Abstract

A female’s college and career goals may ultimately be restricted by declining interest and achievement in mathematics that originates during her pre-high school years. This researcher examined how a piloted pre-engineering program in one eighth grade middle school team impacted adolescent girls’ interest and achievement in mathematics. The results suggest that Project Lead The Way (PLTW) impacted both boys’ and girls’ interest and achievement in mathematics. In five of seven attitude scales, PLTW had a positive effect on gender that was not parallelized in the control group. When achievement was considered, differences in growth levels between the two groups were statistically significant in six of the 11 standards in the experimental group. As this educational research was undertaken to assist local decision makers in supporting or opposing a district adoption of PLTW for all middle school students, effectively communicating the results to the various stakeholders is an engaging, useful manner was paramount.

Study Purpose

Research Question

Does the pre-engineering program Project Lead The Way (PLTW) positively influence a middle school girl's interest and achievement in mathematics as assessed by Femmena-Sherman Mathematics Attitude Scales, Blue Ribbon Testing© scores in Mathematics, student and teacher focus groups and classroom observations? A secondary purpose was to assist local decision makers in supporting or opposing a district adoption of PLTW for all middle school students. Thus, effectively communicating the results to the various stakeholders in an engaging, useful manner was paramount.

Why is it so important that we increase the number of women in STEM, particularly engineering-related fields? As females bring different life experiences to the table by virtue of their gender, the field of engineering, as well as other male-dominated domains, suffers in the end from opportunities lost when women are not part of the innovation teams.

Methodology

Sample and Participant Selection

- 299 eighth graders in the school placed on 3 teams
- Teams were created randomly by guidance counselors the spring preceding the pilot school year
- 179 eighth graders in the study: control group (9) & experimental group (96) - 2 teams
- Average ability levels of the experimental group girls (and boys) were the same as on the other two teams (checked at beginning of study again)
- One class of seventh graders also participated, whose data was not included in the study

Treatment (Program)

- 3 marking periods of PLTW, continued 2 marking periods of art, 1 marking period of computers, and 1 marking period of family and consumer science on one 8th grade team (experimental group) over the course of a single school year
- Design and Modeling and The Science of Technology were the 2 PLTW Gateway To Technology modules delivered.
- Math curriculum was the same on both teams

Results

![Figure 1. Gender of experimental group students whose mean average interest in each standard of Blue Ribbon Testing was higher.](image1)

Data Collection

- Blue Ribbon Testing© scores in mathematics in fall and spring
- 7 of the 9 Femmena-Sherman Mathematics Attitude Scales administered in fall and spring
- student focus groups in spring
- classroom observations in spring
- teacher focus groups in spring

Theoretical Framework: Nature vs. Nurture

Biological theoretical perspectives suggest that math achievement is tied to the gender one is assigned at birth. Possible biological causes of discrepancy among boys and girls’ achievement (ability) in mathematics include: iron deficiency, spatial visualization, speed of math fact retrieval, and brain structure.

Social theoretical perspectives state otherwise. These propose that attitudes impact achievement, as confidence, expectations, and attributing success to ability rather than effort are factors that contribute to discrepancies in boys’ and girls’ math abilities and scores (Ai, 2002, Atweh, Forgasz, & Nehres, 2001, Stipek & Gurlinski, 1991). Possible causes of discrepancy among boys and girls’ attitudes towards mathematics include: math anxiety, lower levels of confidence; teachers’ attitudes, expectations, and treatment of students, including questioning patterns, stereotype threat; and presence of males.

A growth mindset can be encouraged through a female’s engagement in gender-neutral programs that include specific features (Dweck, 2006, 2008, Boyer, 2016). STEM programs which engage females may serve to foster both achievement in, and positive attitudes towards, mathematics.

Conclusions and Implications

Addressing middle school mathematics achievement, when there is no gap (as illustrated in national and local data), by nurturing positive attitudes towards it, may be the best way to prevent the attitude and achievement gap that clearly still exists at the high school level.

The empirical research outcomes of this and other action research must be communicated to the research community, as well as shared with educational leaders and stakeholders, in multiple formats, including engaging visual representations, so that decisions regarding program adoption, funding, and support may be justified.

School leaders, as change agents, have a moral responsibility to implement innovative programs that will address the inequities inherent in the mathematics education of females in the United States that persist into the 21st century.

Reference


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**Figure 1.** Gender of experimental group students whose mean average interest in each standard of Blue Ribbon Testing was higher.

**Figure 2.** Percentage of students improving or maintaining scores on six or more standards of Blue Ribbon Testing by group and gender.

**Figure 3.** Percentage of females indicating a like or love of mathematics at the end of the school year by group.

**Figure 4.** Frequency of words used by students to describe what math instruction was engaging, useful manner was paramount.

**Figure 5.** Percentage of questions posed in mathematics classes answered by females at the end of the school year, by group.