# Relationship Between Guided Interactive Activities and Self-concept in Engineering Students

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## Abstract

The number of women who decide to study engineering is under-represented within studentpopulations, despite efforts made by governments and universities [1] [2]. Chile is no exception. In 2019, 28.7% of students who entered STEM disciplines were women, increasing only by 1.3% in 2020 to 30%. Family, cultural, economic and social factors influence this under-representation, factors which tend to reduce women´s self-concept on learning and ability in this area. Women have lower self-concept in the STEM disciplines than do men, consequently the dropout rate for women is double that of men [3].

An intervention was designed aiming to promote and increase self-concept in learning capabilities in first-year engineering students in Computer Engineering and Industrial Engineering. Such intervention was based on three types of collaborative activities within the classroom, which seek to encourage questioning and debate among students in order to internalize expected learnings. Activities were aimed at solving real problems relevant to the scenario that the country was facing in order to demonstrate the contribution that contents learned may have in all areas of society.

The intervention was implemented through a quantitative, explanatory and non-experimental study, applied on a 110-student sample, studying Database within the Computer Civil Engineering and Industrial Civil Engineering disciplines from Andrés Bello Universityin Santiago, Chile, of whom 22.7% were women. The results obtained from applying interactive and collaborative activities in the classroom contributed towards increasing the self-concept in the study sample, increasing from 7.1% to 22% in women. Additionally, the sample obtained a mean positive correlationof 0.52 between self-concept and academic performance, while women had a low positive correlation of 0.39.



**Keywords: self-concept, Interactive Activities, collaborative activities**


## Introduction

Both in Latin America and Europe more women than men enter higher education in recent years [1]. Enrollment in Chile reached 53% in 2018 [4]. The distribution of the study areas selected by women is uneven, given that they have greater interest in the social sciences, health sciences, economics and administration. The STEM disciplines are underrepresented, as only 30% of women choose STEM disciplines, this percentage varies depending on each of the countries, Bolivia has a high representation of women in science (62%) while Argentina has 52%, Chile trails with 30% [2].

STEM disciplines mirrors this underrepresentation, with areas such as computer science, physics and mathematics the least represented by women [1]. Factors that influence career selection in STEM disciplines are deep-rooted gender stereotypes in Latin America, reflected both at family and societal level [4], [5], [6]. Many countries and / or universities have yet to incorporategender equality as policy. Various initiatives are being developed that focus on promoting equality and empowerment of women (UN and UNESCO) [1] [2] The European W-STEM project coordinated by a research group operating out of a university in Barranquilla, Colombia, has focused on three relevant aspects: attracting women to study STEM disciplines; access processes that allow for a higher conversion rate seeking to turn applicants into enrolled students and thirdly retention and orientation processes seeking to reduce student dropout rate [1].

Women must face several difficulties within their university education, among which male hegemony stands out, leading them to confront male chauvinismbehaviors that affect their self-esteem and self-concepts. Added to this is the scarcity of female reference figures in academic life, leading to a high first-year drop-out rate, further impacting area underrepresentation. The dropout rate for women is twice that of men in this area, 41% versus 17%. The number of women graduates in STEM disciplines from Latin America fell by 10% [3]. This current research aims to increase female self-conceptthrough collaborative classroom activities that may allow increasing their retention rates in the STEM disciplines.

Andres Bello University has 39,175 undergraduate students, of which 4,829 study at the Engineering Faculty, with only 21% being women.

The present document is organized as follows: Section II describes background and related works. Section III, methods and materials. Section, IV Analysis and discussion. Section V Conclusions and future work.

**Theoretical Framework**

*Self-concept and academic self-concept*

Self-concept can be defined as a measure of evaluation regarding how a person perceives him or herself [7] [8], these in turn are made up of several domains, divided into more specific dimensions. According to [9], the general self-concept consists of three main dimensions from which other sub-dimensions emerge:

- Academic self-concept: represented by the image that the person has of him or herself as a learner in a specific area of knowledge, namely, the ability to learn and to face learning in an instructional context. The sub dimensions present here would be: academic self-concept regarding all areas of knowledge, mathematical self-concept and verbal self-concept, specific to language or similar.

- Social self-concept: the image that the person has of his or herself, how they deal with social relationships and peer interaction. Subcategories being; the physical capacity, which refers to how good I am in a certain sport or my physical capacity; my physical appearance, how physically attractive I am and the relationship with my peers, what is my ability to make friends and keep them.

- General Private Self-Concept: represents the internal or intimate image individuals hold of themselves. The factors within this dimension being: Family relationship, which refers to the image that the person has of himself in relation to his role within the family; Honesty, which refers to how trustworthy I believe that I am; and emotional stability, namely, the image that the person has relating to how much stress and / or worry can they handle as a result of the different tasks and problems that they must face and dealt with.

The general self-concept plays a key role in the personality of each individual. A positive self-concept is essential when dealing personally, socially and professionally with the world. It is stated in [7] that academic self-concept starts at childhood, from experiences, feedback from others, personal achievements and academic self-concept in various academic areas. Including self-assessment and perceived peer competition.

*Academic self-concept in terms of Gender and STEM*

As mentioned previously, academic self-concept is divided into three sub dimensions: all-round academic self-concept, maths self-concept and language self-concept. In [8] a positive correlation is established between general academic self-concept and academic performance. It is important to mention that a good self-esteem predicts better coping mechanisms and perseverance in academic challenges. Jansen states that students' academic self-concept is a good predictor of academic performance and a desirable educational outcome per se.

