D4.2: Report of SSIBL implementation within CoP

and reflections on facilitation, support and implementation within each participating secondary school - Round 2

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Glossary

Alma Löv	Museum of Unexp. Art
BBC	Beit Berl College
COSMOS	Creating Organisational Structures for Meaningful science education through Open Schooling for all
CORPOS	Core ORganisational Structure for Promoting Open Schooling
CoP	Community of Practice
HEI	Higher Education Institution
IE-UL	Instituto de Educação da Universidade de Lisboa
KdG	Karel De Grote Hogeschool katholieke hogeschool
KU	Karlstad University
MoE	Ministry of Education
SDG	Sustainable Development Goals
SSI	Socio-Scientific Issue

SSIBL	Socio-Scientific Inquiry-Based Learning
SOTON	University of Southampton
STEM	Science Technology Engineering Mathematics
TPD	Teacher Professional Development
UU	Utrecht University
WP	Work Package
WSC	Winchester Science Centre

1. Introduction to SSIBL-CoP implementations during Round 2

This deliverable focuses on what has taken place within each participating secondary school in the COSMOS project during the second implementation round. The aim of this deliverable is to describe the implementation of the COSMOS approach, including CORPOS-SSIBL-CoP implementations and to present reflections on the facilitation, support and implementation process for each school. In some countries there were schools that had participated in the first round and in others there were new schools joining the project. In addition, some countries had both existing and new schools participating.

In this first section an overview of the number of schools, teachers and students involved, is presented. In total, 10 different secondary schools have been involved during this round of implementation, including more than 1100 students in the ages of 12-17 years and 29 teachers.

The overview also includes information about the people involved in CORPOS and CoPs, what kind of SSIBL theme the schools have worked with and for how long. Besides science teachers, there are examples where teachers in other subjects have been involved, and also in some countries, principals and administrative staff have taken part in the project. The HEI and societal partners and external stakeholders such as researchers, medical experts, and so on. The total amount of time spent on implementation in the school varied from a few hours in total to around 50 hours. See Tables 1.1-1.3.

The following sections present elaborated reports from each participating country, describing the implementations in more detail with reflections on the processes and outcomes in terms of lessons learned and how these can serve as inspiration for future development of Open Schooling.

Table 1.1 Overview of number of participating schools, teachers and students in each of the countries involved in the COSMOS project during the second round of implementation.

Country	Number of new second-dary schools involved	Number of continuing schools	Number of teachers involved	Number of students involved	Age of students (in years)
Belgium	0	2	7	140	14-16
Israel	1	0	10	16	13-14
The Netherlands	1	1	5	S1: 430 S2S: 65 S2M: 25 S2Wv3: 55 S2Wv4: 29 Total: 604	12- 15 15-17 15-17 14-15 15-17
Portugal	0	2	2	100 22 23 Total: 146	13-14) 14-15 16-17
Sweden	1	1	4	90 (new school) 16 (continuing school) Total: 106	14-15
UK	1	0	1	126	12-13
TOTAL	4	6	29	1138	12-17

Table 1.2. Overview of CORPOS members and their role in each of the participating country and school.

Country school number	CORPOS members & role
Belgium 1 (continuing)	3 partners from HEI, 2 partners from societal partner, 1 partner from another HEI, 1 partner from local hospital, 1 partner from city administration, 2 year 3 teachers.
Belgium 2 (continuing)	3 partners from HEI, 2 partners from societal partner, 1 partner from youth health coaching organisation, 1 partner from youth sports and physical education organisation, 5 year 3+4 teachers.

Israel 1 (new)	Science teachers (5), Civic studies teacher, Mathematics teacher, Arabic teacher, English teacher, school principal.
The Netherlands 1 (new)	3 staff from HEI partner, 4 staff from societal partners (two different institutions: 2 researchers on animal-human relations from Utrecht University; 2 science museum UMU communicators and educators, 1 teacher coordinator representing 7 participating science teachers grade 7 and 8.
The Netherlands 2 (continuing)	3 staff from HEI partner, 4 science teachers (societal partners available but not participating in CORPOS).
Portugal 1 (continuing)	1 partner prom HEI, 1 societal partner, 1 primary school teacher, 2 secondary school natural sciences teachers.
Portugal 2 (continuing)	1 partner prom HEI, 1 societal partner, 2 primary school teachers (one of them in charge of the library), 1 secondary school physics teacher.
Sweden 1 (continuing)	1 partner from HEI, I societal partner, 1 science teacher, 1 mathematics teacher, 1 1 special resource teacher, 1 school nurse.
Sweden 2 (new)	1 partner from HEI, I societal partner, 1 science teacher, 1 technology teacher.
UK 1 (new)	2 partners from HEI, 1 science teacher.

