest and attitudes interest towards STEM. The students who attended self-selected into this science day and were surveyed on current levels of Math Anxiety and Resilience. This experiment allowed students to learn and explore science in their own creative way from a physics-based approach; and is an example of baseline student assessment that teachers can conduct in a classroom. Nevertheless, the same size was too small to confirm significance and it is encouraged that more research is conducted on the matter.

Introduction

Middle Schoolers and Science Interest

There is a noticeable decline in middle school students' interest in science. This plays a role in their development of what they wish to pursue as a long-term career. Recent analysis has identified that STEM supports two thirds of jobs in the US (Advancing Technology for Humanity, 2020). The Bureau of Labor Statistics (BLS) (2005, 2010) projects that "the U.S. will have a difficult time filling careers in Science, Technology, Engineering and Mathematics (STEM) that will be vacant due to retirements and a decrease in student interest in STEM" (Wyss, Heulskamp and Siebert, 2012). This emphasizes the importance of increasing students' attitudes towards STEM so that we may maintain and continue improving our global economy. There has been ongoing research to learn more about factors influencing this decline in STEM interest within middle school students; and identify ways to improve this trend. Many of these studies have identified that students' development in STEM is affected by psychological factors such as confidence levels, self-efficacy beliefs, motivation, math anxiety, and resiliency.

Resilience

Resilience is the inert ability of an individual to equalize negative stress factors by normalizing the outcome. STEM research is exacting and draining, requiring high "resilience" levels to avoid burnout. Students who aspire to a career in STEM, will Experience a better quality of life and benefit from their educational milieu by attaining higher grades and achieving their graduation goals. Perseverance exemplifies a young mind's determination, even while facing possible failure, to press on regardless of the outcome. This is a quality which will enhance future endeavors. It is crucial that students recognize that asking for help is not a sign of weakness but recognition of the support needed to continue forward in pursuing future goals.



Math Anxiety

Math is the foundation for ensuring future possibilities for progress in science. Without the basis of learning logical thinking and reasoning, students will lack the requisite knowledge to be successful to pursue their individual goals in STEM. Math is not exclusive to science; other professions such as trades, teachers, and financial advisors also require an adequate level of proficiency. With the ever-increasing advances in technology, never has math been required to such a degree. Math skills are essential not only for advanced problem solving, but also to maneuver the daily intricacies of family and community. As for possibilities of future employment, a STEM degree is highly sought after by employers in the applicable fields.