Several authors such as [7], [8] and [10] state that men have greater academic self-concept in mathematics and science, while women have a higher academic self-concept in languages. They also state that a good academic self-concept in mathematics at school predicts higher odds of choosing a university career with a mathematical component and a lower probability of choosing a career with a high degree of verbal component. In [7] it is stated that women tend to have a more negative academic self-concept in mathematics than do men, even if they achieve the same grades or qualifications, attributing success in this area to external factors and failure to internal factors.

Women in Chile obtain worse results in mathematics than do men in the standardized University entrance test (known as PSU). This implies that fewer women can apply for this type of careers given the highly competitive level. This mathematics gap has been present since childhood, as boys surpass girls in this area, largely due to the self-concept that girls have about their abilities in mathematics, coping with stress and competitive situations [6]. Women have a lower academic self-concept than men even when they have an equal or higher performance than them, or put another way, women have a more realistic view of their abilities than do men [11]. Self-concept is related to student achievement and motivation. which can be modified when teaching the actual course contents.

It is well known that there are many factors why women are underrepresented in STEM disciplines, foremost amongst these is the ingrained gender stereotypes present in many countries where it is assumed that men have an almost innate scientific ability unlike women [5]. Another associated factor is related to the way both genders face life, as women and men face life differently; women tend to direct their studies or work towards common goals, such as those found in education and health, while men are comfortable pursuing individual goals. Unfortunately, STEM disciplines have always been viewed as individualistic careers, lacking clear community objectives may lead young women to loose motivation in pursuing these types of careers.

Some studies have shown that women place greater value in aspects such as their personal relationships (family, friends and community) than they do on their careers, spending fewer hours at workthan men do. Adaptive lifestyles centered on home and family are more satisfying for women, thus it is their work-life that must adapt to their interests as opposed to men who place greater emphasis on their careers, on economic compensation, on taking risks, placing all these over and above their personal relationships [12].

*Classroom activities that contribute to increasing self-concept in STEM disciplines*

Many studies show the benefits of applying Active Learning within the classroom setting [13], [15] and [16]. These investigations have been able to conclude how beneficial it is to apply this type of learning in underrepresented groups in the STEM area. Research has focused not only on performance results but also in promoting classroom participation, since participation is related to academic success, to critical thinking, to a sense of belonging, to a greater course understanding, and to a lower anxiety level [13].

In [13] the quality of group discussions was compared between those groups where they expect the instructor asks for a volunteer to respond and those where they are expected to be asked for an answer, discovering that the groups who thought that they may be called out randomly achieved a higher level of reasoning in their discussions. In the study cited in [15] the conclusion was that activities that include taking turns and which have explicit student instructions enjoy greater comfort levels within the working groups.

In study [16] the conclusion was that women were more likely to participate after holding small group discussions, this effect being more pronounced when various teaching approaches were used. The suggestion is made that the best way to improve on the negative impact that large group classes have on female participation is to use various teaching strategies and small group interactions. Peer discussion among group members encourages students to make a greater effort to understand the content that is being addressed in order to better argue their conclusions. In turn, [3] states that peer reviews are tools that allow students to develop critical skills, fuller understanding of the topics addressed, immediate feedback, which in turn allows students to better chart their progress. Finally, [17] states that teamwork gives students the opportunity to contribute from different perspectives.

Given the above, the following research question emerges: Does the application of teamwork activities, debates, peer assessment in small groups in the classroom contribute to increasing self-concept in women in STEM disciplines?

**Methods and Materials**

The sample numbered 110 first-year students of the Computer Civil Engineering and Industrial Civil Engineering disciplines studying the Database course at the time, all from Andrés Bello University. The sample included 22.7% female students.

The research used a quantitative, explanatory, non-experimental methodology, with women's self-concept as dependent variable with independent variables being classification of activities carried out in the classroom and academic performance. Various instruments were used in order to obtain information on each study variable. Sample self-concept was measured using a specially designed survey, while classroom activities were measured with evaluation rubrics and academic performance was obtained from students'recordsheld by the university institutional site, figure 1 below further illustrates the concept.

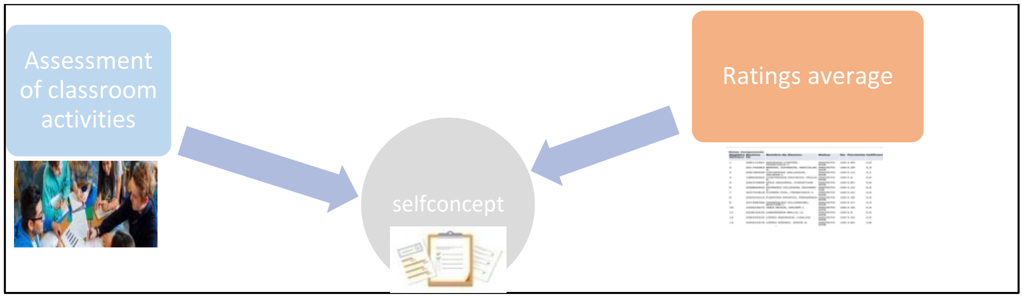


*Figure1: Study variables and measuring instruments*

The intervention lasted 16 weeks and was made during the second semester of 2020.