Table 1.3. Overview of chosen SSIBL themes in each country and school, duration of implementation and CoP members and their roles.

Country school number	SSI	Duration of SSIBL-CoP implementation activities	CoP members & role
Belgium 1 (continuing)	One general theme: The Green Revolution. Subthemes: sustainable building – mobility – healthy sports activities – healthy snacks – gaming – effects of interior colour on the wellbeing of hospital residents.	Three 2-hour lessons (ASK) • Defining the global theme. • Defining the subthemes and research questions based on the input of the external partners. Three 2-hour lessons (FIND OUT) • Working on answering the research questions. • Preparing the final presentation One 2-hour lesson (ACT) • Presenting the research and SSIBL implementation. • Reflection on the process Total: +/- 14 hours	3 HEI partners; general SSIBL implementation coaching; input on poster presentation. 2 societal partners: the input from round one (regarding specific methods and activity types) was updated by the teachers and implemented again in round 2. The other partners (HEI, city administration, architects etc.) gave input in the ASK and FIND OUT phases. One of these external partners attended the final presentation.
Belgium 2 (continuing)	One general theme: Health. Subthemes: healthy cooking – sports –	1 lesson (+/- 2 hours) to determine the subthemes and selection by the students (ASK).	3 HEI partners: input regarding renewed curriculum goals in science and STEM education.

	staying in shape – sound.	2 workshops (+/- 3 hours each) per theme: 1 for input (background and contextual information: FIND OUT) and 1 interactive session (ACT) (usually 1 week later). Each student attended +/- 2 workshops. **Total: +/- 14 hours**	2 societal partners: information regarding a student activity for defining and selecting the subthemes. 1 partner from a youth health coaching organisation for input regarding healthy food and cooking. 1 partner from youth sports and physical education organisation for the interactive session.
Israel 1 (new)	Sustainable nutrition.	2 weekly lessons during 6 months (12 lessons), a full day activity at two educational centres run by the Kfar Saba Municipality (The KIPOD Centre for Sustainability, and The Municipal Centre for Science enrichment). **Total: 50 hours**	Science education coordinator and a science teacher who is a nutritionist/dietician led the project. 10 subject teachers (Science, Arabic, Civics, English, Mathematics). Head of the Municipal KIPOD Centre for Sustainability. Municipal Nutritionist/Dietician. Head of The Municipal Centre for Science enrichment (Eshkol Pa-is).
The Netherlands 1 (new)	Pigeons in the city	14 lessons + half a day at science museum + half day research on street. **Total: 24 hours**	3 partners from HEI (process management & educational advisory & development assignment to assess SSIBL goals). 2 staff from societal partners, 2 science museum, communicators and educators facilitating full day at museum. 2 stakeholders: researchers on animal-human relations from Utrecht University.

			1 teacher coordinator representing all participating science teachers grade 7 and 8.
The Netherlands 2 (continuing)	A. Sustainable school for the future.	1 full school day. **Total: 6 hours**	A. 3 partners from HEI (process management & educational advisory & development assignment to assess SSIBL goals) + 1 science (physics) teacher coordinator for 3 other science teachers + 1 architect, 1 municipal councillor, 1 installer, 1 school headmaster.
	B. Microplastics.	15 lessons + half day excursion in research lab. **Total: 21 hours**	B. 3 partners from HEI (process management + educational advisory + development assignment to assess SSIBL goals) + 1 science teacher + 2 researchers from different research institutes of Utrecht University (one coordinating and guiding the excursion, one guest lecturer at the school).
	C. Particulate matter in the air from home to school (pollution).	2 lessons + school day. **Total: 9 hours**	C. 2 partners from HEI (advisory role) + 2 science (chemistry) teachers + GLOBE NL (facilitating teaching materials.
	D. Three SIBBL lessons during a school year, topics: HPV vaccination or not? Crispr-Cas: what's the limit for you? Dilemmas in sport.	2 separate lessons during semester (a series of 3 was planned, due to illness teacher no lesson on Crispr- Cas). **Total: 2.5 hours**	D. 1 HEI partner (advisory) + 1 science (biology) teacher school.
Portugal 1 (continuing)	Sustainable buildings	Regular classes, one full day at Pavilhão do Conhecimento. **Total: 24 hours**	1 partner prom HEI,1 societal partner (Ciência Viva), 1 primary school teacher, 2 secondary school natural sciences' teachers, 1 secondary school visual arts teacher, members from the project

