HOW SOCIO-SCIENTIFIC INQUIRY-BASED LEARNING (SSIBL) IN COMMUNITIES OF PRACTICE FOSTERS STUDENTS' SCIENCE ATTITUDES AND ACTION COMPETENCE FOR SUSTAINABILITY

Jelle Boeve-de Pauw, Mart Doms, Marie-Christine Knippels & Andri Christodoulou

European Conference on Educational Research
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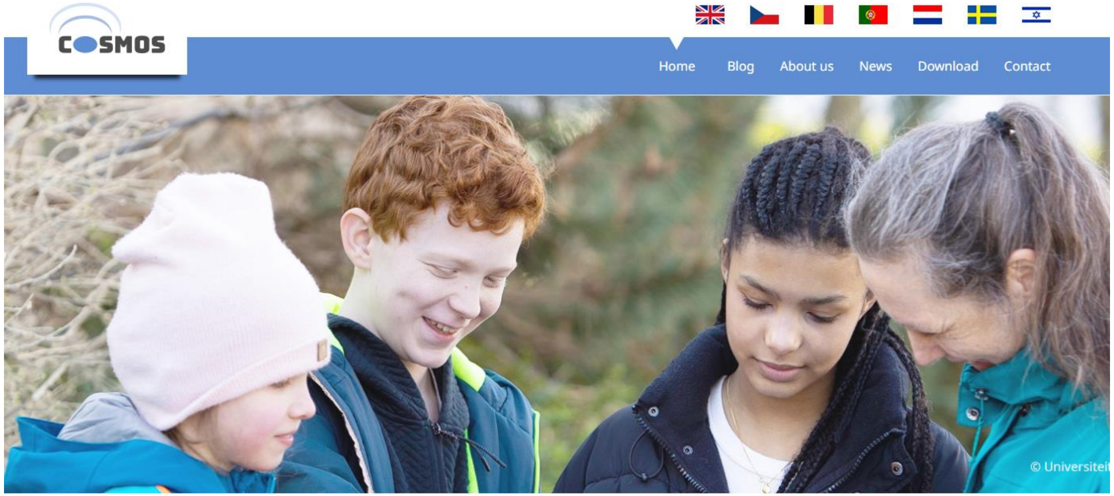
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005982

Open schooling, where schools, in cooperation with other stakeholders, become an agent of community well-being shall be promoted” (EC, 2024)

COSMOS: **C**reating **O**rganisational **S**tructures for **M**eaningful science education through **O**pen **S**chooling for all

HEI & societal partners in each national context (6)



Connecting Science Education to Communities

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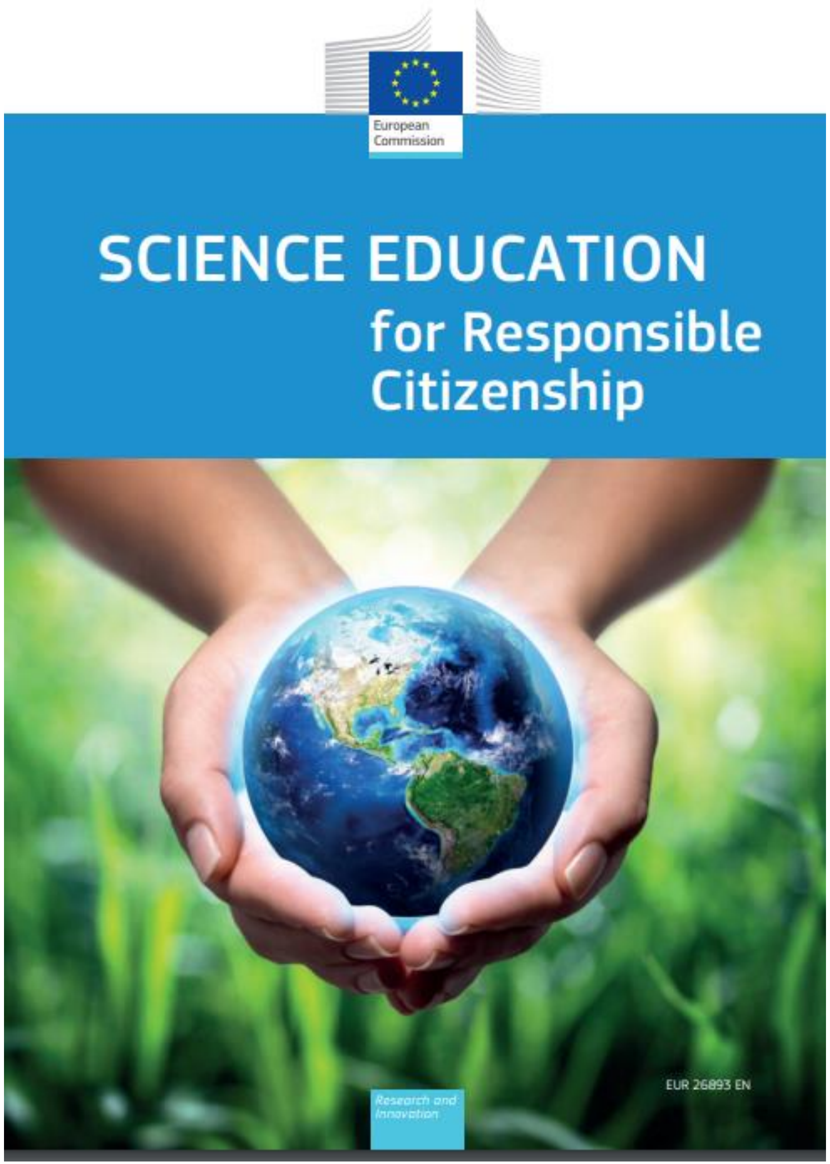
Overcoming these [global] challenges will require all citizens to have a better understanding of science and technology if they are to participate **actively and responsibly** in science-informed decision-making and knowledge-based innovation. It will involve **input from user groups**, specialists and stakeholder groups. Professionals, enterprise and industry have an important role to play. In this way, **everybody learns and benefits from the involvement**.

European Commission (2015)



Major challenges that COSMOS aims to respond to:

- Young people do not see science as relevant for them and their societies (EC, 2015; Struyf et al., 2017)
- Developing global competences including scientific literacy, environmental literacy, and responsible citizenry (OECD, 2023)

How are we responding to these challenges?