A survey was designed in order to find out the initial status of students' self-concept, based on the Perception Of Success Questionnaire (POSQ) and the Academic Self-Concept Scale (ASCS), instruments which have already been used in prior research [18]. This survey was based on five questions which focused on measuring student perception regarding the following: class participation, attention, compliance and understanding. Questions were answered using a 1 to 5 Likert scale, where 1 is totally disagreeand 5 is fully agree. An additional question was asked regarding how they perceived their ability in the subject, the answer being made in a 7-point Likert scale, where 1 is ability perceived astotally deficient in the subject and 7 is ability perceived asfully developedin the subject. The survey included a section where students could make open-ended comments on the class if they considered it appropriate. A survey example is included below, shown as figure 2.

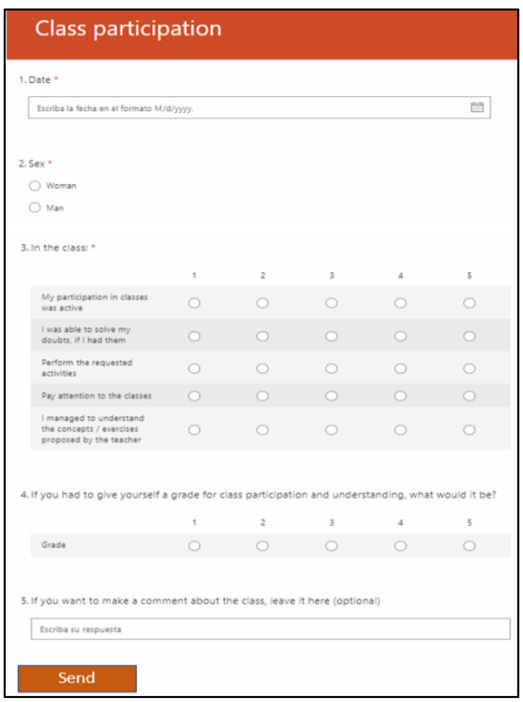


*Figure 2: Self-concept survey*

Activities were designed using techniques such as dividing the class into small groups, flipped classroom, peer evaluation, group discussions, activities applied to problems the country is facing and activities involving explicit indications and timings.

A detailed list of activities carried out is found below:

*First activity*

Objective: Design a relationship entity model regarding a survey of HealthResidencesforCovid 19 patients
Week: 10
Duration: 120 minutes
Techniques used: randomly chosen small groups, flipped classroom, peer evaluation

Description of Activity: The class was randomly divided into five member teams. The problem laid out was identical for all teams; designing a relationship entity model that would allow an updated registry of patients living in designated Covid-19 residences. Teams were assigned different virtual rooms where they worked collaboratively in building the model, with a 45-minute time limit. The teacher entered each of the rooms to solve any doubts and support teamdecition-making. When time was up, all teams were directed to the main room were the teacher conducts an online draw and selects five teams from the seven-team universe. Each team chose a delegate, whose task was to present their model to the audience. These delagates had five minutes to state the design decitions applied, along with the benefits of such a proposed model.

The teams that did not present their results played the role of evaluators, in order to do this, they had to ask each team a question and select the best solution, arguing the reasons for their decision, with a 30-minute time-limit. The activity ended when the teacher consolidates contents generated within the activity, delivering feedback to each of the teams, with a 30-minute time-limit.

*Second activity*

Objective: Design an extended relationship entity model for a platform providing help and guidance to women victims of violence
Week: 12
Duration: 120 minutes
Techniques used: small groups lead by a female student, flipped classroom, peer evaluation.

Activity description: The class was divided into five member teams, each team had to be made up of at least one female. Each team had to have a leader, who had to be the female member. The problem laid out was identical for all teams. This consisted of designing an extended entity-relationship model that would be part of a new platform to provide help and guidance to women victims of violence, given the increase in cases of femicides in Chile in the context of the pandemic.

Teams were assigned different virtual rooms for model building, where they worked collaboratively under a 45-minute time-limit. The teacher entered each of the rooms to answer questions and support teamdecision-making.

When time was up, all teams were directed to the main room were the teacher conducts an online draw and selects five teams from the six-team universe. Each team had their leader present their extended relationship entity models to the audience, stating any design desitionstaken, each team had five minutes to do so.

The team that did not present their results played the role of evaluators, in order to do this, they had to ask one question to the team, questions were made by team leader, each team then select the best solution, the leader stating the reasons for their decision, with a 30 minute time-limit.

The activity ended when the teacher consolidates contents generated within the activity, delivering feedback to each of the teams, with a 30-minute time-limit.

*Third Activity*

Objective: Design a relational model related to database page views delivered referring to Covid patient notification and forms required for entering Chile in pandemia.
Week: 14
Duration: 120 minutes
Techniques used: same-gender small groups, flipped classroom, peer evaluation, team leader.

Activity description:
The class was divided into five-member teams; teams were either all male or all female in composition.

Two issues were designed for, aiming to design a relational model given a set of database page views. The first issue was related to coronavirus notification forms, for those patients who are diagnosed as positive for Covid-19. The second issue is related to the forms that are required to be filled-in when entering Chile in times of pandemia. At least one male team and one female team were given both problems. Teams were assigned different virtual rooms where they worked collaboratively on data-base normalization up to the third normal, particularly over the data-base page views given previously. The activity had a 45-minute timeline, the teacher entered into each of the team rooms to solve any doubts and provide support in the construction of the relational model.