			Smile, a local initiative aimed at making the neighbourhood sustainable.
Portugal 2 (continuing)	Sustainable school building and surrounding area.	Regular classes, one full day at Pavilhão do Conhecimento. **Total: 30 hours**	1 partner prom HEI, 1 societal partner (Ciência Viva), 2 primary school teachers (one of them in charge of projects' implementation), 1 secondary school physics teacher, 1 Environmental Engineer from the City Hall (Project Agenda 21), 1 member from the Nature Protection League.
Sweden 1 (continuing)	Snuff – should we stop selling this in Sweden?	12 lessons of 1 hour. **Total: 12 hours**	1 partner from HEI, 1 science teacher, 1 mathematics teacher, 1 teacher resource person, 1 school nurse.
Sweden 2 (new)	GMO.	6 lessons of 40 minutes and 2 full days). **Total: 16 hours**	1 partner from HEI, 1 societal partner, 1 science teacher, 1 technology teacher.
UK 1 (new)	Vaping	18 lessons of 1 hour, one full day at the university (5 hours). **Total: 23 hours**	2 Biomedical researchers who analysed the chemical composition of vapes and took part in a lesson about their findings. 1 Psychologist from Soton University specialising in addiction doing a Q&A session with students in class. 1 medical doctor, who advised on the impact of vaping on young people. 1 Smoking cessation nurse from Hampshire, who did an online lesson with students. 1 Lifelab member (School of Medicine outreach facility), who advised on their experience of developing educational resources about vaping.

			1 Trading Standards Agency officer, who advised on the issues of trading unregulated vapes in the local area. 1 Professor in Engineering specialising gin renewable energy and batteries, who discussed with students the environmental impact of lithium batteries found in vapes.

2. Belgium Report (Partners 3 & 8/KdG & Djapo)

The implementation in Belgium involved two secondary schools, both of them continuing in the COSMOS project since the first round. Seven teachers and 140 students in the ages of 14-16 years participated. In addition, others were involved, which will be elaborated on further. One of the schools chose to work with a SSIBL theme called The Green Revolution, a theme that included several subthemes related to sustainability, such as building and health. The other school focused on different subthemes related to health. In both schools approximately 14 hours were spent on the activities. In the following sections the process of the implementation and reflections are presented.

2.1. SSIBL-CoP implementations in secondary schools in Belgium

Development of CORPOS and CoP in School 1 (continuing) in Belgium

In both of the continuing secondary schools, we held a kick-off in the beginning of the school year to summarise the experiences in round one and to establish new goals regarding creating a sustainable CORPOS. Both schools didn't see opportunities in building upon the CORPOS from the first implementation year, because of the limited development of those entities. In both cases, the CORPOS ultimately consisted of the teacher teams and the COSMOS HEI partner. To this school, the HEI partner provided input and coaching on research design (FIND-OUT) for students and poster presentations (ACT) for teachers.

Stakeholder analysis was run by the teacher team. They were also inspired by other teacher teams during the conference in Prague. Long-term and deeper connection with external partners proved again to be difficult to realise.

In both of the continuing secondary schools, we followed the same timeline in the beginning: there was a kick-off meeting in the schools before the teacher conference and a follow-up meeting afterwards. In School 1, the process design was finished by then, and was followed by some planned

consultations with the COSMOS HEI partner regarding the project development with the teachers and the FIND OUT phase with the students. The HEI partner was standing by during the process for further coaching if needed, but this turned out not to be the case.

Based on the evaluation of Round 1, a bigger emphasis was put on student participation and connection with external partners. These were mostly listed and provided by the teachers, but they were contacted and consulted by the students to gather information about the chosen subtopic, to formulate possible research questions (ASK) and/or to answer them (FIND OUT). One of the external partners was present during the final presentation (ACT), giving feedback on the process and results. In both schools, the COSMOS HEI partner attended the ACT-phase. A reflection/evaluation meeting was also held with both teacher teams after the project with the students had ended.

SSIBL theme in School 1 (continuing) in Belgium

The teacher team decided not to renew the SSI theme from round one, in order to give more room to student participation (cf. intrinsic motivation) and student interaction with the external partners.