Community engagement	Inquiry-based learning	Socio-scientific issues	Action

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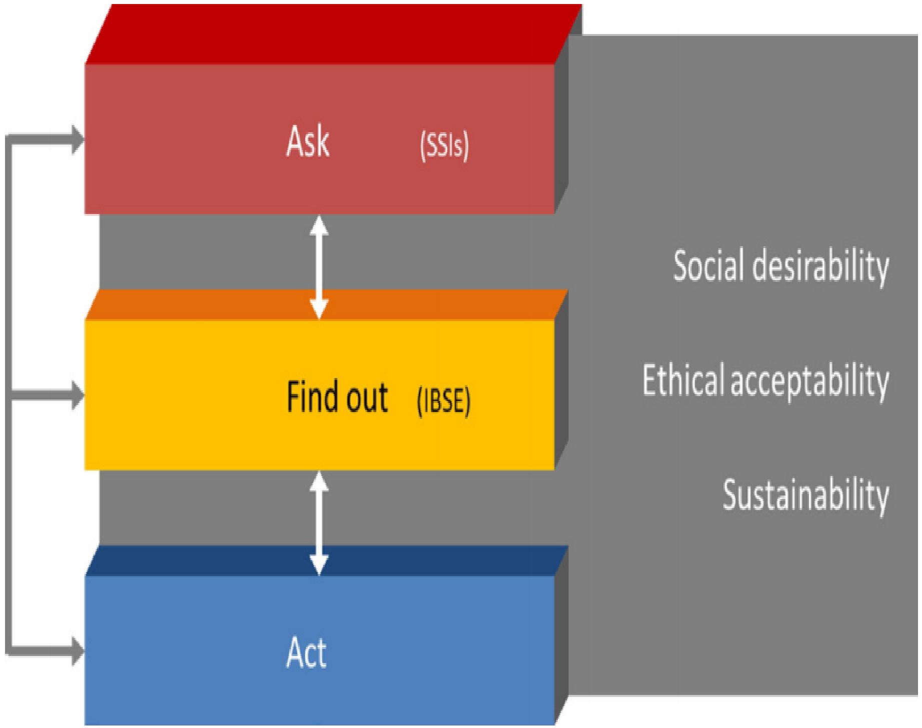
Socioscientific inquiry-based learning (SSIBL)



ASK - Socioscientific Issues (SSIs)
science topics with implications to society (e.g., COVID-19 pandemic, climate crisis). These issues are used to make science **personally relevant** to students, who raise questions about SSIs they would like to investigate.

FIND OUT – inquiry-based science education
Students engage in **investigations** to answer their questions

ACT
Students take **appropriate action** as part of their learning

(Ariza et al., 2021, Levinson et al., 2017, Levinson, 2018)

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What we mean by 'inquiry' in SSIBL

Scientific inquiry

What do I know about the issue? What do I understand about the science of it? What science do I need to know?

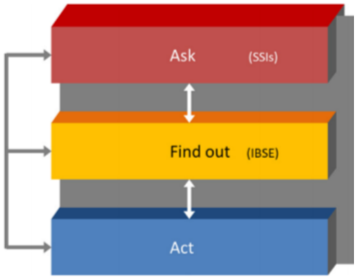
Social inquiry

What do others think? What are the arguments for/against the issue? What factors influence decisions made (economic, values, ethical, moral)?

Personal inquiry

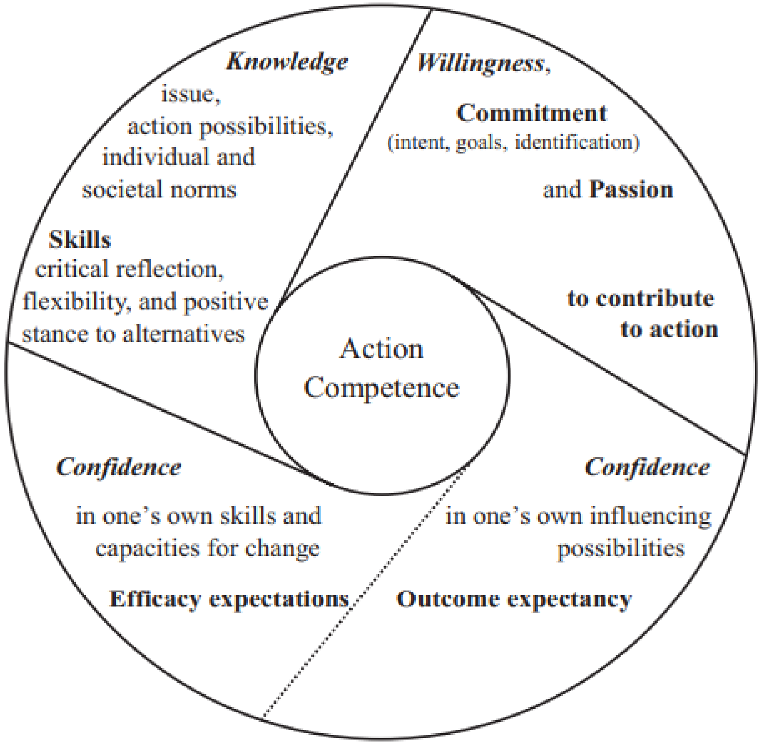
What do I feel/think about the issue and what should be done about it?

FIND OUT



Action competence (Sass et al., 2020)

WHAT WE KNOW
Do we have the knowledge and skills to take action? Do we know what actions are possible?



WHAT WE FEEL
Are we willing to take action? Are we committed and passionate about the issues we are working on?

HOW MUCH WE BELIEVE IN OURSELVES
Do we have confidence in our own skills and abilities to take action?
Do we have confidence in our own ability to influence others/achieve change?

Communities of Practice

CoP: “places were situated learning occurs” (Davidson & Hughes, 2018, p.1289)

- *joint enterprise* – the common aim that brings members together which is agreed and negotiated through collective participation
- *mutual engagement* – participation in the community’s culture and practices
- *shared repertoire* - resources co-created over time (e.g., language, values), within a certain set of social norms and routines developing a shared way of seeing, doing and being, a *shared practice*

(Lave & Wenger, 1991; Wenger, 1999)