After the time allotted for the activity had ended, all teams were directed to the main room. The teacher then selected a team of men and a team of women for each of the issues reviewed using an online draw, for them to present to the rest.

The teams that did not present results played the role of evaluators, in order to do this, they had to ask a question to each team and then select the best solution, stating the reasons behind their decision, with a 30 minute time-limit. The activity ended when the teacher consolidates contents generated within the activity, delivering feedback to each of the teams, with a 30-minute time-limit.

At the end of the sessions where activities were undertaken, the teacher asked students to carry out the assignment self-concept survey (dependent variable).

Each of the activities had an evaluation rubric that the teacher had to complete and deliver in the next session to each of the teams for their feedback. The application of the rubrics enabled grading each activity carried out for each of the groups (independent variable).

The intervention lasted seven weeks, beginning in week 8 of the semester with the application of the academic self-concept survey within the assignment, the aim being to measure the initial self-concept of the sample.

Subsequently, three, two-week phases were set aside for activities. The first week involved understanding concepts and the second week of each phase consisted in an activity where contents seen will be applied. In this way, course contents regarding entity relationship modeling was seen in weeks nine and ten, entity relationship modeling seen in weeks eleven and twelve and relational modeling in weeks thirteen and fourteen.

The activities were assessed using the rubrics designed for this purpose, allowing grading the activity itself (independent variable). Students were asked to complete the self-concept survey that measured its impact before ending the session where activities were made. The activities carried out in each of the weeks are shown in Figure 3.

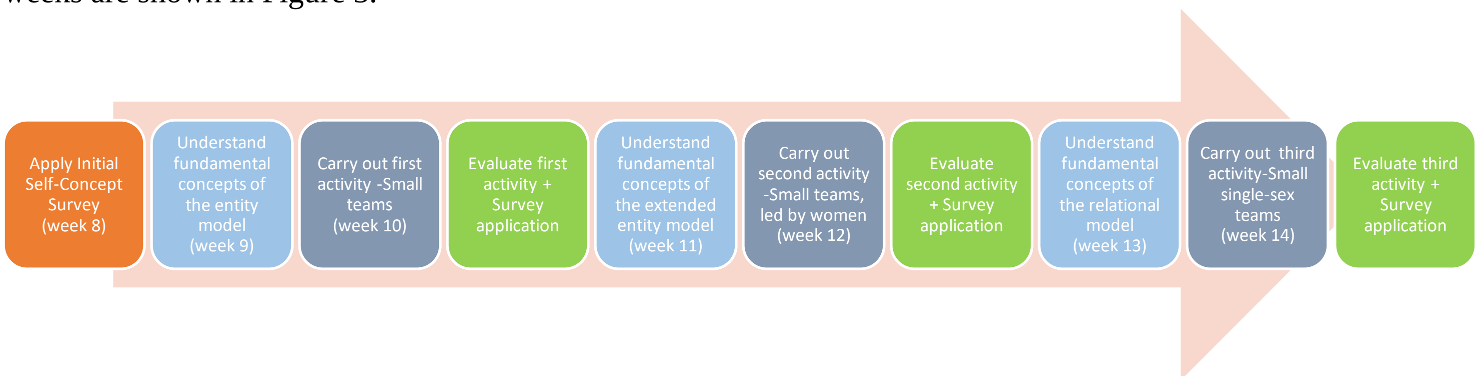


*Figure 3: Worksequence*

In order to ascertain variable behavior over time and their correlation, the experiment was divided into four phases. The first phase was the initial survey; the second phase was framed in order to develop activity 1, the third phase dealt with activity 2 while the fourth phase dealt with activity 3.

For the first phase, dealing with the initial self-concept survey, sample mean and standard deviation for sample and same-sex groups were calculated. Regarding phase two, three and four, averages and deviations for the sample and for each group, in particular for the three variables studied (self-concept survey, formative activity evaluation and academic performance) were also calculated.

In order to know the impact of these activities in the classroom, effect size was calculated using Cohen's d, making a comparison between each of the phases.

Finally, as can be seen in figure 4, a correlation analysis was performed between variables to determine if there is any type of correlation between the dependent and independent variables.