The whole SSI definition process was carried out by the students and coached by the teachers. First, a general theme (the Green Revolution) was chosen by the students. After that, the students were divided into teams and were tasked to pitch a specific subtheme they were interested in to the rest of the group. The most popular and pertinent subthemes were selected by voting. Afterward, the students contacted the partners and gathered information about the context and possible research questions. Guidelines were provided by the teachers regarding project management and methods to set up and maintain goal-oriented communication.

During the FIND OUT phase, each group worked in different paces based on the variables of their project design. The students developed questionnaires, collected and interpreted data, and used them to formulate conclusions, oriented e.g. on possible actions to improve the situation defined by the SSI. No specific emphasis was placed on active citizenship. However, the students discussed several aspects of civic involvement in the selected subthemes, as well as the societal impact of their actions within the project. Table 2.1 presents an overview of the SSIBL-CoP implementation in school.

Table 2.1 Overview of SSIBL – CoP implementation in School 1 (continuing school) in Belgium.

SSIBL dimension	Description including CoP role/participation	Duration Total: 14 hours
ASK	Student activities (coached by the teachers): • Defining the general theme (the Green Revolution) by using brainstorming methods. • Defining subthemes by using systems thinking, introduced by the societal partner in Round 1. • Group process. • Pitching possible subthemes to the rest of the group and selecting a few by voting. • Contacting external partners (mostly provided by the teachers) to distil possible SSI and gather additional information.	+/- 6 hours.
FIND OUT	Examples of research contexts: • How can we build in a more sustainable way? • How can sports activities improve the mental focus of students? • How can we motivate students to eat more healthy food? • What is the impact of gaming on school performances? • How can we solve the mobility issues in our city? • How can we measure the impact of interior colour choice in the interior design of hospitals? In nearly all of the subthemes, an external partner was contacted by the students, providing help setting up a survey, collecting and interpreting data. When the general FIND OUT phase was designed by the students, the COMSOS HEI partner provided feedback to the students on site. Preparing for the final presentation was part of this phase.	+/- 6 hours.
ACT	Each group presented their results during a final event, attended by the COSMOS HEI partner and one of the external partners. The presentations had to visualise the project phases and the SSIBL implementation.	2 hours.

Development of CORPOS and CoP in School 2 (continuing) in Belgium

As already mentioned, we held a kick-off in the beginning of the school year to summarise the experiences in round one and to establish new goals regarding creating a sustainable CORPOS. The reason for this being that both schools didn't see opportunities in building upon the CORPOS from the

first implementation year, because of the limited development of those entities. So, in both cases, the CORPOS ended up comprising the teacher teams and the COSMOS HEI partner. To this team, this partner provided input and coaching on attaining the renewed curriculum goals in science education.

Stakeholder analysis was run by the teacher team. They were also inspired by other teacher teams during the conference in Prague. Long-term and deeper connection with external partners proved again to be difficult to realise. The teachers chose to contact some organisations working on youth-related topics. The communication intensity was not consistent over time and sometimes even difficult to maintain, due to late response from the organisation. This process resulted in two workshops, each provided by one organisation in the FIND OUT and ACT-phase.

As already mentioned, presenting the process for School 1, we followed the same timeline in the beginning in both of the continuing secondary schools; there was a kick-off meeting in the schools before the teacher conference and a follow-up meeting afterwards. In School 2, the COSMOS HEI partner organised a coaching day in January, in order to give some input on curriculum and ideas in order to determine the general project concept. The HEI partner was standing by during the process for further coaching if needed, but this turned out not to be the case.

External partners were consulted by the teachers regarding possible research questions (ASK), specific information about the subtopics (FIND OUT) and workshop possibilities (ACT).

In both schools, the HEI partner attended the ACT-phase. A reflection/evaluation meeting was also held with both teacher teams after the project with the students had ended.

SSIBL theme in School 2 (continuing) in Belgium

The teachers chose another SSIBL theme compared to in Round 1 in order to develop more lesson material that can be used in the future. They determined the general theme (i.e. health), based on the curriculum possibilities, former student feedback (regarding the lack of physical education in their lesson programme) and the importance for the students' everyday life. The students held a discussion about the subthemes provided by the teachers, helping them to select one or two of their favourite ones. Subsequently, the students attended two workshops. During the first one, the teachers gave contextual information about the subtheme and gathered further information about the views, preconcepts and opinions of the students. During the second one, the students participated in an interactive session regarding the topic: the prepared a healthy meal, they practiced sports, they

debated on the positive and negative impact of thorough and professional physical activity and training, and they conducted small experiments and a limited measurement of sound levels in the vicinity of the school. The teachers intended to build on the experiences of the students during next school year, maybe to re-insert physical education into the curriculum, to offer healthy alternatives to (often unhealthy) student lunches etc. No specific emphasis was placed on active citizenship in this school either, but as in School 1 the students discussed several aspects of civic involvement in the selected subthemes as well as the societal impact of their actions within the project. Table 2.2 shows an overview of the SSIBL-CoP implementation in School 2.

