

**[ M A T  
R I X ]**

**Panel:  
“Impact Evaluation in  
science vocation”**

# How to evaluate STEM education & communication activities

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# Overview

- Why to evaluate
- What to evaluate
  - STEM stance variables
- How to evaluate
  - Collections of instruments
- Past and on-going evaluation efforts

# Why evaluating STEM education and communication activities?



- STEM non-formal education, communication and outreach activities are **professionalizing**
  - **Need of specific knowledge production**
  - **Too many doubts** regarding the impact of what we do
  - **Unrealistic culture** of “feasible/plausible impact”

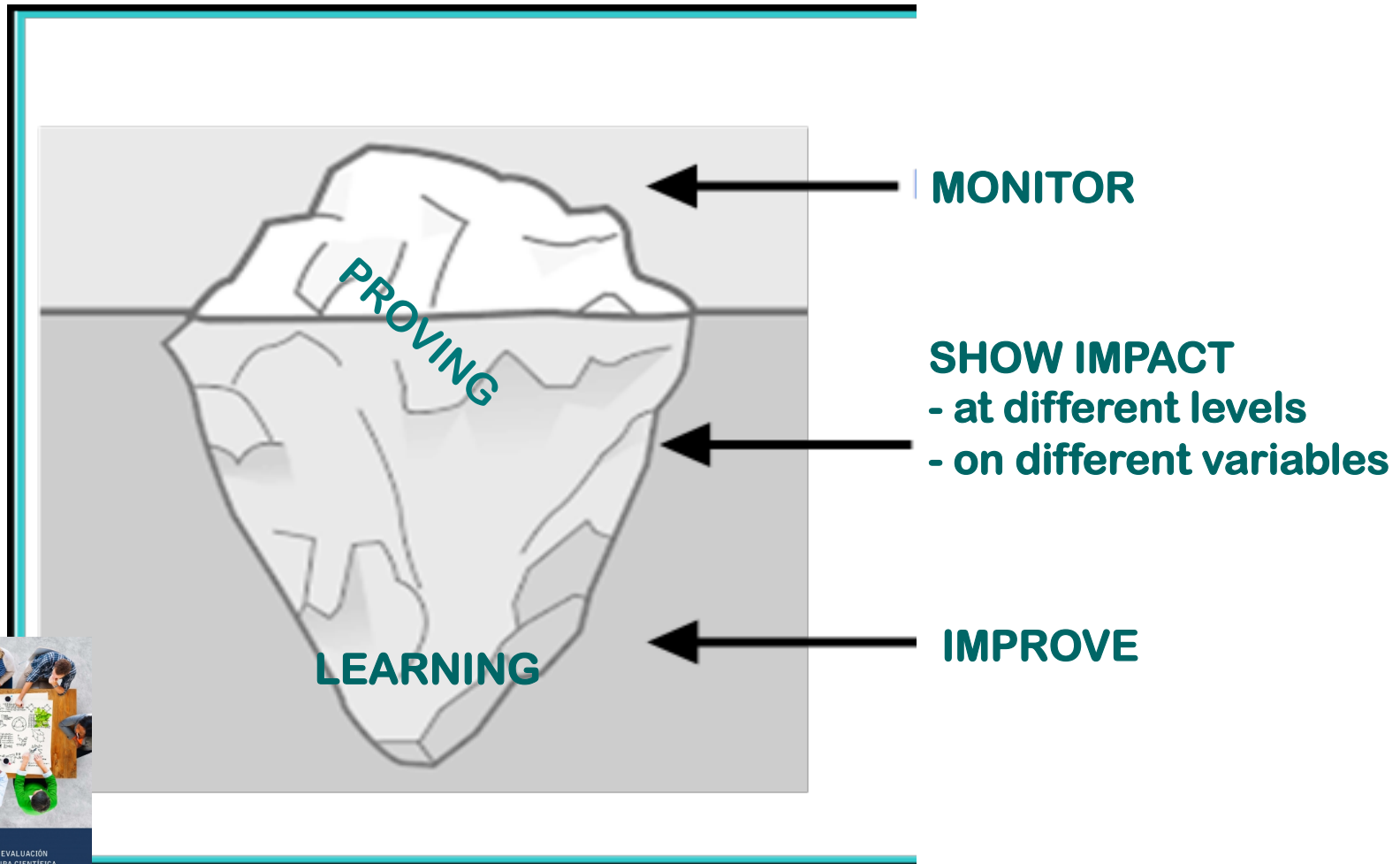
# Why evaluating STEM education and communication activities?



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  - **Unrealistic culture** of “feasible/plausible impact”
- Objectives of STEM communication have changed: **higher expectations!**
  - Information and literacy is not an objective anymore
  - **Real engagement and active participation** is the new goal (RRI paradigm)
  - There are important worries
    - **STEM vocations**: issues of quantity, quality, diversity, equity, gender
    - **Critical thinking in the post-truth era**: pseudo-science, activism, ...



# Why to evaluate?



GUÍA BÁSICA PARA LA EVALUACIÓN  
DE PROYECTOS DE CULTURA CIENTÍFICA

# What to evaluate?



- Evaluation of
  - **Design**
  - **Implementation**
  - **Effect**
    - Immediate impact
    - Short-term impact
    - Long term impact
- Regarding your objectives!
- Objectives have to be **SMART**:
  - **Specific**
  - **Measurable**
  - **Achievable**
  - **Relevant**
  - **Time-bound**

## **BE AWARE!!!**

**Your mission is not your objective for a particular project. Your mission is your dream!**

**Your objectives can't be those exactly of the call you are applying. You have an specific way of achieving the call objectives!**

# How to evaluate? Choosing indicators



- We need to identify indicators we can and want to measure
- Indicators are different regarding **what we evaluate**
  - Design (e.g. Efficiency)
  - Implementation (e.g. Accessibility, Sustainability)
  - Impact
- And regarding **why we evaluate at which level**
  - Monitoring (e.g. Coverage)
  - Proving level X of impact (e.g. Learning via pre-post comparison)
  - Improving (e.g. Relevance)

# How to evaluate? Choosing indicators



**IMPACT OF THE ACTION**

**PERCEPTION OF IMPACT OF THE ACTION**

**OPINION ON ACTION**

**ACTION**

TELL ME THREE EXAMPLES OF NANOTECH APPLICATIONS YOU DIDN'T KNOW BEFORE THE ACTIVITY

AT WHICH DEGREE DO YOU THINK THE ACTIVITY HAS HELPED YOU TO KNOW NEW STEM PROFESSIONS?

