Promoting STEM Education for Girls through Social Media and WhatsApp Teacher Interventions*

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Abstract

We conducted a randomized controlled trial in Peru to promote engineering careers among high school girls through a role model intervention delivered via Instagram and an information campaign targeting teachers via WhatsApp. The interventions aimed to influence girls' educational preferences and college enrollment decisions. Preliminary findings suggest a negative impact on the self-reported educational preferences of girls outside the top 25% in math, with the interventions reinforcing their intention to avoid engineering. However, for top-performing girls, particularly those exposed to both the role model and the teacher information campaigns, the interventions had a significant positive effect on preferences for the engineering major. In addition, we find that the Instagram-based role model content led to an overall increase in girls' college enrollment, regardless of major, likely due to a positive shift in perceptions of university life. Our study demonstrates the effectiveness of widely-used social media platforms as a powerful tool for role model interventions, highlighting their potential to engage young women and reshape their perceptions of higher education. Furthermore, our findings emphasize the critical role teachers play in reinforcing or, in some cases, hindering the effects of such interventions, particularly for students with different levels of academic performance.

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1 Long Abstract

Despite significant progress in expanding women's access to higher education, a substantial gender gap persists in STEM fields, particularly in engineering, all over the world. In Peru, women make up only 30% of engineering majors' applicants. This imbalance has important societal and economic consequences: it exacerbates gender-based income inequality, limits innovation and productivity, and hinders economic growth by underutilizing the full spectrum of talent. There is evidence that women's under-representation in STEM is driven in part by lower confidence among women in their STEM abilities, with family dynamics, school environments, and broader sociocultural factors playing a crucial role. For instance, Carlana (2019) shows that the gender gap in math performance in schools, and girls' confidence in their math ability, are larger when students are assigned to math teachers with strong gender stereotypes, leading girls to self-select into less challenging educational paths. Other recent studies have shown that female math teachers (Card et al., 2022; Lim and Meer, 2020; Sevilla et al., 2023) and classroom visits by female role models (Agurto et al., 2022; Breda et al., 2023; Porter and Serra, 2020) can shift girls' perceptions and preferences for STEM education and career paths.

In this paper, we employ a randomized controlled trial in Peru to examine how role models targeting high school girls and information videos shared with teachers can encourage young women to pursue engineering studies in college. Unlike previous studies, our interventions leverage social media, specifically Instagram reels, as the platform for delivering the role model content. The use of social media is widespread among teenagers worldwide. In the US, teenagers spend more than 4 hours per day on average on social media, with 70 percent of those aged 15 to 17 years being on Instagram, Snapchat, and TikTok daily (Anderson et al., 2023). In Peru, the expansion of broadband technology since 2010 (More Sánchez and Argandoña Martinez, 2020), has led to a rapid increase in the usage of social media apps. A recent survey suggests that two-thirds of adults in Peru use Instagram; however, accurate statistics for teenagers are not available.[1] Given its status as the preferred communication medium for younger generations, using social media to implement role model interventions may allow us to more effectively engage with the target audience, while also facilitating scalability.

Female role models can challenge stereotypes and influence the educational preferences of Peruvian high school students, as shown in Agurto et al. (2022), but these effects may not translate into actual enrollment in an engineering major, due to potential resistance from parents, especially in lower socioeconomic groups. The support and encouragement of teachers may be crucial, especially when girls' preferences may challenge social norms and conflict with family preferences. For this reason, our study also targets high school teachers. Specifically, we complement our Instagram-based role model intervention with an information campaign targeting teachers via WhatsApp, the most commonly used phone-based messaging app in Peru.

The study involves 73 high schools in Peru, randomly divided into two treatment groups (50 schools) and one control group (23 schools). We targeted all final-year high school students in the sampled schools.

[1] See https://www.statista.com/forecasts/1409959/social-network-usage-by-brand-in-peru.

Figure 1: The Instagram Account



Note: The figure displays the Instagram account logo and name, as well as the first post (on the left), which states: " We are a group of university students and we are excited to share our life in university with you. Stay tuned to learn about our experiences, academic advice and special moments that make this stage unforgettable."

We first invited them to complete an online baseline survey, facilated by the school principal and the head teachers. Only the students who completed the baseline survey and for whom we obtained parental consent were subsequently involved in the interventions. In the treatment schools, we implemented a role model campaign on Instagram. Specifically, we created an Instagram account called "My Days in University" (Mis Dias En La U) – see Figure 1 – and invited final year female students to follow the account. These students were encouraged to engage with the content by liking a series of short videos posted on the account by female engineering college students over a total of 6 weeks. The short videos/reels documented the female students' experiences in college, while studying engineering, e.g., going to class, studying for homework, completing projects and interacting socially with other students. A total of 9 videos were shared over 6 weeks; after that, no more videos were posted but the account remained online, with the the videos still visible to account followers.