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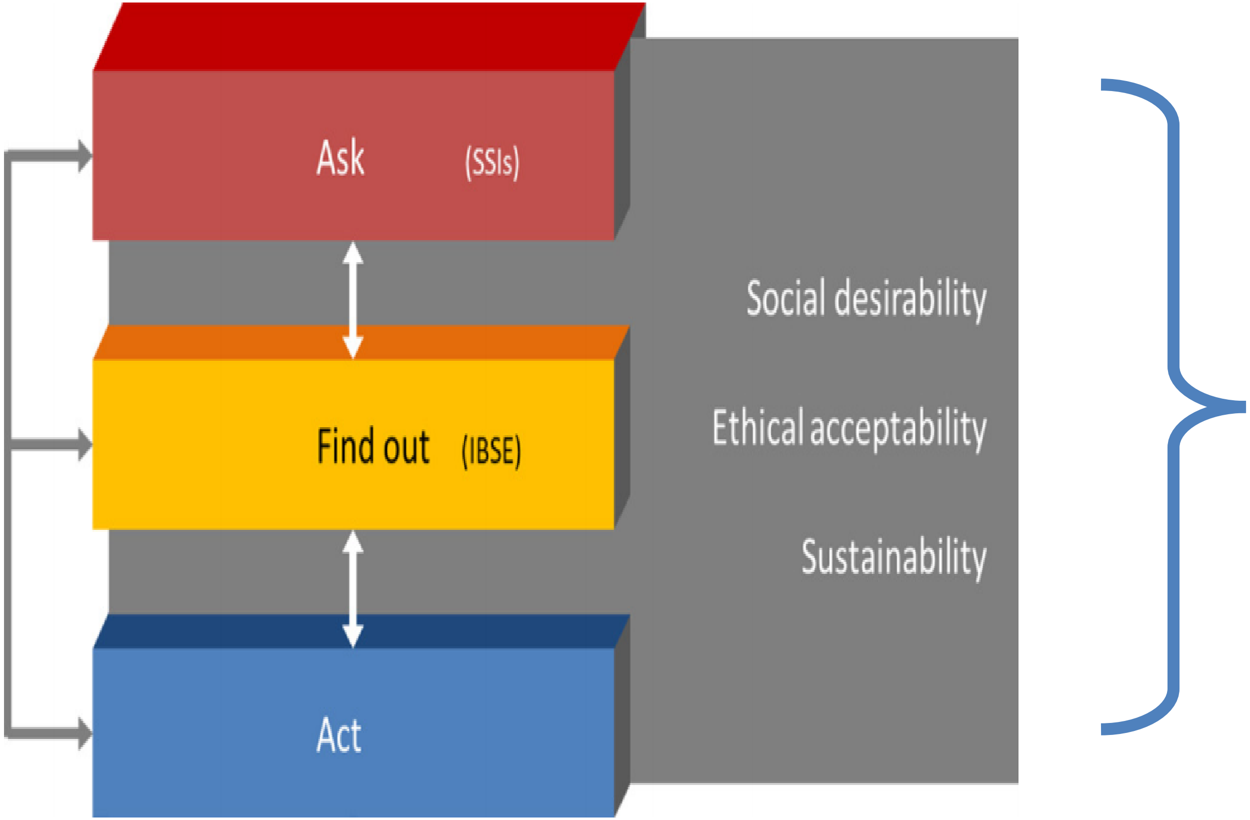
SSIBL & Community engagement



SSIBL-CoP
Community engagement, involvement and participation at each stage

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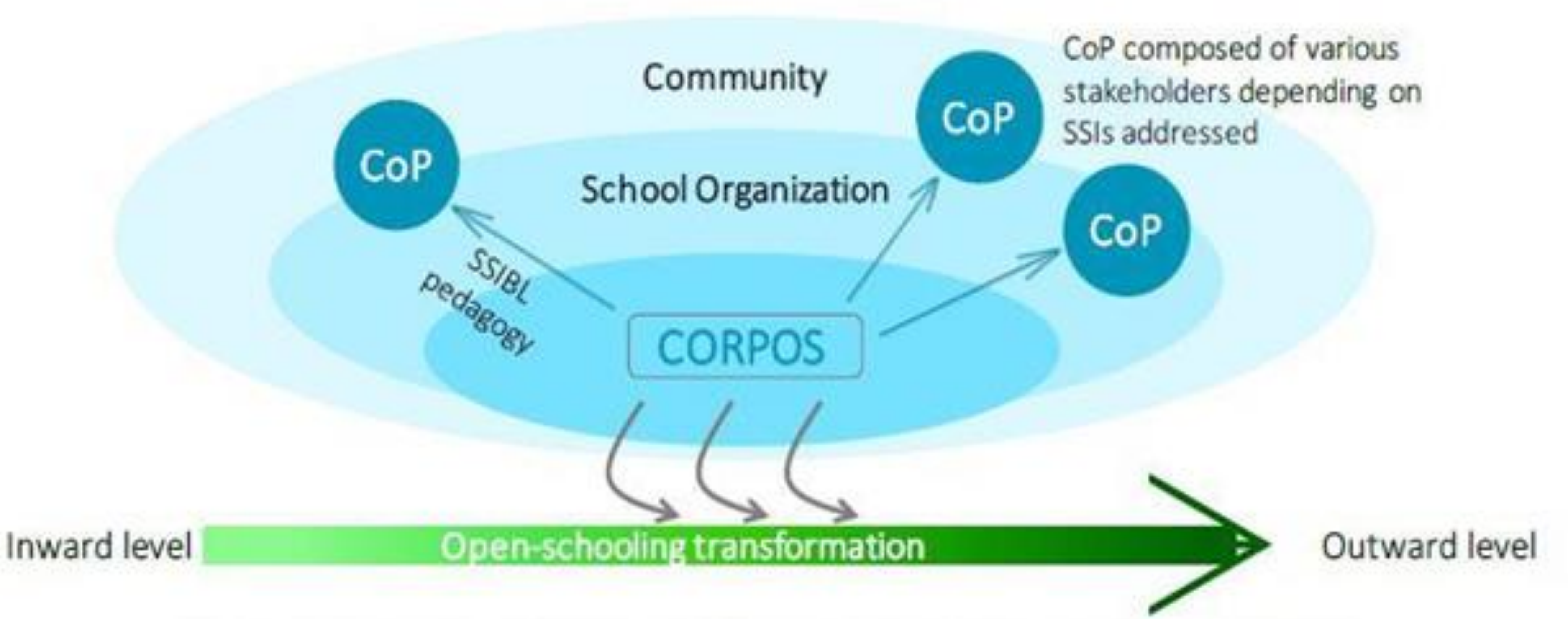
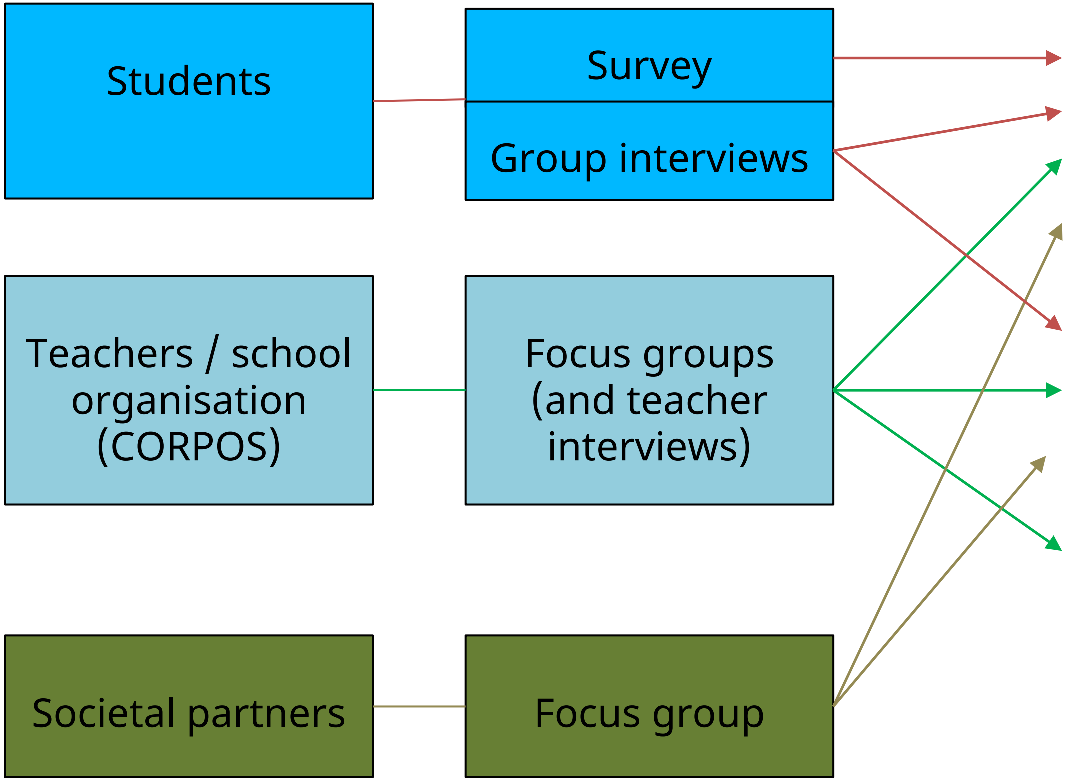