Table 2.2 Overview of SSIBL – CoP implementation in School 2 (continuing school) in Belgium.

SSIBL dimension	Description including CoP role/participation	Duration Total: 14 hours
ASK	This phase was strongly led by the teacher team. They determined the general theme in advance and specified some subthemes with the students, using brainstorming methods and systems thinking, introduced by the societal partner in Round 1. They divided the students into groups based on their thematic preferences. Some questions from the students were gathered during this phase. Subthemes: • Healthy food and cooking / health problems related to eating habits. • Sports activities and their impact on wellbeing. • Thorough physical activity, advantages and dangers. • Sound and the human body. Dangers and guidelines.	+/- 2 hours.
FIND OUT	During this phase, the students participated in a workshop, providing more background information on the subtheme. One of these sessions was provided by an external partner, the other ones were given by the teachers. Each student attended approx. 2 workshops.	+/- 6 hours.
ACT	During this phase, the students participated in an interactive session, carrying out activities linked to the subtheme. One of these sessions was provided by an external partner, the other ones were given by the teachers. One of the sessions included a hired box with materials and activities. Each student attended approx. 2 workshops.	+/- 6 hours.

2.2. Reflections on facilitation, support and implementation within the participating secondary schools in Belgium

Reflections concerning facilitation of SSIBL-CoP

In both continuing secondary schools, clear goals were defined during the focus group meetings at the end of the first implementation year.

For School 1, regarding the dimensions of open schooling, the teacher team wanted to address the participation of external partners in a more dedicated and sustainable way. This was also the case for School 2, but that teacher team also wanted to increase student participation, specifically during the ASK-phase.

During the kick-off meeting, and afterwards, during the teacher conference in Prague, we discussed possible ways to intensify the search for external partners. One of the possibilities was to start by searching possible external partners before defining the SSI, in an attempt to facilitate external partner bounding. School 2 used this approach to a certain extent. They checked potential organisations and contacted them before submitting the general theme and subthemes to the students, assuring the connection. School 1 did not, as they deliberately chose to prioritise student participation and student interaction with external partners. To achieve this, the students started began by defining a general theme and possible subthemes. Afterwards, the teachers provided them with a list of potential partners (i.e. experts on the topics) the students had to contact.

Successes and challenges in facilitating and supporting CORPOS and CoP.

In both schools, a good communication and collaboration with the HEI and societal partners was established during the first implementation year and was maintained during the second one. On the other hand, long-term and deeper connection with other external partners proved again to be difficult to realise. It seems to be hard to motivate partners to get involved beyond what they can contribute and/or get out of the project. They apparently lack the time to connect on a deeper level to the wider goal of the collaboration. Long-term advantages for the partners remain difficult to point out. As both schools were operating quite autonomously and no specific arrangements were made to report spontaneously on a regular basis, no further supporting of CORPOS after the initiating phase was found necessary (nor CoP for that matter).

In School 1, the plan to contact and enrol external partners, by letting the students lead the communication phase, paid off. The best results were reached within the own network (students' parents). The two teachers who coached the project activities were both part of the CoP, which was an advantage.

In School 2, the coaches who were not part of the CoP were briefed in a minimal, but sufficient way. The external partners provided a mostly standard workshop. Further sustainable interaction with those partners, other than doing similar things during the coming years, proved difficult to obtain, probably for the same reasons as maintaining and deepening a CORPOS.

Successes and challenges in facilitating and supporting co-design of SSIBL-CoP units/lessons

In both secondary schools, the external partners were not involved in the conceptual design of SSIBL education nor in the setup of sustainable partnerships. Therefore, the CORPOS consisted of the teacher team, the COSMOS HEI partner and (to a lesser extent) the societal partner, who provided most of the needed teaching methods and activities during Round 1.