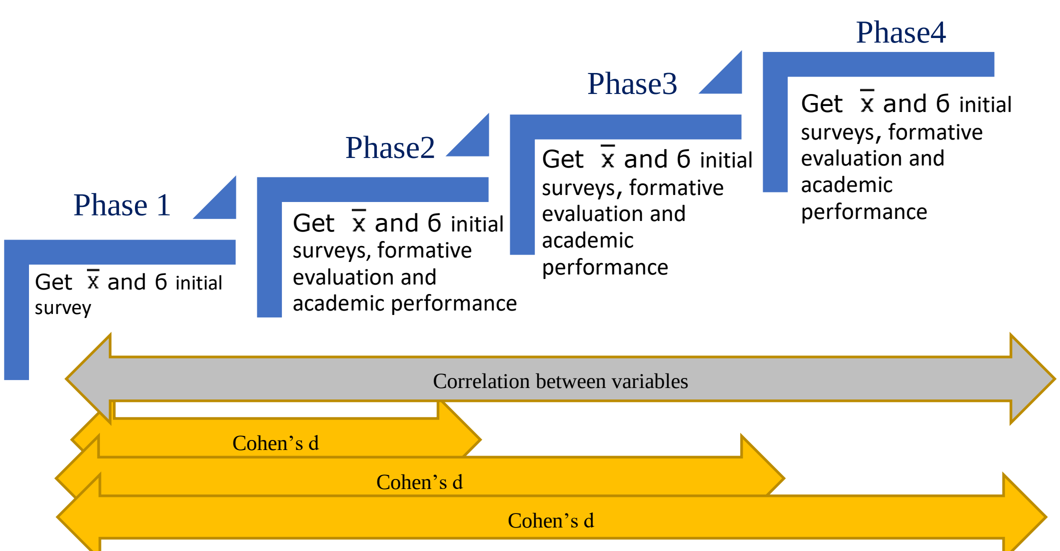


*Figure 4 Impact of independent and dependant variables*

## Results and Discussion

Table 1 shows the averages per gender for all aspects related to self-concept measured in the initial survey, it can be seen that men on average award themselves a higher grade in general self-concept within the assignment (mean = 5.5. Sdev = 0.6) than do women (mean = 5.0. Sdev = 0.6). It is also clear from the table that women obtain better results than men in aspects related to class activity perception (mean = 4.4. sdev = 0.8), their perception of classroom concepts understanding (mean = 4.2. sdev = 0.4) and class attention perception (mean = 3.8 sdev = 0.8), however women perceive to have a lower class participation (mean = 2.2. Sdev = 1.0) and perceive themselves to have lower problem-solving capacities (mean = 3.6. Sdev = 1.0), with a standard deviation of 1.0 (sdev = 1.0).

Results indicate that women have lower perception of their class participation, problem solving, or their hability to ask their teachers pertinent queries, yet show a higher degree of commitment and responsibility than men do since they show a higher average level of attention in class, they execute more of requested activities and show greater understanding of concepts exposed.

Male students present a more optimistic attitude than female students when evaluating their self-concept regarding the subject (mean men = 5.5, mean women = 5.0). However, in aspects such as paying attention in class (mean = 3.5, sdev = 0.8), undertaking proposed class activities (mean = 3.9, sdev = 1.1) and understanding class concepts (mean = 4.0, sdev = 0.7), they show lower averages than women do. This reflects a certain level of incongruity in how men perceive themselves regarding their understanding of subject matter (see figure 5).

| | FEMALE | | | MALE | | |
|---|---|---|---|---|---|---|
| Aspects of self-concept evaluated | AVG | SDEV | N | AVG | SDEV | N |
| Perception of active participation in class | 2.2 | 1 | 25 | 3.2 | 0.7 | 85 |
| Perception of executing requested activities | 4.4 | 0.8 | 25 | 3.9 | 1.1 | 85 |
| Perception of paying attention to class | 3.8 | 0.8 | 25 | 3.5 | 0.8 | 85 |
| Perception to resolve my concerns if they exist | 3.6 | 1 | 25 | 3.8 | 0.8 | 85 |
| Perception understands concepts / exercises proposed by the teacher | 4.2 | 0.4 | 25 | 4.0 | 0.7 | 85 |
| Qualification | 5.0 | 0.6 | 25 | 5.5 | 0.6 | 85 |

*Table 1: Measured aspects of self-concept.*

Figure 5 compares aspects of interest regarding self-concept, separated by gender.