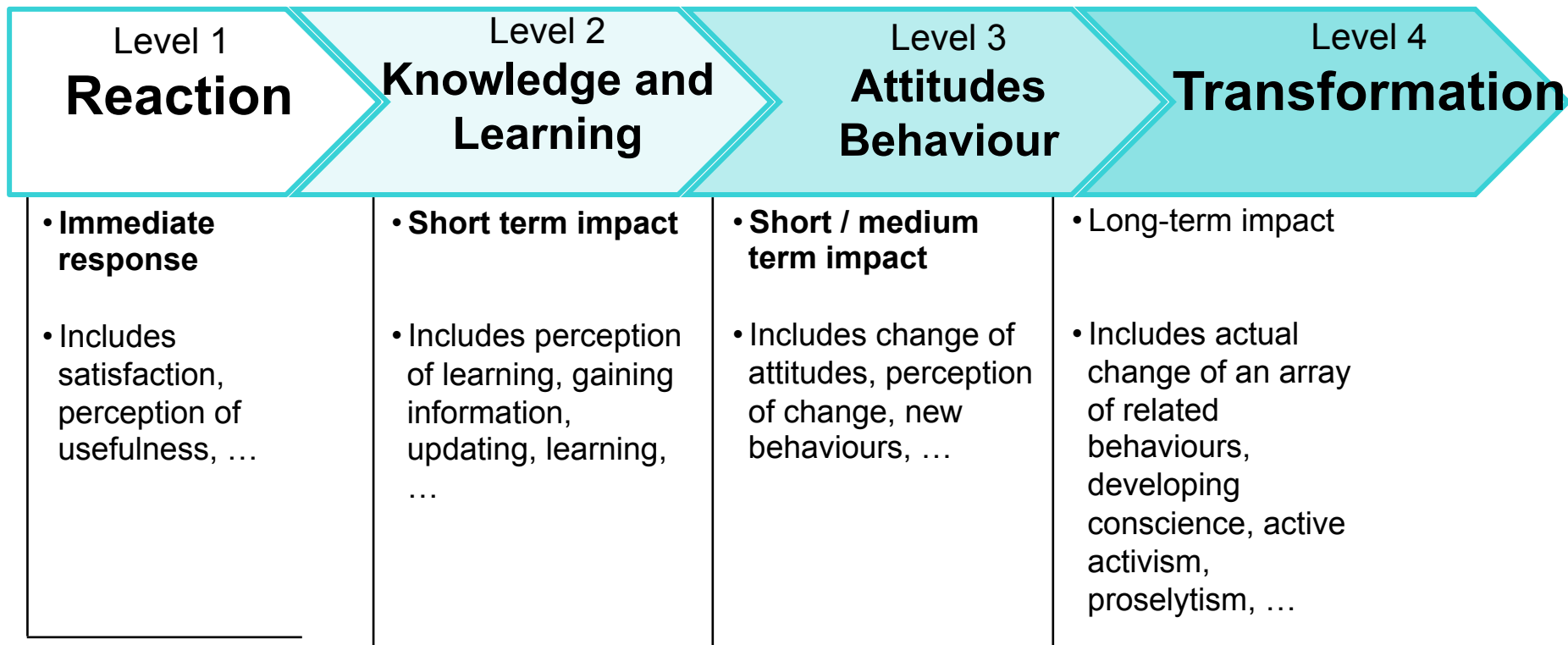
WHAT DID YOU LIKE MORE OF THE ACTIVITY?





# How to evaluate? Levels of impact

- Choosing a reasonable, feasible, plausible **level of impact** (in agreement with the coverage, degree of contact, potential public, level of investment,...

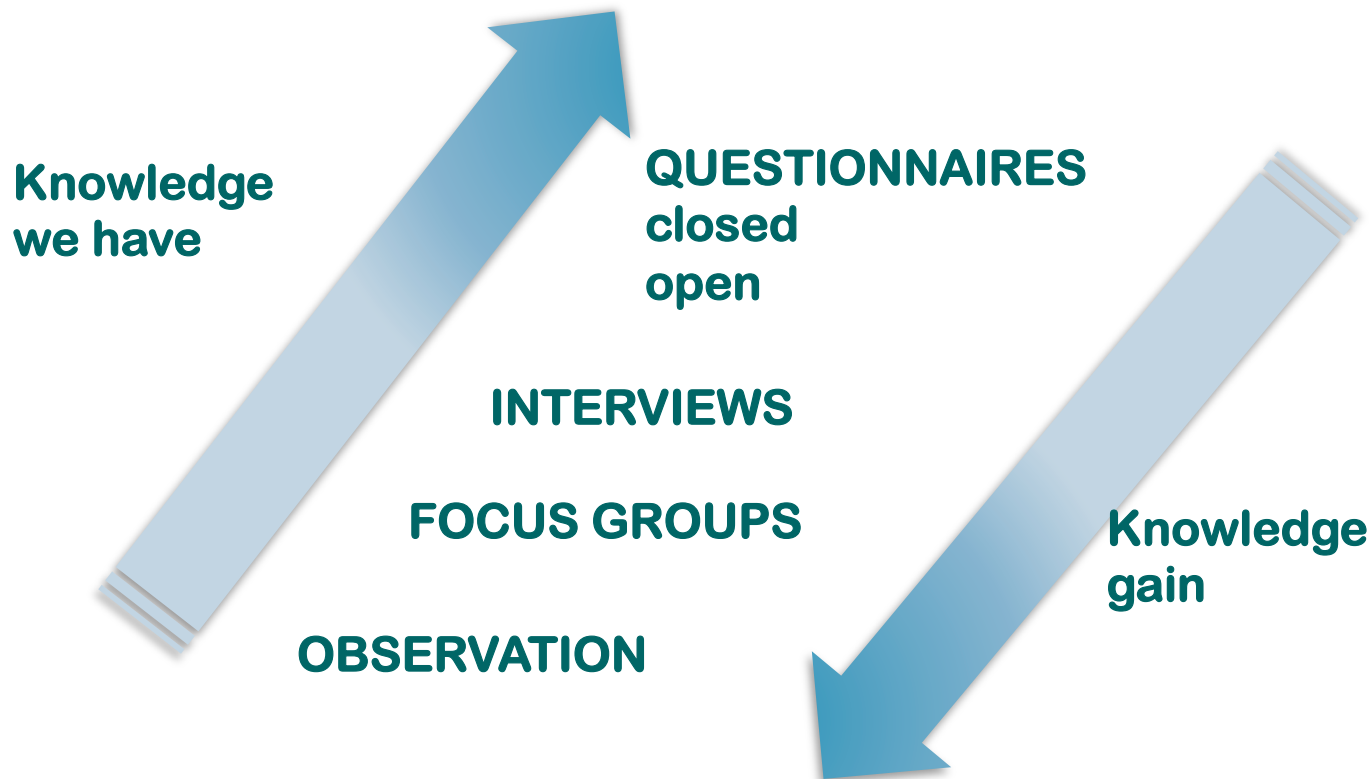




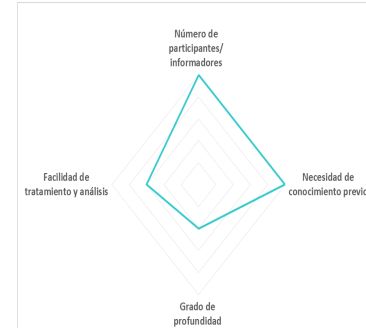


# With what tools?

- Selecting tools taking into account
  - What we already know about the variable to test
  - How much do we want to know

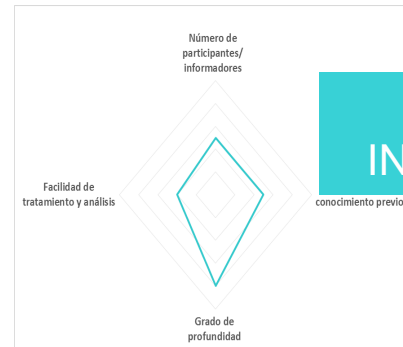
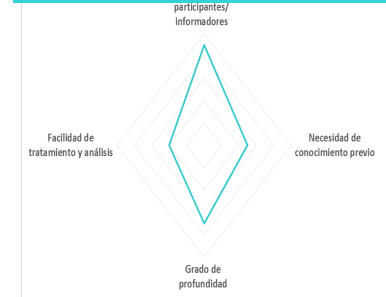