Figure 2. Components and process of open schooling transformation in COSMOS

Evaluative Framework



1. **Stakeholder Outcomes** (EQ1): What is the effect of COSMOS implementation on students, teachers, school organisation and other stakeholders?
2. **Pedagogical Processes** (EQ2): Which are the critical factors that facilitate or impede SSIBL-CoP implementation in the COSMOS schools?
3. **Organisational Processes** (EQ3): Which are the critical factors that facilitate or impede viable and sustainable CORPOSs in schools?

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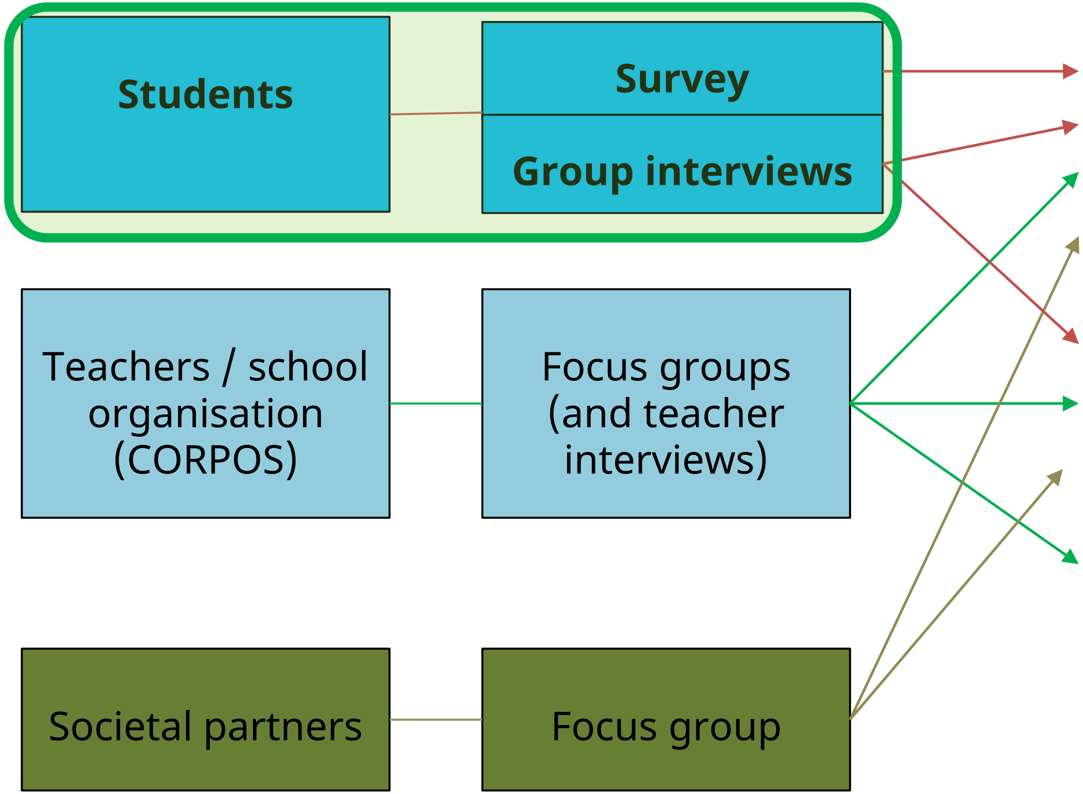
Evaluative Framework



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Methodology

<u>Research question</u>: What is the impact of SSIBL-CoP implementation on students' attitudes towards science and on action competence?

>> Design-based research consisting of two rounds

>> Using a mixed methods data collection process

- Surveys
- Group interviews with students

Round 1: 7 primary & 8 secondary schools in 6 countries (Netherlands, Sweden, UK, Portugal, Belgium, Israel) with teacher teams (40 primary/40 secondary teachers in total) to co-design and implement 'SSIBL-CoP'.