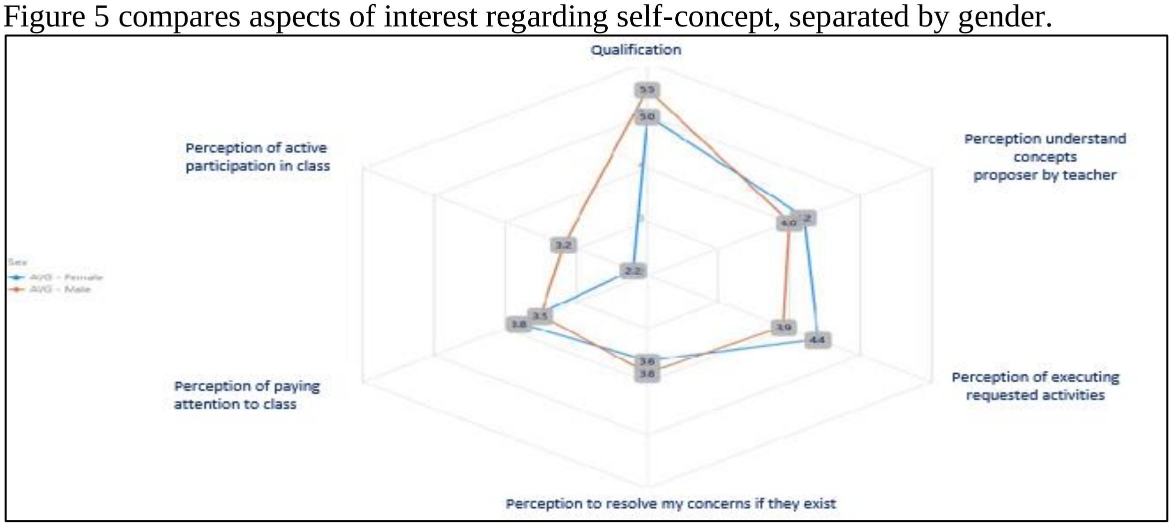


*Figure 5: Average self-concept aspects, per gender*

Table 2 shows self-concept in both sample groups. Notice how women gradually increase their self-concept as they carry out each activity. All activities allowed to increase self-concept in women, the first one (phase 2) reached 5.7% increase in women's self-concept (phase1= 5.0, phase2= 5.4) and 1.4% increase for men (phase1= 5.5, phase2= 5.6) when compared to the previous measurement. The second activity reached 4.3% increase in women's self-concept (phase2 = 5.4, phase3 = 5.7) and 4.2% increase for men (phase2 = 5.6, phase3 = 5.9) when compared to the measurement of self-concept in the first activity. Finally, the third activity shows an increase in self-concept of 5.7% for women (phase3 = 5.7, phase4 = 6.1) and a decrease of 2.8% for men (phase3 = 5.9, phase4 = 5.7) regarding the second activity.

| | WOMEN | | | | | | | MEN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | self-concept survey | | Assessment of classroom activities | | Ratings Average | | Sample number | self-concept survey | | Assessment of classroom activities | | Ratings Average | | Sample number |
| | $\bar{X}$ | 6 | $\bar{X}$ | 6 | $\bar{X}$ | 6 | | $\bar{X}$ | 6 | $\bar{X}$ | 6 | $\bar{X}$ | 6 | |
| **PHASE 1** | 5,0 | 0.6 | NAN | NAN | 4.8 | 0.5 | 25 | 5.5 | 0.6 | NAN | NAN | 4.3 | 0.2 | 85 |
| **PHASE 2** | 5.4 | 1.2 | 5.6 | 0.3 | 5.4 | 0.4 | 22 | 5.6 | 0.5 | 5.6 | 0.2 | 5 | 0.3 | 80 |
| **PHASE 3** | 5.7 | 0.4 | 5.8 | 0.2 | 5.6 | 0.2 | 24 | 5.9 | 0.6 | 5.7 | 0.1 | 5.1 | 0.5 | 82 |
| **PHASE 4** | 6.1 | 0.6 | 6.1 | 0.3 | 5.1 | 0.2 | 20 | 5.7 | 0.6 | 5.7 | 0.4 | 4.8 | 0.3 | 78 |

*Table 2: Self-concept*

Encouraging students to work in small groups and in activities that allow them to answer real problems contributes positively to sample self-concept as a whole, increasing in self-concept by 7.1% (initial mean = 5.4, final mean = 5.9). Women obtained the highest percentage increase, reaching a final increase of 22% (initial mean = 5.0, final mean = 6.1), surpassing the male self-concept which reached 5.78% (initial mean = 5.5, final mean = 5.9). Among possible reasons for such results may be the fact that women had to exert an active role, which allowed them to gradually increase their self-concept. It is interesting to note that the best results by men were seen when the leader of each team was a woman.

The average for all aspects related to academic self-concept, it is possible to see that both groups increase their average academic self-concept over the weeks. In the first activity, both men and women show a 2.9% increase in general self-concept compared to the initial self-concept. In the second activity, where women were team leaders, a higher increase in women (7.1%) than in men (4.2%) is seenwhen comparing to the general self-concept obtained in activity 1. Finally, at the third activity, women reached an increase of 2.9% compared to the previous activity, while men did not show any increase in this phase.

It is interesting to note that the highest increase in the sample occurs in activity two, where women take on a central role in activities. When comparing the initial and final measurement of the general self-concept for the sample, it is seen that women achieve the highest increase with 12.8% (initial mean = 3.9, final mean = 4.8) compared to 7.1% for men (initial mean = 4.0, final mean = 4.5).

To measure the size of the effects caused by each activity, a Cohen's d analisis was made for each activity, separated by gender, results are seen in Tables 3 and 4.The first activity achieves a large effect of 5.16 in women, and a smaller effect of 0.18 in men.The second activity achieves a mid-sized effect of 0.33 in women, and a larger effect of 0.54 in men, with respect to the first activity.When calculating the effect of the activity with respect to the initial situation, women achieve a large effect of 10.19 while men also achieve a large effect, but more modest, standing at 0.66. The third activity achieves a large effect of 0.78 in women and a medium effect of 0.33 in men with respect to the second activity, yet when calculating the effect of the third activity with respect to the initial situation, women achieve a large effect of 9.3 and men achieve a mid-sized effect of 0.33.

| COHEN'S D WOMEN | Initial | Activity 1 | Activity 2 | Activity 3 |
|---|---|---|---|---|
| Initial | | | | |
| Activity 1 | 5.16 | | | |
| Activity 2 | 10.19 | 0.33 | | |
| Activity 3 | 9.3 | 0.73 | 0.78 | |

*Table 3: Cohen's d in women group*

| COHEN'S D MEN | Initial | Activity 1 | Activity 2 | Activity 3 |
|---|---|---|---|---|
| Initial | | | | |
| Activity 1 | 0.18 | | | |
| Activity 2 | 0.66 | 0.54 | | |
| Activity 3 | 0.33 | 0.18 | 0.33 | |

*Table 4: Cohen's d in men group*

Figure 6 shows average results per activity during the semester, by gender.
Women increased their results by 2.9%; and men by 1.4% in activity two when compared to the first activity. Where women achieve the greatest increase is in activity three, where a 4.2% increase is obtained compared to activity two, while men do not show any increase.

