

Comparing math attitudes in secondary education depending on the use of Innovamat

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KEY FINDING: Students who use Innovamat show more positive math attitudes in some dimensions than those who use other educational resources, including greater intrinsic motivation towards math.

1. Research question

Socioemotional factors are critical in mathematics education. Constructs such as math anxiety or math motivation are strongly related to students' math achievement (Ashcraft & Krause, 2007; Suinn, Taylor & Edwards, 1988). In this study, we investigated whether students who use Innovamat in high-school show different math attitudes than students who use other educational resources.

2. Research Method

To do so, we asked 1948 students from 21 high schools to answer the "Mathematics Motivation Questionnaire" (MMQ), which is a reliable, validated 19-item self-report instrument based on a five-point Likert scale (0= never; 4= always) for the measurement of children's math attitudes (Fiorella et al., 2021). The MMQ encompasses five different constructs: (1) intrinsic value (IV), (2) self-regulation (SR), (3) self-efficacy (SE), (4) utility value (UV) and (5) test anxiety (TA). IV refers to the enjoyment experienced by performing a particular academic task (e.g., "I enjoy doing things in math"), SR refers to a metacognitive system that regulates students' learning strategies, SE refers to the expectancies students have in regard to math success, UV refers to the extent to which an academic task fits within a person's current or future goals (e.g., "Math is useful for my future"), and TA refers to the negative emotional reaction students experience when being evaluated in mathematics. The test also included six additional questions about how students' perceptions about math changed from one year to the next, and how important math history is for them.

Students were separated in two groups depending on whether they used Innovamat in their high-school. The sample included 11 high-schools who used Innovamat (treatment group) and 10 high-schools who used other resources to learn math (business-as-usual), which in this case were considered the control group.

3. Results

The results of multiple t-tests showed significantly higher results for the treatment group as compared to the control group in some of the constructs of interest, including “Intrinsic Value”, “Relative Perception of Math”, and “History of Math”. However, no significant differences were found for the other constructs (all $p > 0.05$). In particular, these constructs asked the following questions:

Intrinsic Value

(from the MNQ questionnaire)

- I enjoy learning math.
- I find learning math interesting.
- I like math that challenges me.

Relative Perception of Math

- I like mathematics more this year than the previous year.
- I think that the way mathematics are taught this year helps me better learn them.

History of Math

- I think that learning mathematics history is important.
- I find mathematics history interesting.

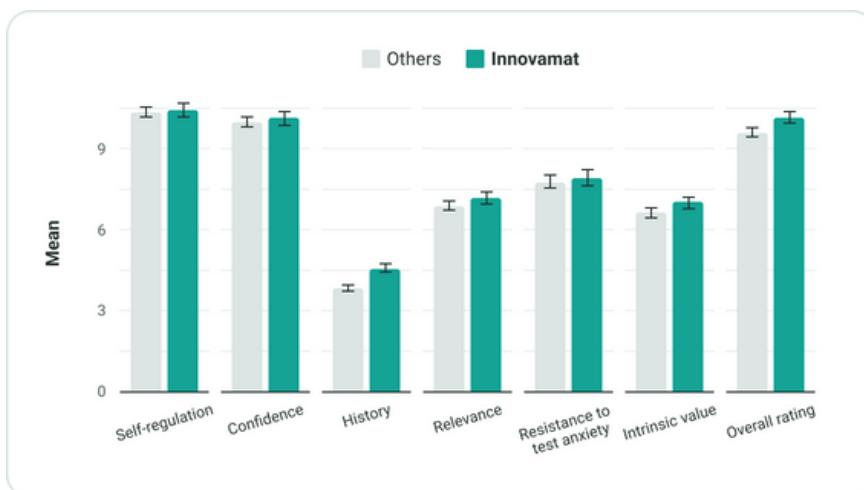


Figure 1. Difference between student’s mean responses depending on whether they use Innovamat or not.

Additionally, we investigated whether the results differed between students depending on their gender. We found a significant effect of gender, with girls responding significantly higher values for self-regulation, but lower values for confidence, resistance to test anxiety, and perceived intrinsic value in Math.

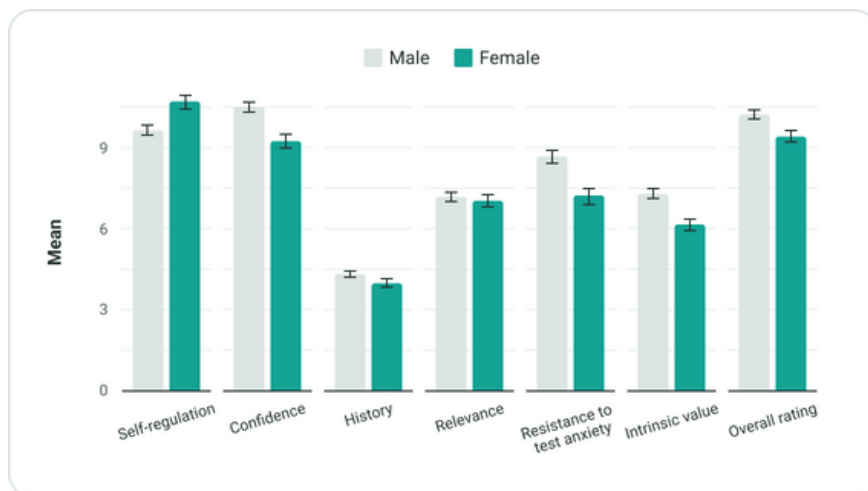


Figure 2. Differences in the results depending on the gender of the students.

4. Conclusion

Students who used Innovamat (treatment group) showed similar math attitudes than students who did not use Innovamat (control group) in some of the constructs of interest, and more positive attitudes in History of Math, Intrinsic Value, and Relative Perception of Math. Of these constructs, we highlight the finding on intrinsic value, given its relationship to several student outcomes, including student achievement (Chiu and Xihua, 2008, Steinmayr and Spinath, 2009) and students' career and course choices (Harackiewicz et al., 2002). Additionally, the questions related to intrinsic value were previously validated in other studies (Fiorella et al., 2021). Note that intrinsic value refers to the enjoyment experienced by performing a particular academic task (Fiorella et al., 2021), and thus the results suggest that the use of Innovamat may have a positive impact on students' intrinsic motivation to do math. However, it is also important to note that the design of the study does not allow us to draw conclusions about the causality of the effect. Despite that the findings are in line with the hypothesis that the use of Innovamat's resources could have positive influences on students' math attitudes, they do not prove that students' greater intrinsic motivation was caused by Innovamat per se. Thus, future research is needed with another design that allows us to draw these types of conclusions. For example, future studies could use a diff-in-diff design, in which students' math attitudes are collected at the beginning and the end of the school year to see relative change in their attitudes depending on the use of different educational resources.

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