# Can Schools Fix the Gender Gap in STEM? A Comparative Study in the Global South about Gender Participation in Maker Education 

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#### Abstract

Research established that most learners perceive STEM learning environments as settings that exclude diverse ways of thinking. We investigate factors behind this trend in two sites that recently implemented fully-equipped makerspaces, but have deeply different socioeconomic contexts. We identify factors associated with increased self-efficacy and attitudes toward STEM among male and female students.


## Introduction

Research in the past decades has established that STEM learning environments are not only largely maledominated but are also widely perceived as such (see, for example, Nasir \& Vakil, 2017). Building on Turkle and Papert's (1992) foundation of "epistemological pluralism," researchers have discussed principles of a maker, constructionist education that equally acknowledges the repertoires of different groups of learners (e.g., Buechley et al., 2008). This research tradition led to remarkable advances on diversity in STEM education. However, it focuses almost exclusively on contexts in the US and Europe. Driven by the question of applicability to contexts in the Global South, we investigate factors that may influence STEM learning in makerspaces in two contexts: one school in Hong Kong serving affluent families and two schools in an economically depressed area in Brazil. These schools underwent dramatic curriculum redesign, including extensive professional development on maker education. We present analyses of quantitative survey data from both sites to identify factors that affect the attitudes of girls and boys towards and self-efficacy in STEM.

## Data collection and analysis

Students answered an online survey (Table 1) containing open-ended, multiple-choice, and multiple-answer questions gathered from validated instruments to assess students' self-efficacy in science and engineering and their attitudes toward STEM (Siegel \& Ranney, 2003; Wang \& Berlin, 2010).

Table 1: Comparison of data collected in Brazil and Hong Kong


## Results

Data from each nationality were analyzed using linear regression models (Cohen, 1992) for each gender and response variable separately. Due to space considerations, we report the results in an abbreviated table (Table 2).

Full tables are available at bit.ly/russoetal-isls-2022. The analysis revealed that groups of students had different significant predictors for their attitude towards STEM and self-efficacy.

Table 2: Unstandardized regression and part correlation coefficients for linear regressions

|  | Class experiments |  | Parent expectations |  | Techniques |  | Grade |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\beta$ | Part corr. | $\beta$ | Part corr. | $\beta$ | Part corr. | $\beta$ | Part corr. |
| Hong Kong |  |  |  |  |  |  |  |  |
| Attitude towards STEM |  |  |  |  |  |  |  |  |
| Female | - | - | 1.20* | . 26 | .34* | . 27 | -5.51† | -. 21 |
| Male | - | - | - | - | - | - | - | - |
| Self-efficacy (engineering) |  |  |  |  |  |  |  |  |
| Female | - | - | - | - | .18** | . 42 | - | - |
| Male | - | - | - | - | .14† | . 35 | - | - |
| Self-efficacy (science) |  |  |  |  |  |  |  |  |
| Female | - | - | .54† | . 26 | - | - | $-3.30 \dagger$ | -2.9 |
| Male | $8.68 \dagger$ | . 48 | - | - | - | - | - | - |
| Brazil |  |  |  |  |  |  |  |  |
| Attitude towards STEM |  |  |  |  |  |  |  |  |
| Female | - | - | NA | NA | .24*** | . 32 | -6.86*** | -. 40 |
| Male | - | - | $N A$ | $N A$ | .19** | . 30 | -3.34† | -. 17 |
| Self-efficacy (engineering) |  |  |  |  |  |  |  |  |
| Female | - | - | NA | NA | .09* | . 23 | -.23* | -. 23 |
| Male | 3.72*** | . 35 | NA | NA | .15*** | . 43 | - | - |
| Note: $\dagger p \leq 0.1 . * p<0.05 .{ }^{* *} p<0.01 .{ }^{* * *} p<0.001$ |  |  |  |  |  |  |  |  |

## Discussion and conclusion

When analyzed as a whole, these results highlight a bigger issue regarding the role of schools in effective societal change across class and gender. Consider that the school in Hong Kong offers state-of-the-art makerspaces and laboratories, including female maker teachers, arguably the peak of hands-on K-12 technology education. Still, gender differences persist and differentially influence girls' and boys' self-perception (e.g., participating in class experiments is a statistically significant predictor for self-efficacy in science for boys in both countries, but not for girls). If this phenomenon can be observed even at those close-to-optimal school conditions, one may wonder what the limits are in terms of how much effect in systemic change schools can have. It is necessary to acknowledge that schools are parts of a broader system with their own paradigms and prejudices, and that kids may bring those values into schools in significant ways. Gender questions in STEM education should be more broadly contextualized--not assigning to schools the entire responsibility of addressing them, but considering larger societal questions and movements.

## References

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