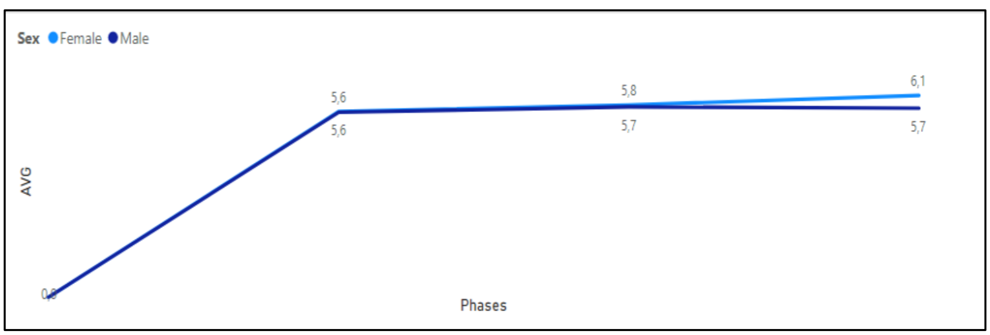


*Figure 6: Average training activities by gender and stage*

It is seen how women in all phases show better academic performance than men do.

The highest percentage increase in both men (10%) and women (8.5%) occurs when the first activity is carried out in the classroom. In phase four, where the last activity is carried out, both groups show a decrease compared to the previous measurement, women fall by -7.1%, while men fall by -4.3%.

Among the reasons underlying these results could be that evaluation carried out at this stage consisted of multiple-choice questions that took into account the initial learning levels in Bloom taxonomy.

When comparing the initial and final situation regarding performance, it can be seen that women achieve an increase of 4.3% (initial mean = 4.8, final mean 5.1) and men 7.2% (initial mean = 4.3, final mean 4.8).

In order to ascertain the relationship between the dependent variables (self-concept) and the independent variable (academic performance) of the sample, the Pearson correlation coefficient was obtained (showing the degree of relationship between both variables). The value was 0.52, reflecting a moderate positive correlation in the sample between self-concept and academic performance. Figure 7 shows the correlation between the dependent and independent variables of the sample.

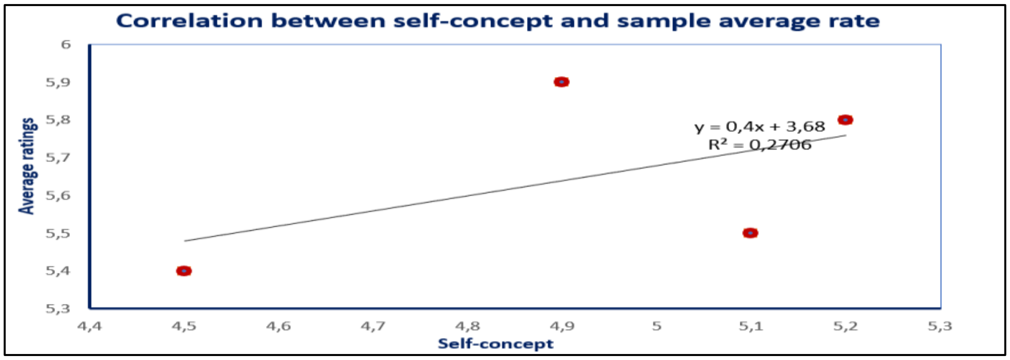

*Figure 7: Correlation between self concept and academic performance per sample landmark.*

The degree of relationship between the dependent variable (self-concept) and the independent variable (academic performance), for the group of women, using Pearson's correlation coefficient, gives a weak positive correlation of 0.39.

Figure 8 shows variable correlation for women.

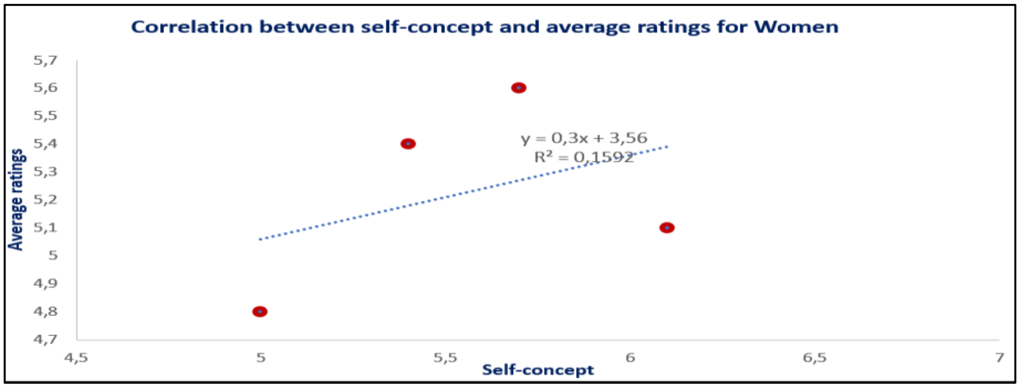

*Figura 8: Correlation between self-concept and academic performance per women milestone.*

The relationship between the dependent variables (self-concept) and the independent variable (formative evaluations) for the sample, using Pearson's correlation coefficient, shows a very strong correlation of 0.97 for the sample. See figure 9.