No noticeable changes are to be mentioned in the composition of the CoP compared to Round 1. In both schools, the core design team consisted of the teachers who developed the conceptual plan of the project. In school one, the same two teachers designed and coached the lessons. In school two, additional teachers were briefed once the design was ready to be carried out, enabling more simultaneous activities during the project lessons. The COSMOS HEI partner and the external partners were consulted for specific tasks (project coaching, input on specific topics), but were not involved in the project design. After the post-Prague follow-up meeting (and the coaching day at the HEI Partner with teacher team of school two), the teachers in both schools worked autonomously and didn't ask for additional coaching moments, except for the ones that were already planned with School 1.

Reflections of the three SSIBL phases (ASK, FIND OUT, ACT)

In School 1, the different SSIBL phases were visually represented and referenced throughout the whole project, also by the students. In School 2, the different phases were less visible. The ASK and FIND OUT phases were clearly implemented in both schools. In School 2, student participation was lower. The students interacted during the workshop but weren't really involved in the decision-making process regarding what the ACT-phase would consist of. They mainly followed the instructions given by the coaches. In School 1, the students got and took more responsibility in making choices and decisions within the framework that was presented by the coaches.

The overall experience

In School 1, both teachers and students were rather positive: they recognised the strength and the societal potential to have youngsters interact with adults in real life situations, experiencing the challenges, solutions and rewards along the way. Some external partners (other than HEI and societal) showed interest in the ACT-phase, some of them did not. In School 1, the leadership attended most of the meetings and stayed involved in the process, giving the teachers a lot of confidence and autonomy. The school leadership showed interest and interaction with the students, the project members and the activities, which motivated the teachers. In School 1, the second implementation year was an explicit improvement regarding SSIBL implementation and connection with external partners compared to round one. The teacher team was able to build upon the experiences and reflection during the previous round.

In School 2, teachers were less enthusiastic compared to the first implementation year, feeling they didn't make as much progress, probably due to high workload. The students confirmed the importance of the topics that were treated and participated in the activities with a positive state of mind. The external partners were satisfied with the collaboration. However. no concrete decisions were made to build on these experiences yet. In School 2, nearly no interest was shown by the school leadership, and they did not participate in the project in any way. Some of the teachers with a coordinating role took the necessary steps to embed the COSMOS project in the school calendar. In School 2, the emphasis was placed on the increase of external partner involvement and the development of new lesson materials, which consumed a lot of bandwidth, leaving less room for expanding on the experiences regarding SSIBL implementation.

2.3. Lessons learned from Round 2 of implementation in Belgium

Open schooling is not a standard part of the school culture in Flemish secondary schools. Teacher teams can focus on some of its dimensions and by doing so, take small but meaningful and satisfactory steps forward. However, in order to achieve school-wide sustainable results, this probably often requires the active involvement of many stakeholders within the school community. In summary

lessons learned from the second round of implementation in Belgium can be summarised in the following bullet points:

- Identifying and contacting external stakeholders can be fairly easily achieved by school teams. Maintaining an open communication line is harder, because it depends on the willingness of the partner to engage in a longer-term partnership. In order to achieve that, defining the win-win potential of the partnership could be an essential ingredient.
- Focusing on improving school openness and implementing SSIBL pedagogy requires minimal experience from the participating teachers in scientific education and inquiry-based learning. Achieving goals in multiple of these dimensions simultaneously tends to be difficult.
- Giving a lot of autonomy and responsibility to students seems to enhance the learning gains but requires a certain amount of interim coaching by the teachers. Not necessarily all teachers have acquired those coaching skills yet.
- The contribution of external stakeholders was improved in both of the secondary schools compared to in Round 1. Student participation also increased in one of the schools.
- The development of *sustainable* CORPOS and CoP structures has not much improved.
- Implementing a SSIBL state of mind and approach in solving SSI has remained a challenge for both teachers and students in the school for vocational education, probably partially due to the lack of experience in science education and time to practice these new methods.

Still, as stated above, first steps have been taken in Open schooling development during the COSMOS project.

3. Israel Report (Partners 6 & 12/ BBC/MOE)

The implementation in Israel involved one secondary school, new in this round of the project. Ten teachers from different subjects were part of the project, not only science teachers. Sixteen students in the age of 13-14 years participated. In addition, collaboration was made with the Head of the municipal Sustainability Centre, The municipal dietician and Head of the Science Enrichment Centre. The SSIBL theme was about sustainable nutrition with the aim to enhance students' and community's awareness concerning the importance of healthy and sustainable diets. In the following sections the process of the implementation and reflections are presented.

