Relationship Between STEM Attitude and Empowerment: A Descriptive Study in Costa Rican Girls

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Abstract
This study aimed to examine the correlation between empowerment perception and STEM attitudes in young girls from a Costa Rican high school. 327 young people aged 11 to 18 years from "Colegio de Señoritas". The sample included only girls, from different ethnic and socio-economic backgrounds, living in different parts of the urban area in San José. In-depth, the study was carried out an S-STEM attitude survey ($\alpha = 0.91$) and Empowerment Scale (modified, $\alpha = 0.89$). As a result, the correlation between STEM attitude and empowerment did not confirm a significant relation. However, girls showed a poor attitude in math and the selection of STEM majors, but they have a better attitude in XXI skills and science. At the same time, young girls present a good perception of their empowerment in almost all areas. However, they are not perceived as generating an impact in the class and they also do not consider receiving enough external support, especially in their academic environment.

Keywords: STEM Attitude, Empowerment, Girls, Skills, High School

Introduction

The information and communications technology (ICT) sector has been growing at a quick pace for the last twenty years. This technological sector is highly dynamic and shows tremendous potential for innovation and for introducing changes impacting deeply on the society in the short-term. Traditionally, the ICT sector demands large numbers of graduates in science, technology, engineering, and mathematics (STEM) disciplines, and its employees are usually well paid. In this challenging environment, one may expect the sector to take advantage of as much brainpower, creativity, and knowledge as possible (Botella, Rueda, López-Iñesta, & Marzal, 2019).

Science, technology, engineering, and mathematics, also known as STEM, are one of the largest fields of study in the educational system. It is also the largest field where women are significantly underrepresented. Over the last century, women have made improvements with assimilating into what was once seen as a male-dominated field. However, significant disparity between women and men in STEM is still existent, and very little progress has been made to achieve a higher level of representation by women in the field (Polk, 2014).

STEM education is capital of importance for countries that wish to have a say on the international platform and accord to knowledge-technological developments considering 21st-century skills intended to enhance students' interest and tendency through science, technology, mathematics, and engineering in STEM education (Tekerek & Karakaya, 2018). Students are expected to generate solutions for problems by using 21st-century knowledge and skills. At this point, the related research concluded that students' interest, attitude, and achievements were affected positively when STEM disciplines were integrated (Tekerek & Karakaya, 2018).

In recent decades, various studies have highlighted the lack of scientific and technological vocations among pre-university students (García-holgado, García-ramos, & Peñabaena-niebles, 2020).

Research on horizontal sex segregation in the labor market, that is, the tendency for men and women to work in different fields of occupation, documents a process of girls and women dropping out of science, technology, engineering, and math (STEM) career path at a higher rate than boys and men throughout the life course (Raabe, Boda, & Stadtfeld, 2019). The participation of women continues being low in STEM professions: 28% according to the UNESCO report (García-holgado et al., 2020).

That girls tend to increasingly prefer subjects other than STEM over their school career is one example of this phenomenon, which past research has investigated through various factors, including socialization. Early-life socialization happens mostly within the family, but the role of peers becomes more important as children grow older. During adolescence, interaction, and exchange with friends, especially in school, is a crucial setting for socialization (Raabe et al., 2019). A significant minority of women choose and access STEM programs at the tertiary level, which appear to be excluded from the options of studies in secondary school girls.

Adolescence is an important period of life, not only because of peer socialization, which has implications for long lasting attitudes, norms, and values, but also because

it is the time when people make life choices regarding their careers. Those decisions can have long-lasting effects on life outcomes, such as income and social status (Raabe et al., 2019).

In order to increase the participation, retention, and attainment of females in STEM in the educational institutions and workplaces and nip gender disparities in the bud, prospective and existing STEM girls/women some studies suggest do it by ought to be empowered. (Boateng & Nyarko, 2016)

Empowerment can serve as a powerful instrument for women to achieve upward social and economic mobility and achieve power and status in society. It is a source of mobility, equality and emancipation, both at the individual and at the societal level. Empowering women is important, and it indirectly leads to a growing demand for education for girls and enhancing their participation in informal and alternative education system. (Tayde & Chole, 2010)

As such, some study delves into the perceptions of women in STEM concerning the manner empowerment activities should be conducted based on their gender experiences in their disciplinary domains (Boateng & Nyarko, 2016). Considered Psychological empowerment is a multicomponent construct that involves the mechanisms through which people gain control over their lives and environments (Speer, Peterson, Christens, & Reid, 2019).