# Tools

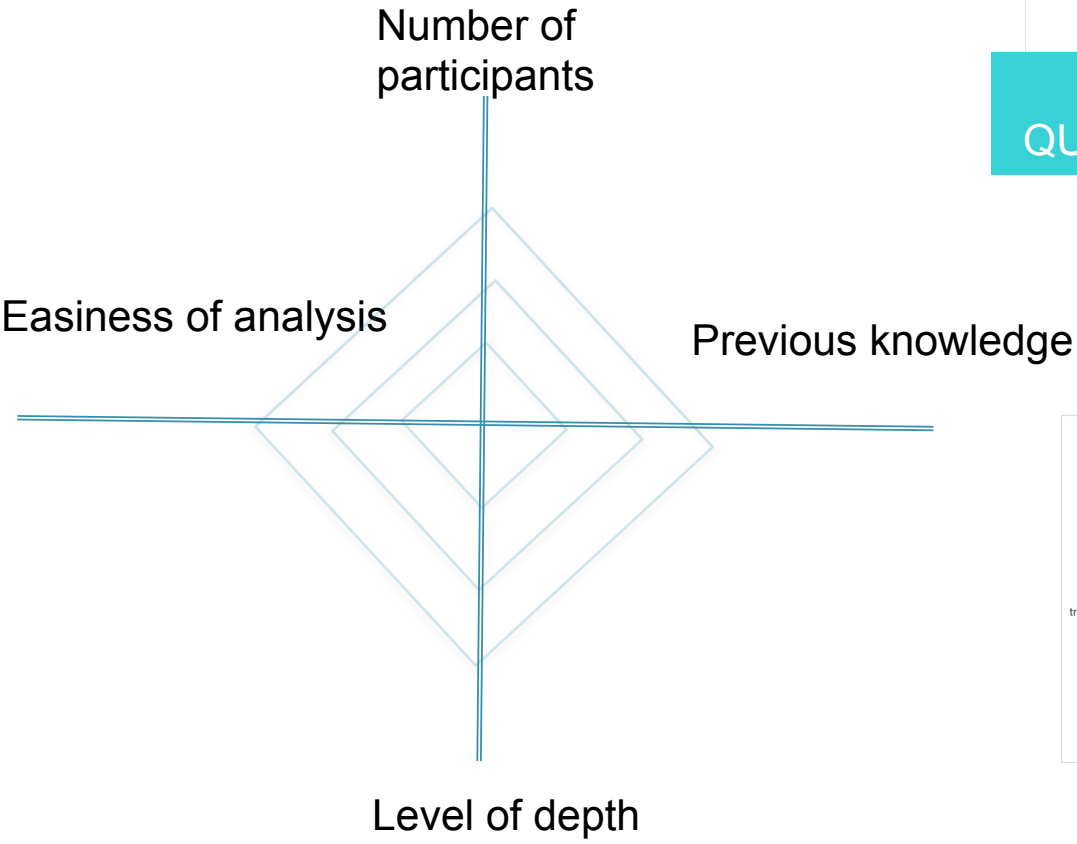


**CLOSED QUESTIONNAIRES**

**OPEN QUESTIONNAIRES**



**OPEN INTERVIEW**



# For example



- Using existing tools ([www.steam4u.eu](http://www.steam4u.eu) )

# 3 Final ideas about evaluation



- **Tell me what you evaluate and I will tell you who you are...**
  - Evaluation guides action, it has to be there from the beginning
- **We do much more than we evaluate**
  - Select what to evaluate
- **We evaluate mostly to improve...**
  - Formative evaluation to learn and change what we do.
- **Evaluate in an ethical way!**

**Moltes gràcies!**

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# IMPACT EVALUATION OF STEM OUTREACH ACTIVITIES



Obra Social "la Caixa"



an NTT DATA Company



**UAB**  
Universitat Autònoma de Barcelona



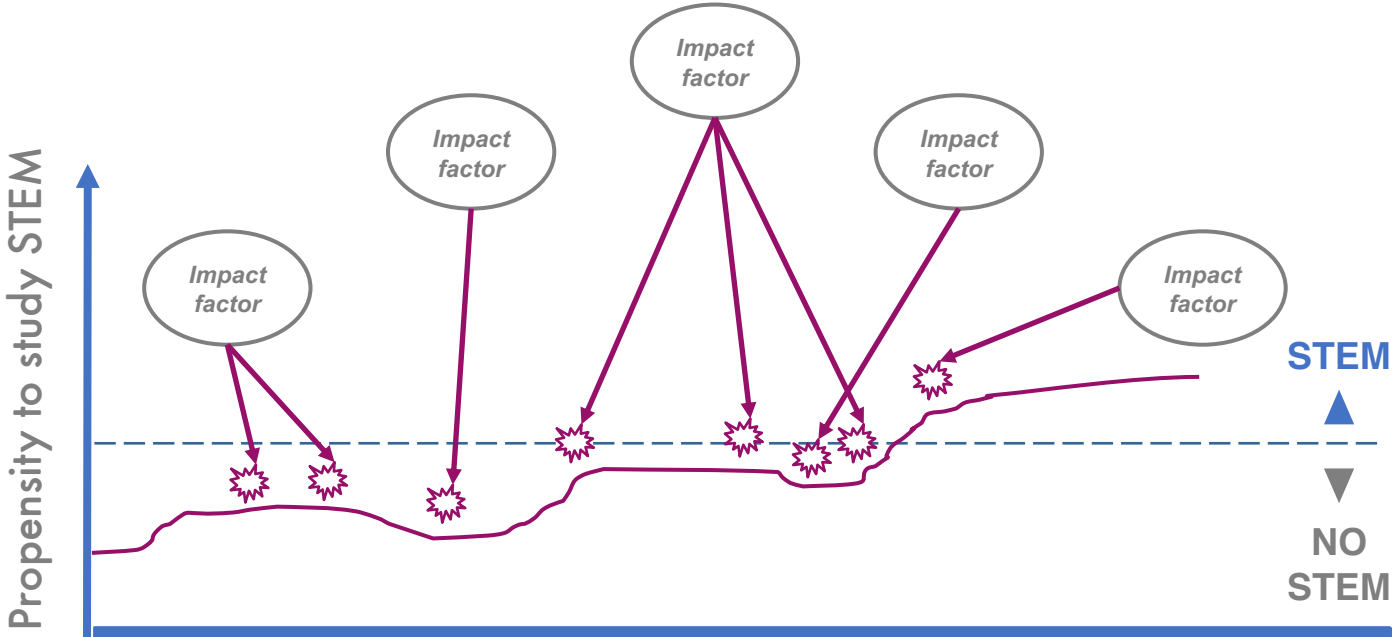
**Universitat Pompeu Fabra**  
Barcelona



# AN IMPORTANT GOAL OF STEM OUTREACH ACTIVITIES

FOSTERING STEM VOCATIONS

INCREASE THE INTEREST IN STUDYING STEM



# OUR GOALS

IS THE ACTIVITY  
WORKING PROPERLY?