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Evaluative Framework – Overview Round 1

Level	Evaluation action	UU	SOTON	KU	IE-UL	BBC	KdG	Total
Students	Pre survey	23	59	161	65	344	113	765
	Post survey	19	31	103	22	243	62	480
	Pre group interview	X	9	3	4	4	3	23
	Post group interview	5	9	3	3	4	3	27

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Evaluative Framework – Student Surveys

Reconstructing the Pupils Attitude Towards Technology-survey

Jan Ardies, Sven De Maeyer and David Gijbels, Institute of Education and Information Sciences, University of Antwerp, Belgium

RESEARCH

Abstract
In knowledge based economies technological literacy is gaining interest. Technological literacy correlates with attitude towards technology. When measuring technological literacy as an outcome of education, the attitudinal dimension has to be taken into account. This requires a valid, reliable instrument that should be as concise as possible, in order to use it in correlation with other instruments. The PATT instrument as developed in the nineties is an extensive survey that hasn't been revalidated over the last three decades. The Pupils' Attitudes Towards Technology (PATT) instrument was reconstructed and revalidated. The validation study was done in two major steps. First a pilot study with 250 students, followed by a main study with 3000 students. Different factors of the instrument were analysed on their internal consistency. Also the goodness of fit indices of the complete model were checked in a confirmatory factor analysis. This resulted in an instrument with six sub-factors and 24 items of attitude towards technology. The six factors are Career Aspirations, Interest in Technology, Tediousness of Technology, Positive Perception of Effects of Technology, Perception of Difficulty and Perception of Technology as a Subject for Boys or for Boys and Girls. The instrument is easy to use, reliable and validated. It opens a door to further research and evaluation of technology education.

Key words
attitude measurement, technology education, technological literacy

Introduction

pupils and students in scientific and technical education (Stichting Platform Bèta Techniek, 2004); and in many other countries governments are changing the national curriculum to add more technology into the comprehensive curriculum for students.

Although industries and policy makers think technology education is far more relevant these days than it was ever before, the public opinion about studying technology and technical jobs is not very positive (Johansson, 2009). The Organisation for Economic Cooperation and Development's (OECD) report on student interest in Science and Technology (S&T) Studies (OECD, 2008) states that although absolute numbers of S&T students have been rising, the relative share of S&T students among the overall student population has been falling. The report shows that encouraging interest in S&T studies requires actions to improve the image and knowledge of S&T careers. A report ordered by the department of education of the Flemish ministry (Van den Berghe, 2006) concludes that the image of technological studies and professions is rather low and that this contradicts the enthusiasm young people have for new technologies. This negative image is strengthened by some prejudices like: the working conditions in industrial environments are not interesting or even boring; and that these jobs imply hard and dirty labour, combined with moderate payment and bad hours. Moreover people tend to think that science and technology are hard and boring to study. These are widely spread ideas about technology within public opinion (Van den Berghe, 2006). Nevertheless systematic research about youngsters' attitudes towards technology and how these evolve during their school

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Self-perceived action competence for sustainability: the theoretical grounding and empirical validation of a novel research instrument

Daniel Olsson[a], Niklas Gericke[a], Wanda Sass[b] and Jelle Boeve-de Pauw[a,b]

[a]Department of Environmental and Life Sciences, The Faculty of Health, Science and Technology, Karlstad University, Karlstad, Sweden; [b]Research Unit Edubron, Department of Training and Education Sciences, Faculty of Social Sciences, University of Antwerp, Antwerpen, Belgium

ABSTRACT
This study contributes to an operationalization of the concept of action competence for sustainability through the theoretical development and empirical validation of a new 12-item Likert-scale questionnaire: *the Self-Perceived Action Competence for Sustainability Questionnaire*, SPACS-Q. Other scales in environmental and sustainability education (ESE) typically measure concepts such as pro-environmental and sustainability attitudes and behaviors, and therefore do not fully cover the concept of action competence for sustainability. An action differs from a 'mere' behavior in that it is voluntary and targeted at bringing about change, which is the overarching goal of ESE. We define action competence as a latent capacity among individuals to act sustainably. We introduce a novel scale measuring this seminal concept. Totally, 614 Swedish adolescents aged 12-19 participated in this study. The scale includes three latent subconstructs: i) knowledge of action possibilities, ii) confidence in one's own influence, and iii) the willingness to act. Confirmatory factor analyses, reliability measures and investigation of convergent validity reveal a questionnaire instrument with excellent psychometric quality. We put forward that the SPACS-Q is a novel and theory-driven, empirically reliable and valid, instrument, and encourage ... use the SPACS-Q when ...

ARTICLE HISTORY
Received 30 August 2019
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KEYWORDS
Action competence; scale validation; sustainability; questionnaire development; psychometric

Evaluative Framework – Student Surveys

PATS - Subscales (#items)	Sample item
Science career aspirations (4)	A career in science would be interesting for me
Interest in science (5)	Science lessons are important
Tediousness towards science (3)	Most jobs in science are boring
Gendered views of science (3)	Boys are better at science than girls
Relevance of science (4)	Science can help improve our lives
Difficulty of science (4)	You have to be smart to study science

SPACS - Subscale (#items)	Sample item
Knowledge of action possibilities (4)	I know how one should take action at school in order to contribute to sustainable development
Confidence in own influences (4)	I believe I have good opportunities to participate in influencing our shared future
Willingness to act (4)	I want to engage in changing society towards sustainable development

Evaluative Framework – Student Surveys

Pre survey

at teachers' convenience

Individual codes

SSIBL-Cop Implementation

"50 shades of SSIBL-CoP"