The discourse on empowerment in this decade has become increasingly stronger concerning studying and working in STEM, according to these studies surge the following question: Does girls' perception of empowerment have a relationship with the attitude they show towards STEM careers?

Methodology and design

This section below describes participant selection and data analysis and outline the sampling strategy, overview the function of the two instruments.

In the present study the researcher explored and correlated STEM attitude and educational empowerment perception.

Hypothesis: Psychological empowerment perception is positively related to the Student Attitudes Toward Science, Technology, Engineering, and Math.

Sampling

The aimed to recruit high school girls from a variety of grades that differed in their course level, age, knowledge but the same institution. In all, over 10 groups of high schools 5 grades were recruited for participation in this study from Colegio de Señoritas de Costa Rica. The sample began as a sample of aleatory. Participants were recruited when they were in their classes. Of the more than 10 groups recruited, all indicated their interest in participating in the study. Once they agreed to participate, all students in the group were recruited for apply in the study via the course webpage. In this way, all the students in the same class were considered participants in the study. In total, 327 girls aged 11 to 18 years (MD = 15) from “Colegio de Señoritas”

responded to the two surveys. The sample included only girls, from different ethnic and socio-economic backgrounds, living in different parts of the urban area in San José de Costa Rica.

Measures

Adaptation of Scales into Spanish. The S-STEM and Educational Empowerment Survey measures were adapted into Spanish by the researcher. The Spanish version of the scale was examined by field experts, all of who have a good command of their native language (English) and work in the education field. Taking feedback into account, the researcher edited the scale items. Spanish language experts examined the form, and necessary editing was done. The extent to which the translation conveyed the accurate meaning of its original translation was examined. The removal of the item of each sub-dimension was not deemed suitable, because all of them were appropriate to Spanish, and could not cause contradictions in terms, but in Empowerment Survey was necessary removal a sub-dimension was not deemed suitable, considering the fact that they were not appropriate to the educational environment and did not serve the purpose of the assessment. The pilot study of the scale was conducted with 15 individuals to determine points that were not understood by the students. S-STEM ($\alpha = 0.91$) and Educational Empowerment Survey (modified, $\alpha = 0.89$) demonstrated reliability.

S-STEM Survey

The S-STEM surveys are robust instruments that elementary, middle, and high school STEM education program leaders can use to understand students' psychological states and the impact programs may have on student attitudes toward STEM disciplines. Measure STEM Attitudes were explained with the following dimensions Mathematics (8 items), Science (8 items), XXI skills (20 items), STEM Careers (12 items).

Educational Empowerment Survey

Educational empowerment is a 21-item scale adaptation of the constructed and validated by Spreitzer (1992, 1995) was used to measure psychological empowerment. The response format of the inventory was a 6-point Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). Spreitzer (1995) explained psychological empowerment with 8 dimensions: meaning, competence, self-determination, impact, social support, comprehensive, access to information (comprehensive), and access to resources.

Procedure

Once the entire class agreed to participate, they were taken to the library and they were invited to use a computer or tablet to answer the online surveys. It took the students about 30 minutes to complete the two surveys in each group.

Analysis of Data

SPSS package, excel and Minitab programs were used to analyses the data obtained from research. Simple analyses were made by using descriptive statistics and

correlation which is one of the statistical analyses. Analysis was conducted to determine if, as hypothesized, a positive correlation existed between S-STEM attitude and empowerment perception