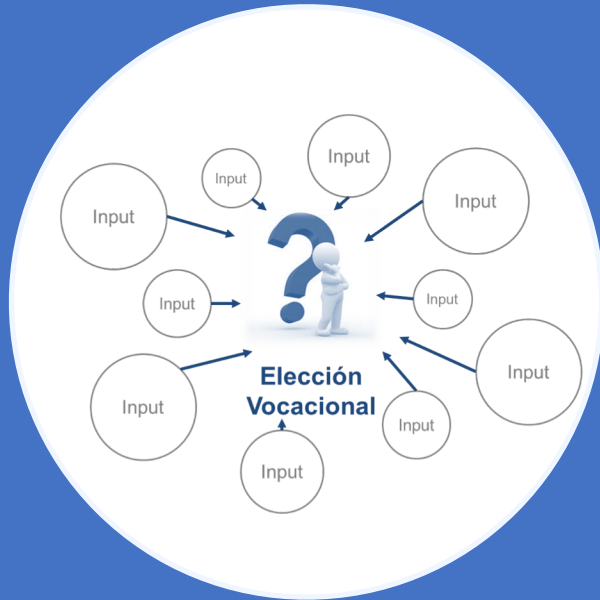
WHAT IS THE PARTICIPANTS  
GROUP LIKE?  
WHICH ARE ITS INTERESTS?

WHAT IMPACT DO WE HAVE ON  
PARTICIPANTS?

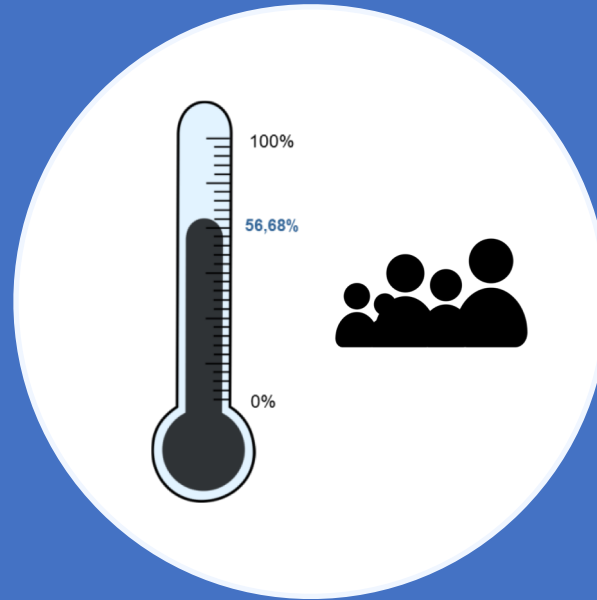
HOW CAN WE IMPROVE?



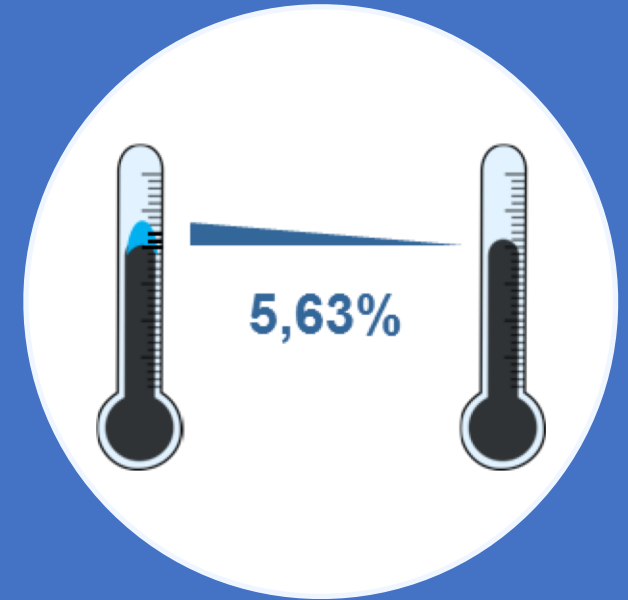
# OUR GOALS



IDENTIFY THE KEY  
INFLUENCING FACTORS  
IN STUDENTS' CAREER  
CHOICES



MEASURE THE  
PROPENSITY OF  
STUDENTS TO STUDY  
STEM AND  
CHARACTERIZE THEM



EVALUATE THE IMPACT  
THAT A STEM OUTREACH  
ACTIVITY HAS ON THIS  
PROPENSITY

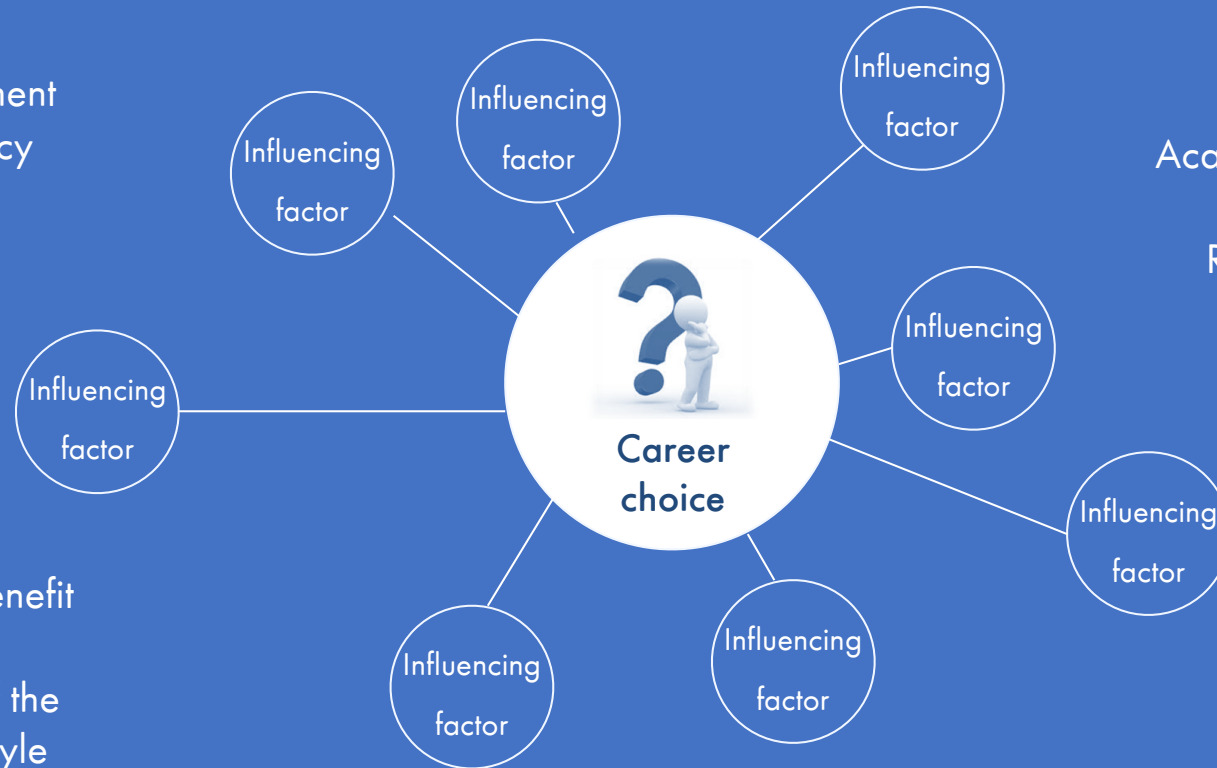
# INFLUENCING FACTORS

**STUDENT**  
Interests, STEM Achievement  
expectations, Self-efficacy

**SOCIAL CONTEXT**  
Perception of the social benefit  
of STEM  
Professions, Perception of the  
STEM professionals lifestyle

**EDUCATIONAL CONTEXT**  
Academic performance in STEM, Perception  
of teacher's perceived opinion,  
Recommendations/guidance received

**IMMEDIATE CONTEXT/FAMILY**  
Perception of parent's perceived  
opinion, Economic, social and cultural  
status of the  
family