Post survey

within 2 weeks after completion of the implementation

Individual codes

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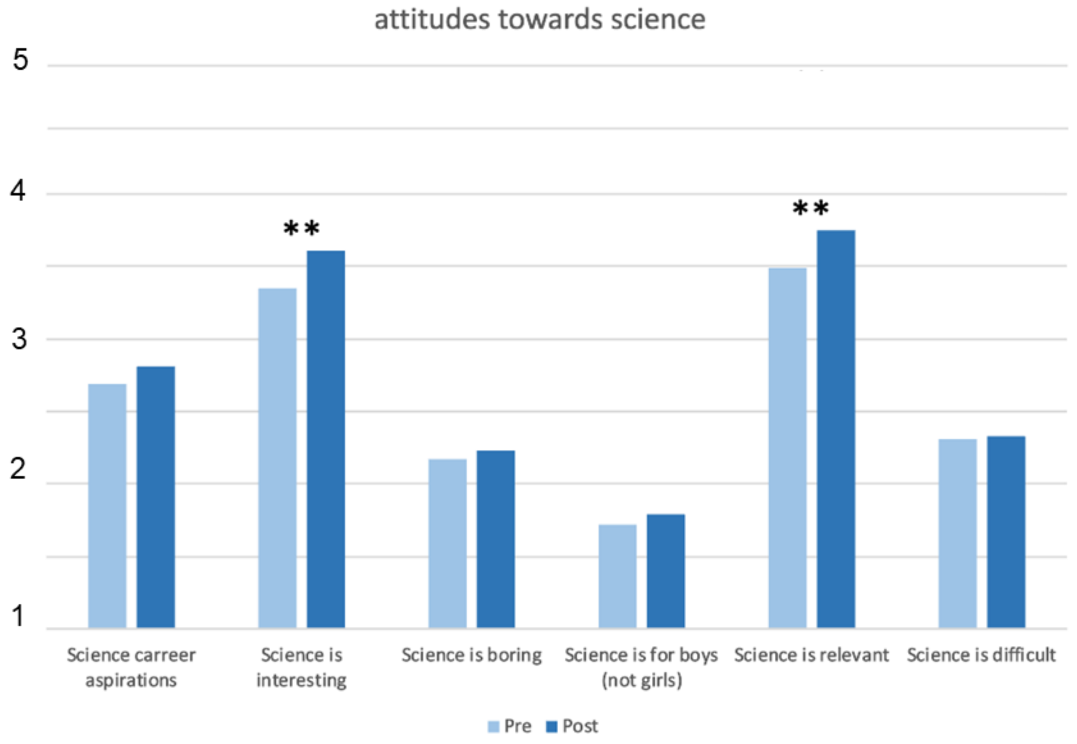
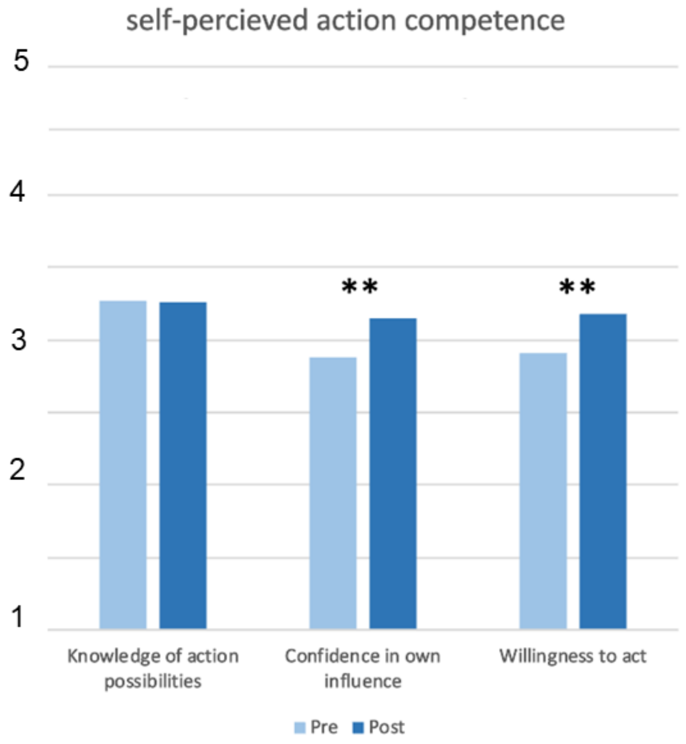
Intermediate results (round 1)

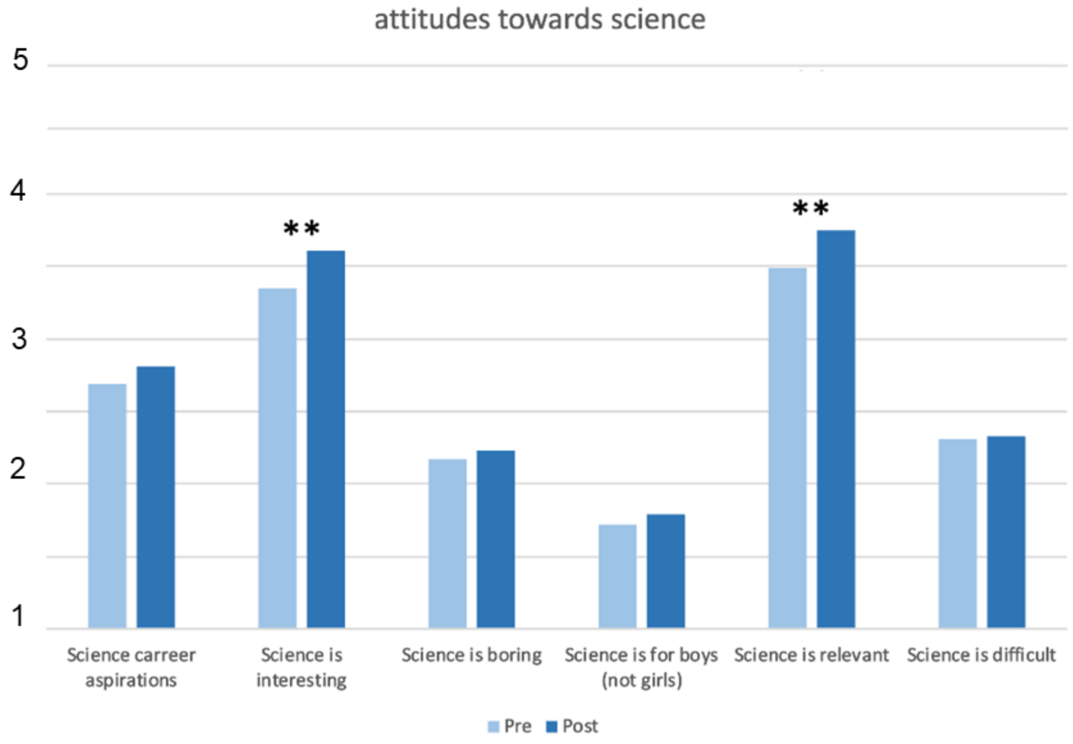
At project level
>> Across all schools

All Cohen's d between 0.2 and 0.5
>> small / moderate





Intermediate results (round 1)



I thought it would be difficult -- and it was.

Yes, it's also real research like this... It's the first time we've done research like this... Yes, that does give you a real glimpse into the world of science and for me it gave me a positive view.

We've all done things that are very socially relevant. Which also already ensures that you really do feel that you can do something for society, so for your daily life.