Results

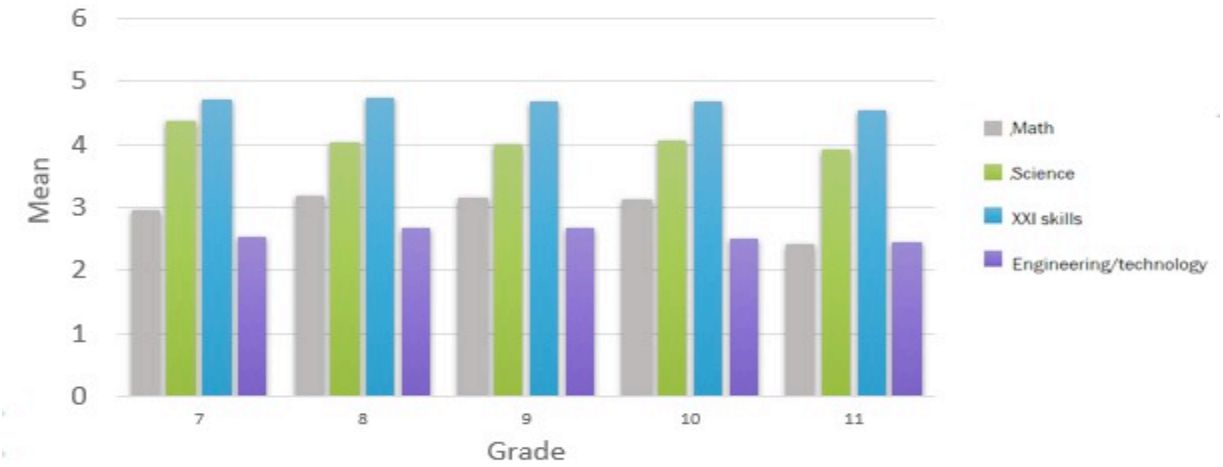

Figure 1: S-STEM results according to high school grade

Students report a less interested attitude towards engineering and mathematics skills. However, they consider that they do have 21st century attitudes.

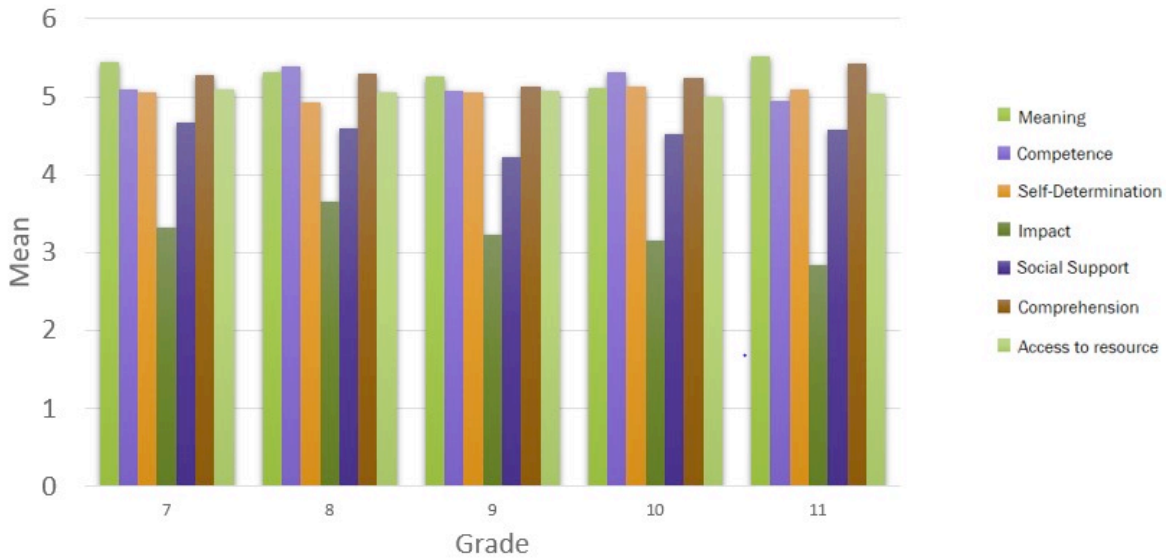

Figure 2: Educational Empowerment Survey results according to high school grade

On the empowerment scale, the students report having the psychological attitudes of an empowered girl, however, they consider not receiving support from their peers.

	Math	Science	XXI Skills	Engineering technology
Meaning	0.196	0.221	0.423	0.225
Competence	0.263	0.274	0.426	0.298
Self-determination	0.261	0.405	0.502	0.513
Impact	0.083	0.13	0.244	0.195
Social Support	0.181	0.237	0.401	0.352
Comprehension	0.194	0.179	0.349	0.336
Access to Resourse	0.214	0.271	0.297	0.254

Table 1 : Correlation Between STEM Attitude and Empowerment

There was no significant positive or negative correlation in any of the cases studied.

Conclusion

The current article tries to find the relationship between attitudes in STEM and the empowerment of girls in Costa Rica. First, the attitudes that girls showed towards STEM careers and skills for the 21st century were investigated, the results are consistent with literature and girls report having less interest in math and engineering skills, a situation that remains constant in all grades. Also, students do consider having XXI skills.

On the other hand, the girls report having skills for school empowerment, without conflicts to assume the challenges and daily tasks. However, they consider that they do not receive enough support from their peers.

Finally, a significant correlation was not found between the attitudes of the students with STEM careers and empowerment, therefore, the fact that they are young empowered in their educational environment does not seem to have a negative or positive relationship with their attitude towards STEM careers.

For future works, will be interesting to explore if active participation of peers, professor, and family may positively impact students' sense of belonging and desire to positive attitudes in STEM.

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