30+ POTENTIAL INFLUENCING  
FACTORS CONSIDERED

70+ ACADEMIC REFERENCES

# INFLUENCING FACTORS

## PERSON CLOSE TO THEM WORKS/STUDIES IN STEM FIELD

Student's perception of having a close family member (parents, brothers/sisters) working or studying in a STEM field

## ACCEPTED INFLUENCE (PARENTS)

Influence of parents accepted by the student regarding their choice of career



## PERCEPTION OF PARENTS' OPINION

Student's perception of the opinion that their parents have regarding their competencies and capabilities in STEM



## Immediate Context Family

## ECONOMIC, SOCIAL AND CULTURAL CAPITAL OF THE FAMILY

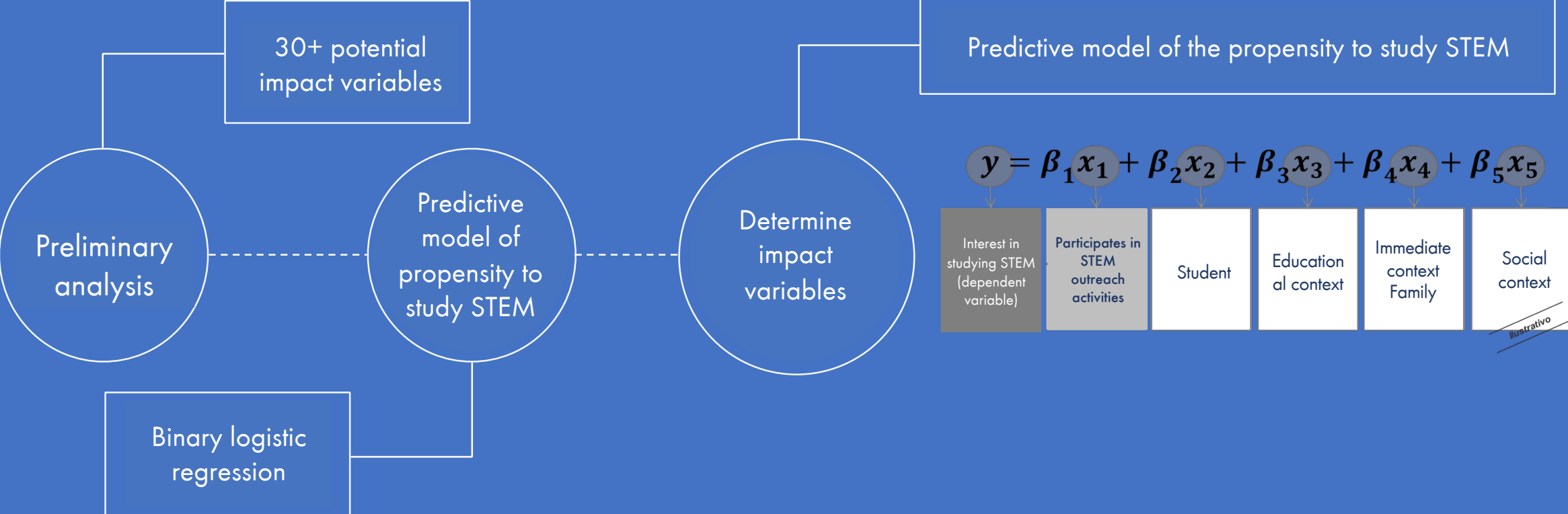
Economic, social and cultural status level of the student's family



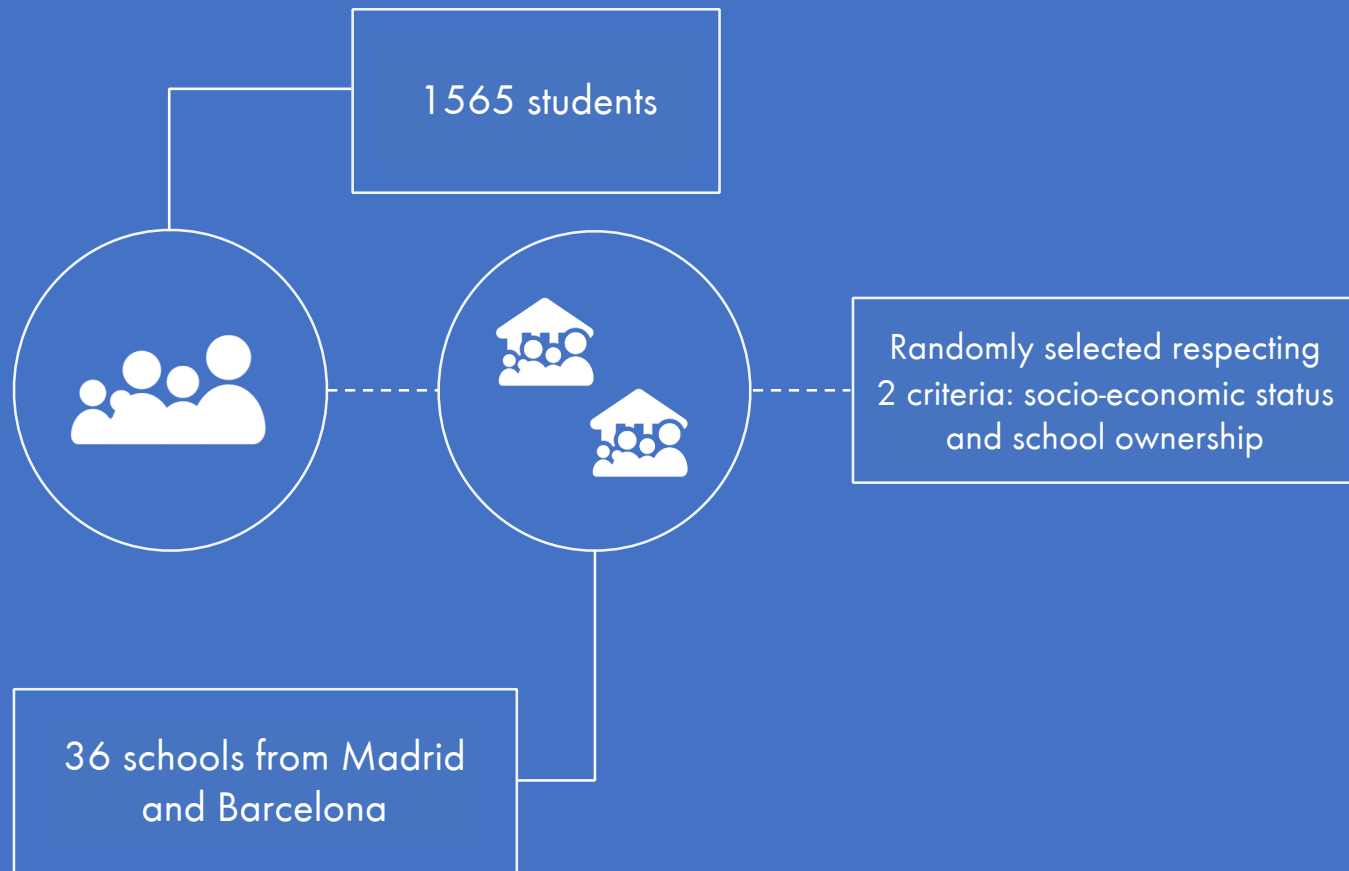
## ACCEPTED INFLUENCE (FRIENDS/PEERS)

Influence of friends/peers accepted by the student regarding their choice of career