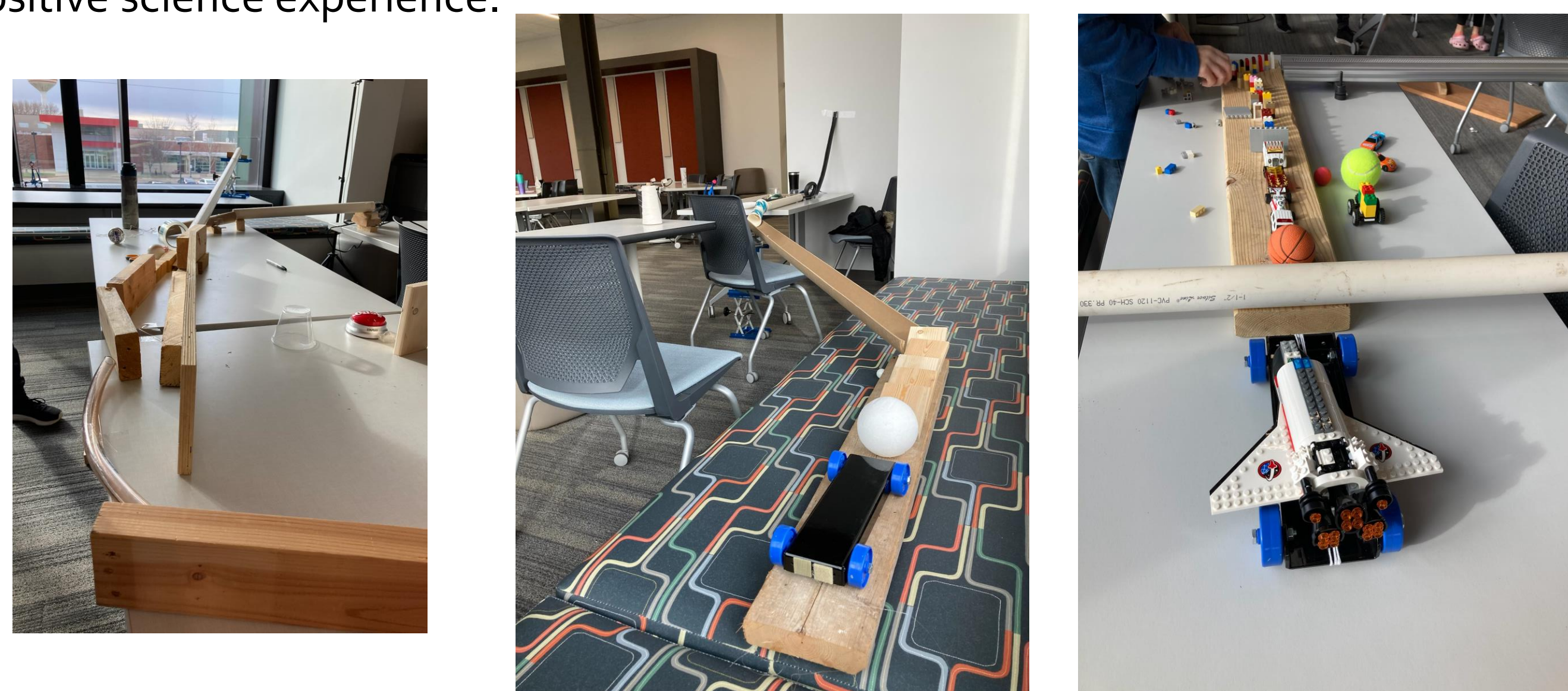


Middle School Science Day

To answer these questions, we developed and implemented an experience to engage middle school aged students in science and survey them on their interest
On the day of the event:

- Students checked-in and signed informed consent
- As a group, students were introduced to the concept of a Rube Goldberg Machine and given directions for their project
- Students were broken into groups and started working on their projects, supplies were provided
- Students planned, built, and tested their machines
- After about an hour and a half, students took a break from their projects to view several science demonstrations
- Following the demonstrations, students filled out the modified CURE and Math Anxiety Scale surveys
- Once everyone finished their surveys, students presented their projects

Each group came up with fun and unique ideas for their Rube Goldberg Machines, and they were able to spend time with a hands-on science activity in the process! It seemed all students enjoyed their time at Middle School Science Day and thus a positive science experience.



Data Surveys

Due to the number of students that participated in our event, statistical significance could not be found in our specific data. There did not appear to be a connection between math anxiety and science interest based on our population of students, however, that could be due to the small sample size or underlying variables that were not accounted for. It is also likely there is a self-selection bias present in our data, as our event would be more appealing to students who already enjoy science.

Even though our data was not statistically significant, it is still usefully in laying a foundation for future research. Specifically, our method and data collection demonstrates that the CURE survey and Math Anxiety Scale can be used on middle school students. These scales were modified to contain vocabulary appropriate to middle school students but were otherwise used in their original form and worked well. When checked for reliability, both scales scored very well, with values of 0.88 and 0.94.

Results

Participant surveys were obtained and input on an excel sheet for further analysis of large group trends by Dr. Jenifer Schon, Director of Northwestern's Institutional Research.

A correlation analysis was conducted to examine the relationship between resilience and math anxiety. The data used to conduct the analysis is represented in the table below. The results were significant, $r(18) = -.39$, $p = .10$. Given the small sample size, the p value approaching significance suggests support for hypothesis one.

Correlations

		CURE	RESILIENCY	MATHANXIETY
CURE	Pearson Correlation	1	.170	-.306
	Sig. (2-tailed)		.597	.359
	N	12	12	11
RESILIENCY	Pearson Correlation	.170	1	-.389
	Sig. (2-tailed)	.597		.100
	N	12	21	19
MATHANXIETY	Pearson Correlation	-.306	-.389	1
	Sig. (2-tailed)	.359	.100	
	N	11	19	19

Discussion

- Successful implementation and running of Middle School Science Day event and data collection
- We know this method works and modified versions of the CURE survey and Math Anxiety Scale can be used with middle school students
- We have developed a data driven approach to Middle School Science outreach
- Laying the groundwork for future research in this area



Sources & Acknowledgements

Carey, E., Hill, F., Devine, A., & Szűcs, D. (2017, January 1). *The modified abbreviated math anxiety scale: A valid and reliable instrument for use with children*. Frontiers. Retrieved January 9, 2022, from <https://www.frontiersin.org/articles/10.3389/fpsyg.2017.00011/full>
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