3.1. SSIBL-CoP implementations in secondary schools in Israel

The CORPOS developed in an organic way, from a mutual need, and became stronger through its mutual activities, ongoing communication and flexibility in coping with challenges. The students' enthusiasm and tangible outcomes (e.g., changing dietary patterns at home) contributed to maintaining all the participants' motivation throughout the process.

Establishing the CORPOS started as the initiative of the science teacher who is also a dietician, who identified the need for educating for sustainable nutrition/diets. Teaching nutrition at the school began prior to the COSMOS project, expanded with the joining of the COSMOS project.

- Identifying the common denominator – (*) We engaged teachers of different subjects, a step that created a broad base for collaboration. (*) We recruited stakeholders from the community, such as the head of the Municipal Sustainability Centre and the municipal dietician, who share with us the vision for promoting sustainable diets.
- Networking events – (*) We conducted a roundtable event for all the participants in the project; (*) conducted joint visits at the municipals centre for science education enrichment and centre for sustainability; (*) created opportunities for collaboration among teachers, such as integration the project content in different subjects. We identify the two latter as versions of networking events.

- Maintaining ongoing communication and collaboration – (*) We conducted organised meetings for the involved teachers for updating and sharing ideas; (*) we created activities that have provide mutual interest and require synchronising among stakeholders; (*) we maintained continuous communication among community partners, updating them regarding progress in the project and inviting them to participate in the school events.
- Challenges and solutions – (*) when the war broke out, it created an immense challenge for maintaining the momentum of the project. We addressed this by adapting the activities to the new reality and emphasising the importance of healthy diets during challenging times; (*) we maintained flexibility in the planning, for example, by postponing the establishment of the school garden while keeping the long-term goals.

The CoP developed gradually, starting with the initiative of the school science coordinator and the science teacher who is a dietician. When joining COSMOS, the learning community was significantly expanded.

Identifying and choosing partners – we started with the teachers' room and suggested to all the school teachers to join us. Teachers from different subjects opted to join. These included in addition to the science teachers: mathematics, civics, Arabic, English and Hebrew. The next step was to allocate partners from the community. We initiated contact with the Municipal Sustainability Centre and the Science Enrichment Centre. Parallel to this, we identified relevant people in the community, such as the municipal dietician, who could contribute and benefit from the project, as well as some of the students' parents who are professionally related to the area of the project.

Regular meetings were conducted with the participating teachers, and we maintained ongoing contact with the community partners, updating the regarding our progress and inviting them to take part in school events. Visits to the Municipal Education Centres were organised to conduct workshops and experiments. In this manner, community members were integrated in the practical activities of the project (such as preparing the holidays gifts).

We shared with our community partners mutual interests: promoting healthy and sustainable diets, raising awareness regarding environmental concerns and climate change, enhancing school-community connections, developing the students' practical and creative skills.

We aspired to realise several common benefits, in different circles: (1) the school: enriching the curriculum, connecting with the community; (2) the teachers: professional development, opportunities for creativity in teaching; (3) community partners: increasing their contact with a young target population, promoting institutional goals; (4) the students: engaging learning, developing environmental awareness, gaining practical tools; (5) the community: promoting healthy and sustainable lifestyles, and strengthening the school-community ties.

Despite the challenges posed by the war, the community proved its resilience and continued to be active, adapting its activity to the evolving and challenging reality.

Choice of SSIBL theme in secondary school (new) in Israel

The topic of sustainable diets was selected as the central SSIBL topic, for the following reasons:

1. Pre-existing interest: the project started with the individual initiative of the science teacher who is also a dietician; this influenced the topic selected for the project.
2. Relevance: The selected topic integrates science and social aspects and has direct implications for the students' daily lives – it is an authentic topic for the students and their families.
3. Connection to climate change: The topic selected relates to broader global sustainability issues, such as climate change, which the Ministry of Education encourages incorporating in all school subjects.
4. Potential for practical action/engagement: The selected topic offers the students opportunities for making significant change in their daily lives and in their immediate surroundings.

The science teachers shared their knowledge with the other teachers, supporting them in understanding how the selected topics relates to their area of teaching.

Table 3.1 presents an overview of the SSIBL-CoP implementation in the secondary school in Israel and the following section further present the members of the learning community and their roles during the implementation.

Table 3.1 Overview of SSIBL–CoP implementation in the secondary school participating in Israel.