# PREDICTIVE MODEL



# SAMPLE



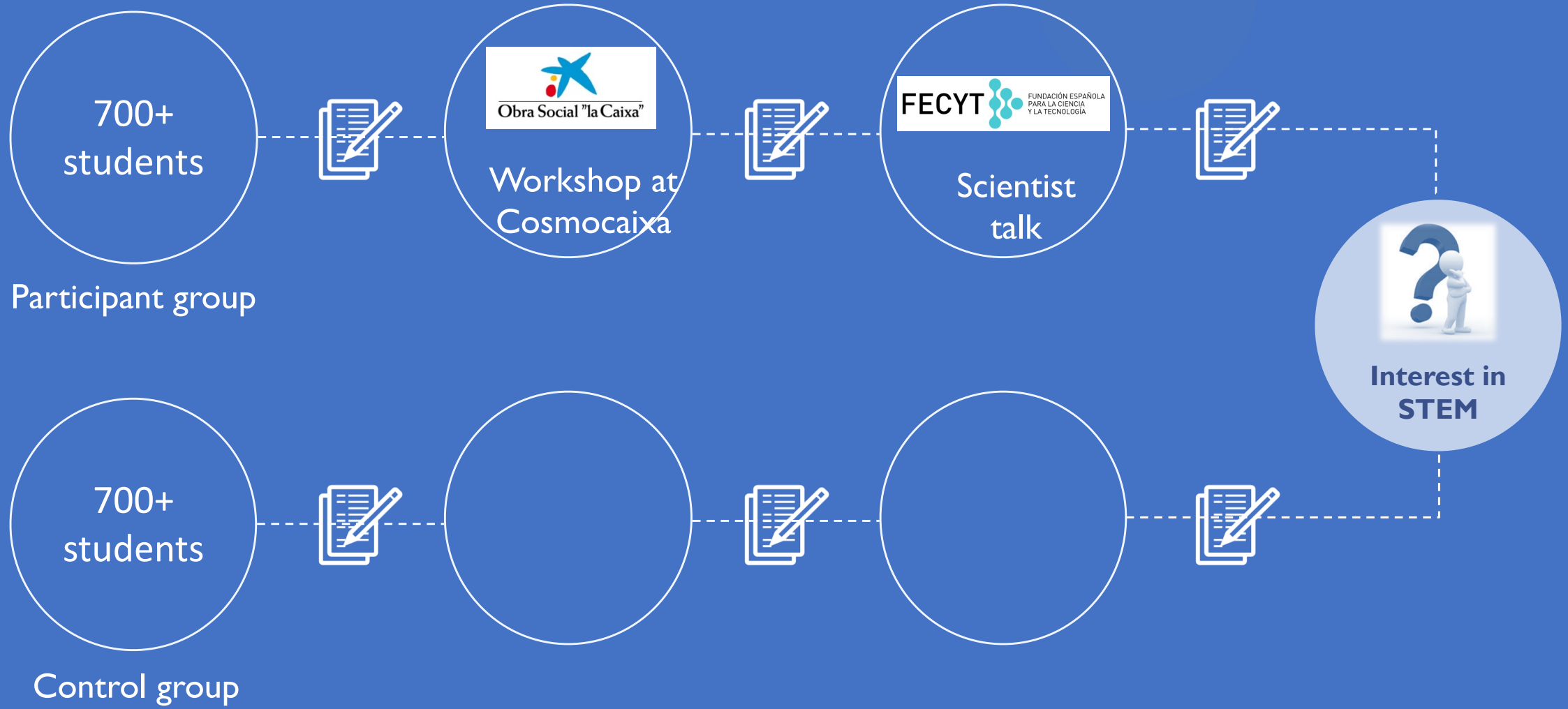
Group	# students
Participating group	849
Control group	716

City	# students
Madrid	764
<b>Barcelona</b>	801

Socio-economic status	# students
High	195
Medium	939
Low	431

Ownership	# students
Public	536
Chartered	955
Private	74

# EXPERIMENT DESIGN

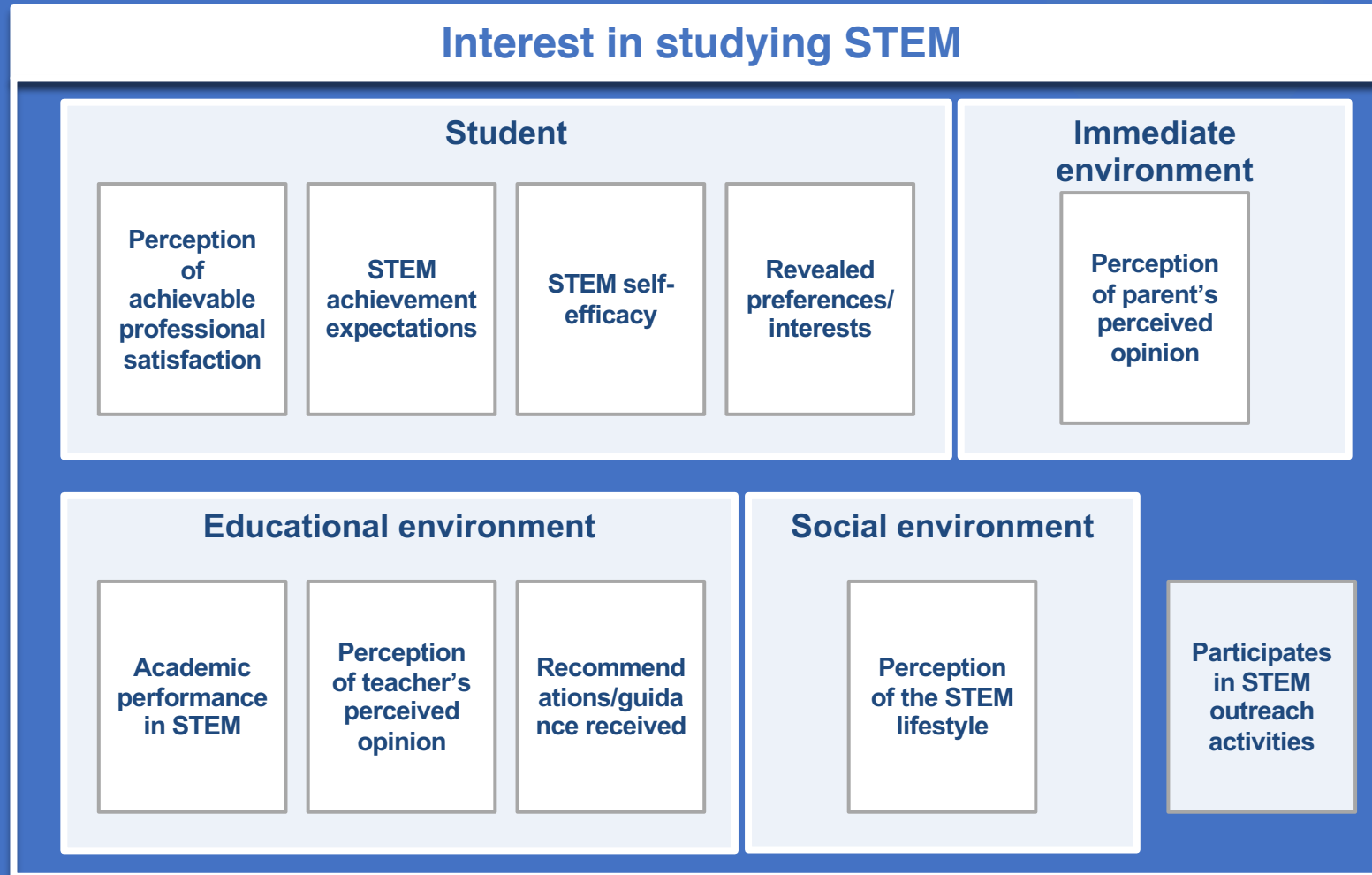


Conditions:

- 14-16 years old students
- Madrid and Barcelona



# RESULTS: KEY VARIABLES



Model's predictive capacity: 85.7%

# RESULTS: TOOLS

## RECOMMENDATIONS

Based on the study carried out, a set of recommendations was created in order to design and implement outreach activities and educational programmes in relation to STEM careers.