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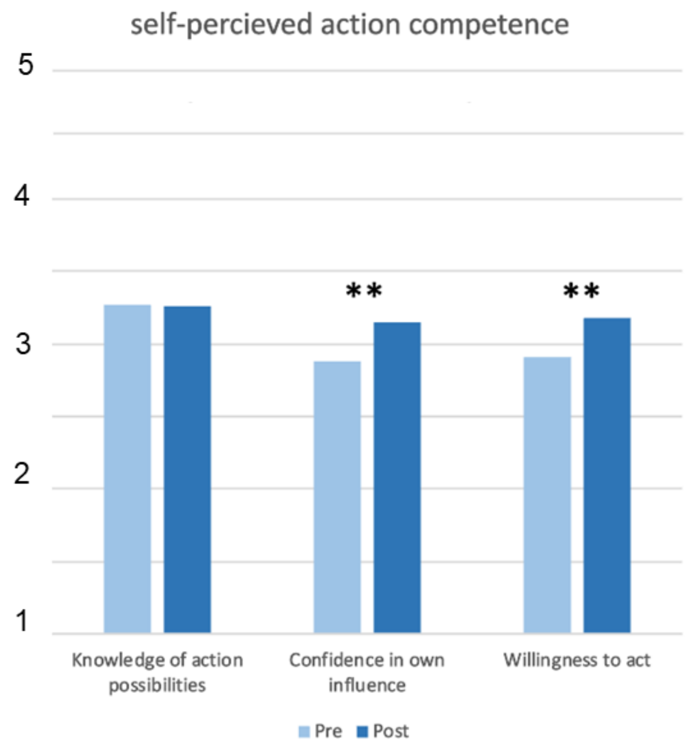
Intermediate results (round 1)

Yes, that when you go to the sports club, that you also bring a reusable drinking bottle....
And that at home, for example, you have a basket or something, where you can reuse all the paper you use... again... yes...

It’s not only, for example, architects or engineers who can change reality, maybe we teenagers.

Yes, I would really like to do something about it anyway....



Intermediate results (round 1)

At school level (TPD)

Discuss in your team

1. Do the attributes that were measured in the survey resonate with the goals of the COSMOS project as implemented at your own school?
2. What do you learn from these results regarding your students' *attitudes regarding scie* and *action competence*, and the impact of participating in COSMOS on these.?
3. Which of these results confirm your own experience?
4. Which of these are surprising for you?
5. What else do you think your students learned that is not reflected in these results?
6. Are these results helpful for you as teachers?
7. (How) do they give direction to your next implementation round in COSMOS?

Discussion point 1: Attitudes towards science

Interest & relevance

- SSIBL-CoP pedagogy supports teaching science in ways that make science more personally relevant for students ("So what")

How do we support teachers and schools in embedding SSIBL-CoP in their practice?

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Discussion point 2: Action competence

Action often takes the form of communication *within* the Community of Practice

- Collective, *indirect* actions are planned and carried out
- CoP members become an audience towards which students can perform/address their actions
- Supports the development of students' confidence to advocate for, and express desired outcomes (Vaealiki & Mackey, 2008)

How can we leverage CoP for action?

How can we move from indirect to direct action as part of action-oriented pedagogical approaches?

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A look into the future

Round 1 & Round 2 ~ 1500 students (after data cleaning)

>> Pair students (logitudinal analyses)

>> Multivariate multilevel regression analyses

>> Effects of implementation round, primary vs secondary, ages, genders (and interactions)

Student group interviews

>> Triangulation

>> Effects beyond the focus of the survey

Focus group disussions with the CoPs in each school

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Thank you for listening!

mart.doms@kdg.be

a.christodoulou@soton.ac.uk

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SAVE THE DATE

Place and Date:
De Vereeniging in Utrecht, the Netherlands
Friday, 22 November 2024

Connecting science education to communities. The COSMOS approach

Invitation to the Final Conference

Event Highlights:

- The results of the three-year collaboration in the COSMOS project will be presented;
- Workshops and round table discussions are on the program for teachers, school leadership, educational researchers and policy makers;
- An opportunity to get to know:
  - COSMOS' pedagogy and framework for Open Schooling in Science Education
  - The school projects and their experiences with the COSMOS approach.

Scan me!

References

Ariza, M.R.; Christodoulou, A., van Harskamp, M., Knippels, M.-C.P.J., Kyza, E.A., Levinson, R., Agesilaou, A. (2021) Socio-scientific inquiry-based learning as a means toward environmental citizenship. Sustainability, 13, 11509.

European Commission (2024). Open Schooling and collaboration on science education. Available at: https://cordis.europa.eu/programme/id/H2020_SwafS-01-2018-2019-2020

European Commission (2015). Science Education for Responsible Citizenship. Brussels: Directorate-General for Research and Innovation Science with and for Society. Retrieved from: https://op.europa.eu/en/publication-detail/-/publication/a1d14fa0-8dbe-11e5-b8b7-01aa75ed71a1

Lave, J. & Wenger, E. (1991) Situated Learning: Legitimate Peripheral Participation. Cambridge University Press, Cambridge, UK.

Levinson, R. (2018). Introducing socio-scientific inquiry-based learning (SSIBL). School Science Review, 100(371), 31-35.

Levinson, R.; Knippels, M.C.; van Dam, F.; Kyza, E.; Christodoulou, A.; Chang-Rundgren, S.N.; Grace, M.; Yarden, A.; Abril, A.; Amos, R.; et al. Science and Society in Education. 2017. Available online: https://www.parrise.eu/wp-content/uploads/2018/0 4/parrise-en-rgb.pdf (accessed on 27 December 2020).

OECD (2023). PISA 2025 Science Framework (draft), May 2023. Available at: https://pisaframework.oecd.org/science-2025/

Sass, W., Boeve-de Pauw, J., Olsson, D., Gericke, N., De Maeyer, S., & Van Petegem, P. (2020). Redefining action competence: The case of sustainable development. *The Journal of Environmental Education*, *51*(4), 292-305, https://doi.org/10.1080/00958964.2020.1765132

Struyf, A., Boeve-de Pauw, J. & Van Petegem, P. (2017). 'Hard science': a career option for socially and societally interested students? Grade 12 students' vocational interest gap explored. Int J Sci Educ, 39(17), 2304-2320.

Wenger, E. (1999). Communities of practice: Learning, meaning, and identity. Cambridge university press.

Vaealiki, S., & Mackey, G. (2008). Ripples of action: Strengthening environmental competency. Early Childhood Folio, 12, 7-11.