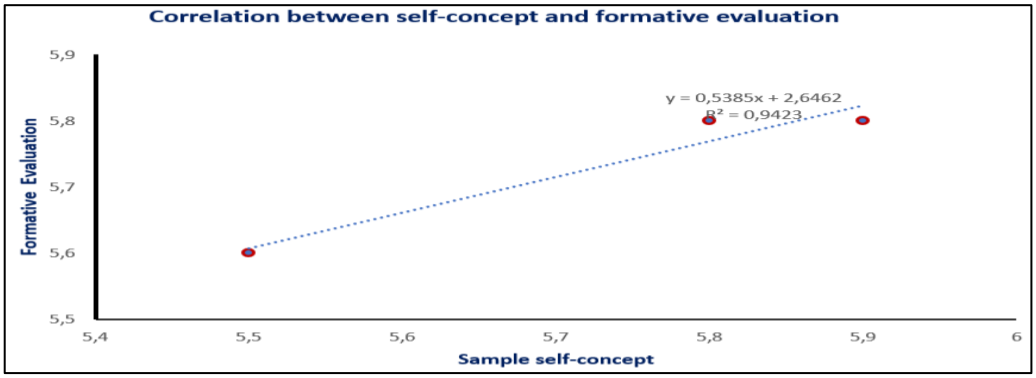


*Figure 9: Correlation between self-concept and simple activity evaluations.*

The Pearson correlation coefficient for the group of women, considering the dependent variable (self-concept) and the independent variable (formative evaluation), is 0.99, a very strong correlation, see figure 10.

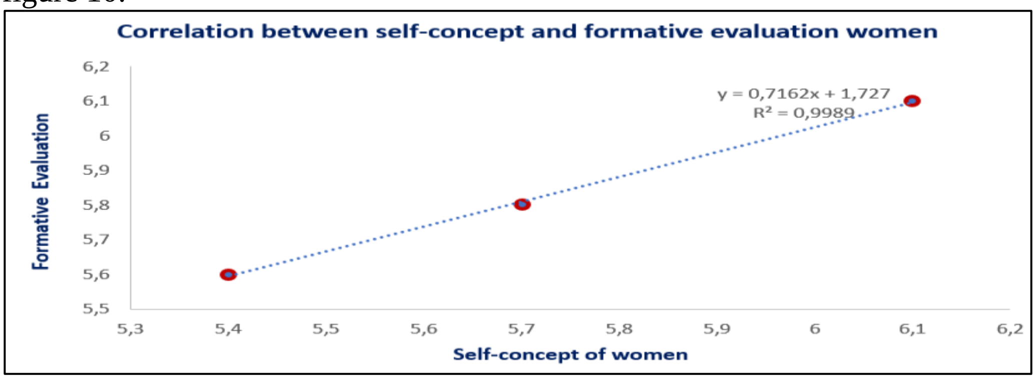


*Figure 10: Correlation between self-concept and evaluations of women's activities.*

The previous analysis allows us to state that the sample has a positive correlation between dependent and independent variables. A similar situation occurs in women groups who also achieve a positive correlation between dependent and independent variables. It can be seen that there is a very strong correlation both for the sample and for the female group between self-concept and training activity evaluations. Regarding self-concept and academic performance, a moderate correlation can be seen in the sample and weak for the female group.

## Conclussion

Answering the following research question was paramount when designing the current research; "Is it possible that the use of teamwork activities, debates, peer evaluation and other techniques in the classroom may lead to an increased self-concept in women in the STEM disciplines?" Given the discussion above in the previous results section, the answer is in the affirmative, as by the end of the intervention, the entire sample achieved a7.1% increase when compared to the initial situation. Women by themselves achieved the greatest increase in self-concept, achieving 22% compared to men who saw a 5.7% increase.

The experiment was able to verify that women in STEM disciplines have a more negative self-concept than men do, even when they may outperform with better academic performance and when evaluated in the training activities [7].

Teaching style was relevant in contributing to the increase of self-concept [7] in women, as did the use of different strategies or techniques in the classroom, such as dividing class into small teams, engaging in peer evaluation, holding exposés and activities of particular student interest. It became evident that working collaboratively with students and particularly with women students, contributed positively to increasing sample self-concept [17].

The fact that women where having a more active role within class, meant they increased their self-concept as did their formative evaluations. It was possible to note that there is a positive correlation between academic performance variable and the self-concept dependent variable, which is in line with available literature that states that the higher the self-concept, the higher the academic performance [8], [10] and [19].

Experience seen shows that the mere fact of dividing the class into small teams that work together to achieve a specific goal contributes to increasing self-concept. If we add to the mix activities that may mean solving problems of interest and concern to all, even better results are achieved. If a direct intervention in the self-concept of women is desired, it was shown that assigning more responsibilities made them take a more dynamic attitude within class, achieving the best percentage increase within the experiment.

Future works would seek to use an increased sample size, adding various types of activities to find out which activity achieves the greatest impact. Other areas of further work would be to find the correlation between self-concept in women and academic performance considering different levels within Bloom's taxonomy, so as to know which is the most appropriate for women studying in STEM disciplines. Finally, the increase in self-concept will be crossed with the retention rate of the students who participated in the intervention of activities in the classroom, in order to determine whether these activities contribute positively to the retention of women.

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