Focus on girls and low family socio-economic status

Impact on undecided students and those with a moderate predisposition towards work

I feel capable, I can see myself doing it and I like it: key to students with STEM careers

The opinion perceived from teachers and parents is vital for STEM careers

Friends' influence facilitates the impact of outreach activities

Improved career guidance furthers interest in studying STEM

Stem lifestyle models and a view of the social benefits of science have a positive impact

# RESULTS: TOOLS

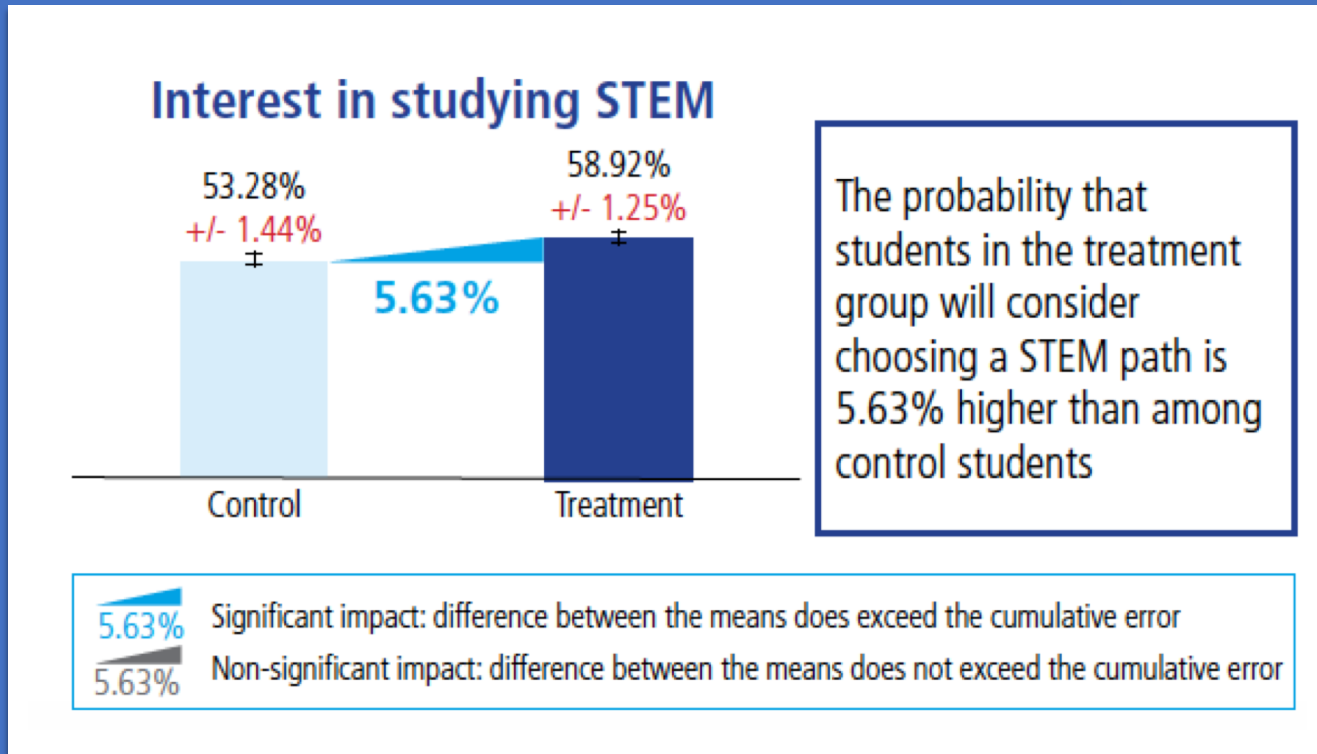
## IMPACT EVALUATION KIT

The kit consists of a questionnaire whose answers are incorporated into the logistic regression statistics engine, implemented using spreadsheets, and it displays the propensity of an individual or group of individuals to study STEM, as well as their characterisation according to the impact variables

## STUDY ON OUTREACH ACTIVITIES

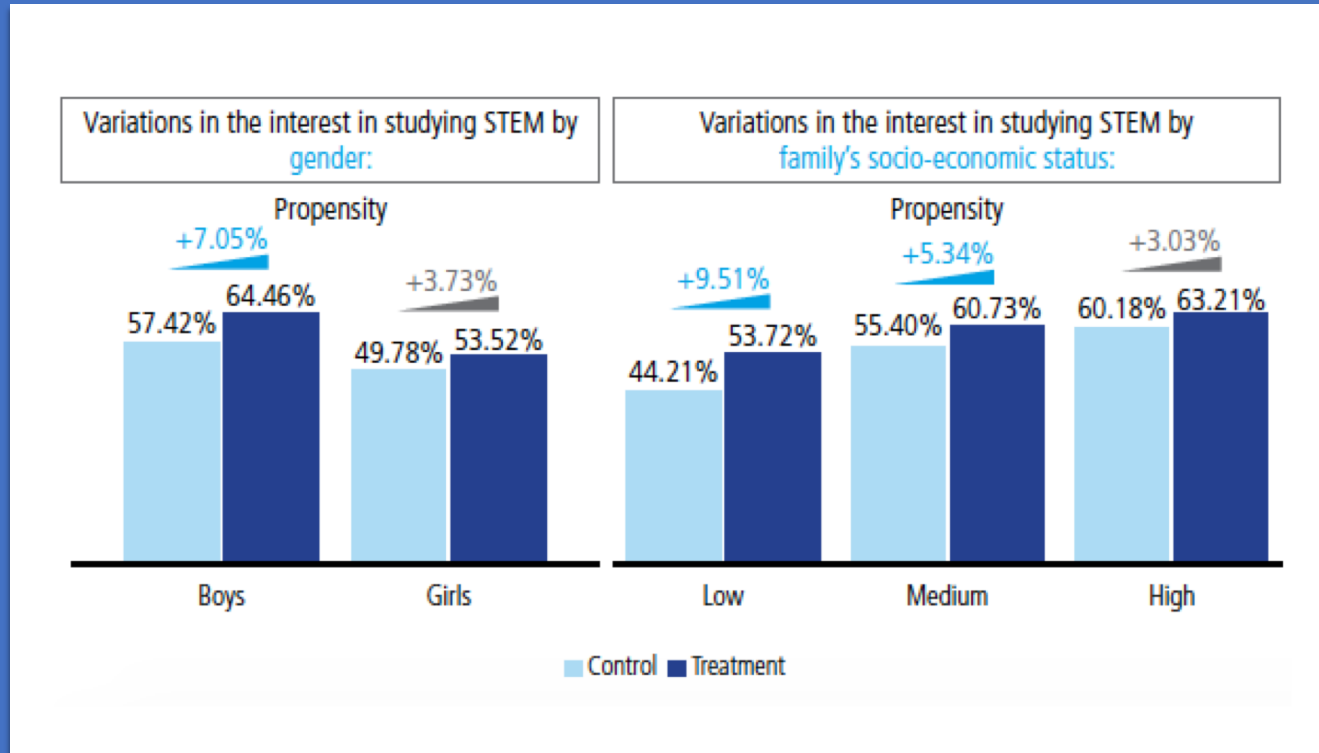
Application of the predictive model to some outreach activities.