In half of the treatment schools (25 schools), we added an additional component: 3 short videos were sent via WhatsApp to the head teachers of the students. These videos featured engineering professors discussing the gender imbalance within the engineering field and emphasizing the desirability of increased female representation in this domain. The professors encouraged teachers to actively contribute to reducing the gender imbalance by challenging and dismantling the gender stereotypes associated with the engineering major. This dual approach aimed to leverage the reach of social media while also targeting key "influencers," the head teachers, to reinforce the impact of the role model intervention.

A total of 780 students filled in the baseline survey (in July and August 2023) and had their parents' consent to participate in the study, with 542 of them being women.[2] In the baseline survey, we also recorded a unique student identification number, which allows following up the students if/when they enroll in college. We implemented a follow-up survey with the study participants immediately after the implementation of the 6 weeks of Instagram-based role model program, between October and November 2023. This survey measured students' preferences regarding different educational and career paths, as well as their perceptions of their parents' preferences. About two months later, in January 2024, after most students intending to attend college had completed their applications,[3] we offered all students the opportunity to apply for a small scholarship, which would be randomly awarded to one applicant, contingent on enrollment in an engineering major the following year. This scholarship application process served as a revealed preference measure for interest in engineering, as applying required filling out paperwork, making it more likely that only students seriously considering an engineering major would apply. Given the small size of the scholarship (about \$750),[4] we do not expect it to have significantly shifted students' preferences. Finally, in Summer 2024, we collected partial administrative data on students' college enrollment and choice of major. However, this data collection is still incomplete, and we currently have enrollment data for 30% of the students in the sample.

Preliminary findings suggest that the interventions had an overall negative impact on girls' self-reported preferences for engineering, and no impact on the decision to apply for the scholarship. However, these aggregate findings mask important heterogeneities driven by girls' math ability. Specifically, the negative treatment effect on self-reported educational preferences is driven by girls who are not top performers in math (outside the top 25%). For these students, the interventions appear to have reinforced their intention to *avoid* studying engineering. Additionally, we observe no impact on their decision to apply for the scholarship, with only a small percentage choosing to do so. In contrast, a large and significant positive impact is observed among top-performing girls in math, particularly when the role model intervention is combined with the teacher information campaign. Additionally, there is suggestive evidence that these high-performing treatment girls received increased support for their engineering preferences from both teachers and parents.

Finally, the incomplete administrative data on college enrollment for the study sample suggest a large and positive impact of the interventions on overall college enrollment for all girls, regardless of major.[5] We draw two key takeaways from these preliminary enrollment results. First, the Instagram-based role model videos may have reshaped girls' perceptions (or misperception) of university life and their potential for success in higher education, likely leading to the overall increase in college enrollment. Second, information interventions targeting teachers and aimed at dismantling stereotypes regarding women in STEM may facilitate or hinder this process. For high-achieving girls, the teacher intervention seemed to reinforce the positive effects

[2] We estimate that this represents approximately 15-20 percent of the female graduating class from the sampled high schools.

[3] College applications in Peru are typically submitted between October and December of the year preceding college enrollment. Universities have two terms, March to June, and August to November. Most enrollment by freshmen happens in the first term.

[4] We anticipated the 2775 soles scholarship to cover for about 4 months of room and board in a public university, or for enrollment fees and 1 month of tuition in a private elite university.

[5] The data collected so far show no evidence of an impact on enrollment in engineering, but we may be underpowered to detect such an effect.

of the role model intervention, boosting their likelihood of enrolling in college. However, for girls outside the top 25% in math, the teacher intervention may have unintentionally discouraged them from pursuing higher education, possibly due to perceived academic limitations or lower expectations.

References

Agurto, M., M. Bazan, S. Hari, and S. Sarangi (2022). To inspire and to inform: The role of role models. *Available at SSRN 4252532*.

Anderson, M., M. Faverio, and J. Gottfried (2023). Teens, social media and technology 2023. *Pew Res Cent*.

Breda, T., J. Grenet, M. Monnet, and C. Van Effenterre (2023). How effective are female role models in steering girls towards stem? evidence from french high schools. *The Economic Journal 133*(653), 1773–1809.

Card, D., C. Domnisoru, S. G. Sanders, L. Taylor, and V. Udalova (2022). The impact of female teachers on female students' lifetime well-being. Technical report, National Bureau of Economic Research.

Carlana, M. (2019). Implicit stereotypes: Evidence from teachers' gender bias. *The Quarterly Journal of Economics 134*(3), 1163–1224.

Lim, J. and J. Meer (2020). Persistent effects of teacher–student gender matches. *Journal of Human Resources 55*(3), 809–835.

More Sánchez, J. and D. Argandoña Martinez (2020). Las redes de transporte de fibra óptica, microondas y satelital y su rol para promover la expansión de la cobertura de los servicios públicos de telecomunicaciones: reporte y mapas de cobertura. documento de trabajo nº 49.

Porter, C. and D. Serra (2020). Gender differences in the choice of major: The importance of female role models. *American Economic Journal: Applied Economics 12*(3), 226–254.

Sevilla, M. P., P. Bordón, and F. Ramirez-Espinoza (2023). Reinforcing the stem pipeline in vocational-technical high schools: The effect of female teachers. *Economics of Education Review 95*, 102428.