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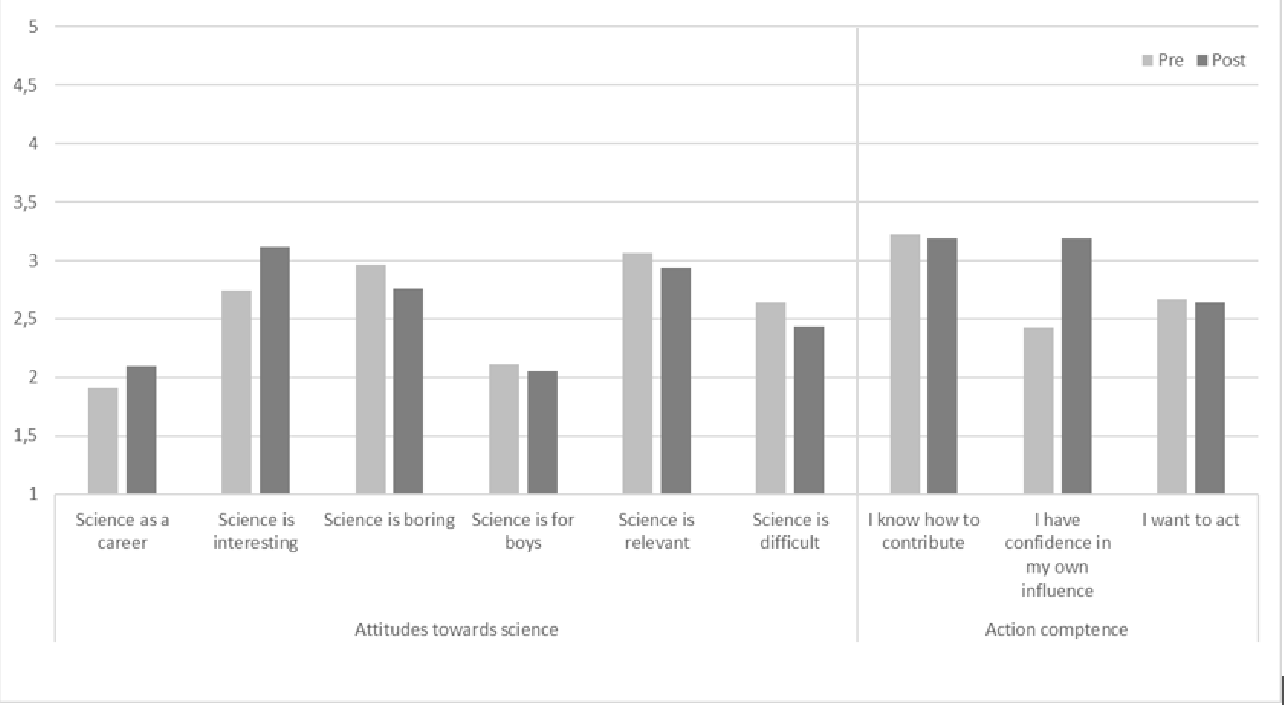
Intermediate results (round 1)

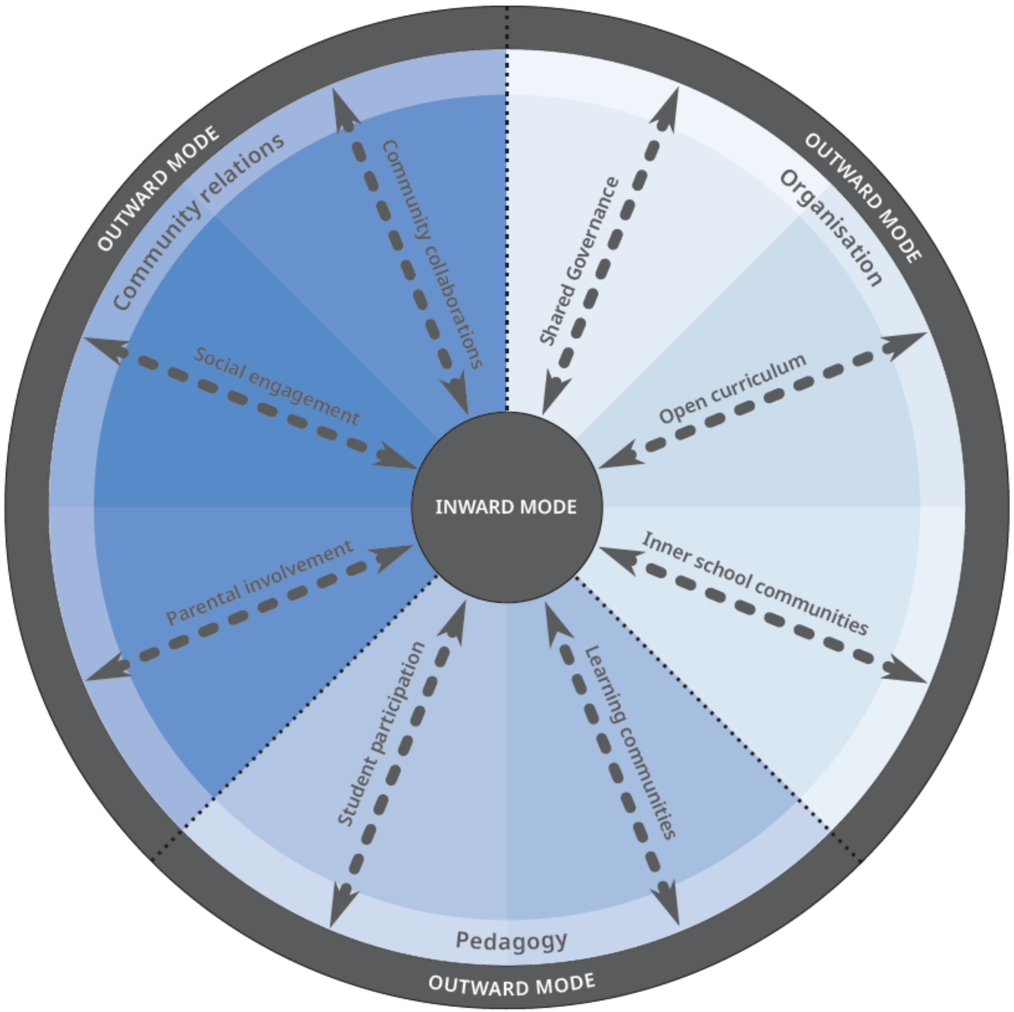
Example school

What do the surveys show for your school?

In your school, **63** students participated in the pre- and **50** in the post surveys. Based on the answers of students that took part in both, the results for your school look like this.



Ecological model of school openness



Sarid, A., Boeve-de Pauw, J., Christodoulou, A., Doms, M., Gericke, N., Goldman, D., Reis, P., Veldkamp, A., Walan, S., & Knippels, M.-C. (2024). Reconceptualizing open schooling: towards a multidimensional model of school openness. *Journal of Curriculum Studies*. Advance online publication. https://doi.org/10.1080/00220272.2024.2392592

School Openness