# RESULTS: STUDY



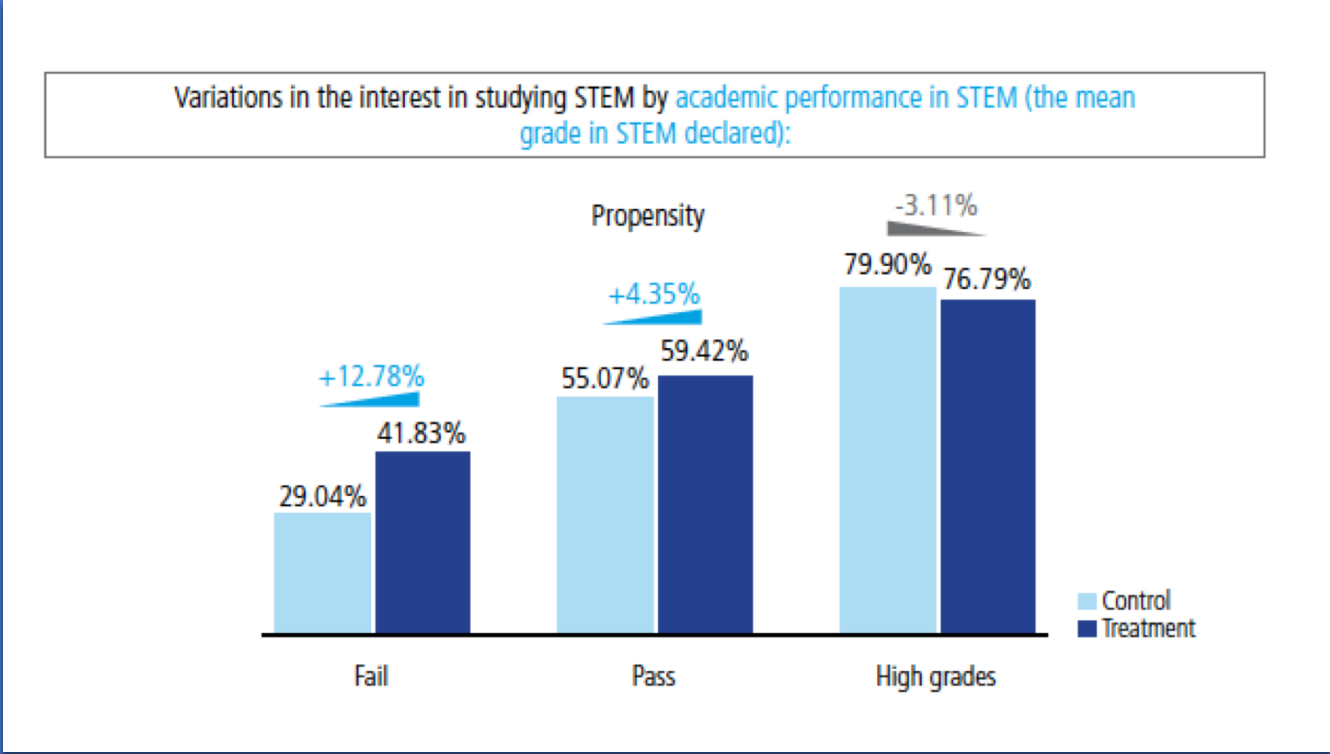
Outreach activities have an impact  
on STEM careers

# RESULTS: STUDY



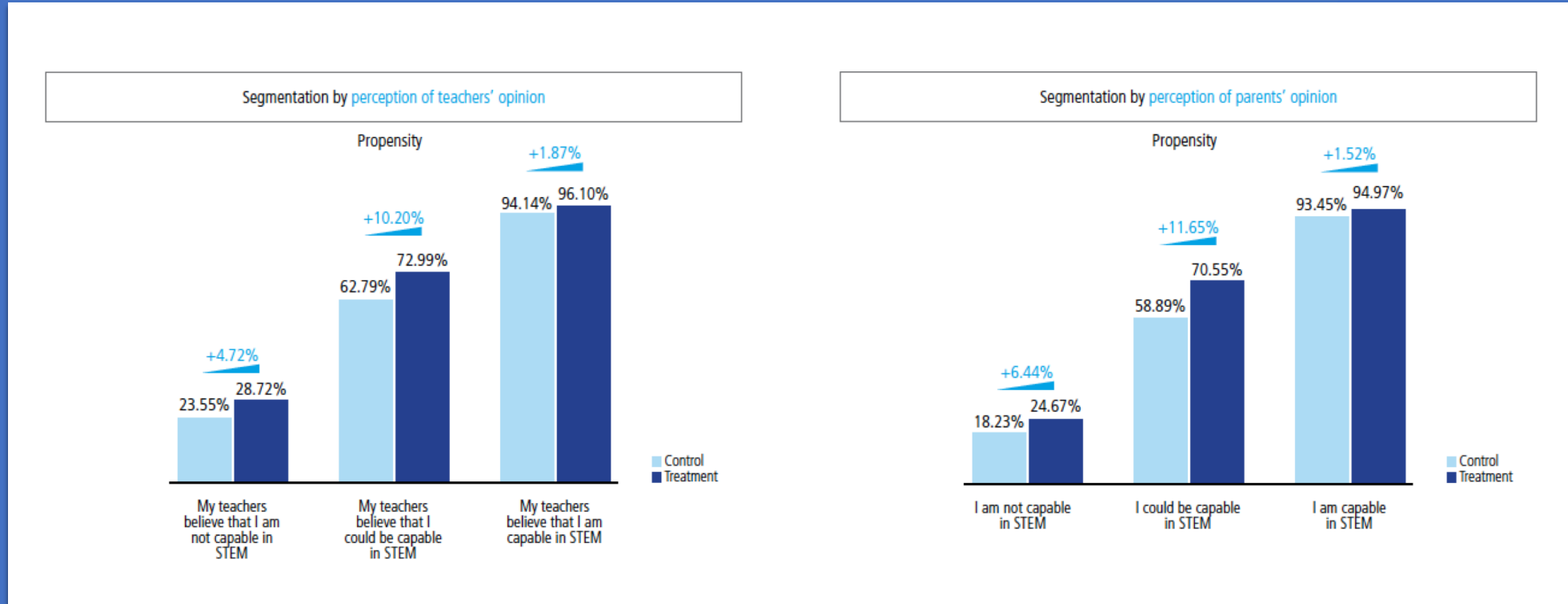
No impact on girls.  
Important impact on low socio-economic status  
context students

# RESULTS: STUDY



Very positive impact on lower-performing students

# RESULTS: STUDY



The perceived opinion of teachers and parents is key in STEM careers

# THANK YOU!

Download the study:

English

<https://www.fecyt.es/en/content/how-can-we-stimulate-scientific-mind>

Español

<https://www.fecyt.es/es/publicacion/como-podemos-estimular-una-mente-cientifica>



Obra Social "la Caixa"



an NTT DATA Company



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