SSIBL dimension	Description including CoP role/participation	Duration 2 weekly classes for 6 months; whole day at the municipal sustainability centre; whole day at the municipal SE enrichment centre. Total: 50 hours
ASK	Key/Driving Question: • How can sustainable diets be promoted among students and the school community? • How to raise awareness, provide theoretical and practical knowledge, and how to promote behavioural change among the students and their families? Theoretical and practical educational activities were conducted at the Sustainability Centre run by the municipality around climate change and related local and global sustainability issues as a foundation for raising inquiry questions regarding healthy and sustainable diets. Teachers of different subjects conducted critical discussions in their lessons that led to raising inquiry questions.	
FIND OUT	Inquiry learning activities: 1. Science inquiry: • Experiments were conducted at the Science Education Enrichment Centre run by the local municipality to investigate implications of climate change on food security. 2. Social inquiry: • Survey among school students to gain information regarding trees & vegetables to grow in the school garden. • Exploring ways to implement principles of sustainable diets with their families and the school community.	

	3. Personal inquiry: • Students explored their personal and family's dietary habits. CoP involvement: • Teachers of different subjects (science, math, civic and languages) incorporated aspects of sustainable diets in their classes. • The school principal supported the whole process. • The municipal dietitian provided professional knowledge, the head of the Municipal Sustainability Centre organised learning activities, the head of the Municipal Science ed Enrichment Centre was involved in the experiments conducted at this centre.	
ACT	• The subject of sustainable diets was incorporated in the curriculum – in diverse subjects (science, math, civics, languages). • Students conducted active learning days at the Municipal Science Ed. Enrichment Centre and at the Municipal Sustainability Centre. • The students who participated in the COSMOS project prepared educational games (from re-used materials) on the subjects of sustainable diets, reducing food waste, healthy diets and led classes with other students using the games they prepared. • The participating students prepared healthy holiday gift packages from re-used materials and distributed these in the school & families. • The participating students led changes in their family's dietary habits focusing on reducing food waste, promoting sustainable and healthy dietary habits. CoP involvement: • Teachers of different subjects (science, math, civic and languages) incorporated aspects of sustainable diets in their classes. • The school principal supported the whole process. The municipal dietitian, head of the Municipal Sustainability Centre organised learning activities, head	

	of the Municipal Science Ed. Enrichment Centre, and families were all involved. Originally, the project included the establishment of a school orchard and food garden as a part of the ACT component of SSIBL, in the aim that this garden would provide the platform for outdoor, project-based and place-based classes in both science and social subjects. Due to changes in the school year necessary during the war, this component was not realised and is planned for the upcoming year. The team identifies this component as one of the ACT actions during COSMOS, and as a foundation for FIND OUT activities in future learning.	

Below there is a list of the roles of different stakeholders in the community learning process.

1. Teachers: Teachers of different subjects (science, mathematics, civics, three languages) incorporated sustainable diets in their lessons. For example, language lessons included reading and writing on the topic.
2. External professionals – (*) The head of the Municipal Sustainability Centre and the municipal dietician participated in the activities and enriched the learning content with their professional knowledge; (*) The head of the Municipal Centre for Enriching Science studies conducted activities on climate change and its connections with sustainable diets.
3. Sharing knowledge via visits, activities and engaging experiences –
    - The community members organised the educational visits, thus providing the learning process with practical learning activities.
    - The community members were involved in the planning and execution of learning activities (such as the holiday gifts, and development of educational games)
    - The community members shared their knowledge and experience, thus enriching the program with a more holistic perspective
    - The community members helped creating connections between the learning in school and implementation in homes and in the community, encouraging the students to lead change in their near environment.
    - The community members received student feedback regarding activities in their areas.

3.2. Reflections on facilitation, support and implementation within the participating school in Israel

Reflections concerning facilitation of SSIBL-CoP

Below there is list summarising the reflection concerning the facilitation of SSIBL-CoP in Israel.

1. Multi-disciplinary collaboration among teachers of different subjects.
2. Community collaborations – As previously described, collaboration with the Municipal Sustainability Centre, the municipal dietician, and the Municipal Centre for Science Education Enrichment provided the students diverse perspectives and practical learning experiences, enhancing the relevance and impact of the project.
3. Initiatives led by the students – we encouraged and supported students' engagement via the learning tasks and activities, such as the educational games they created which provided a frame for their learning, and a resource for them to lead learning with their peers. This approach enhanced their engagement, contributed to developing their leadership attributes and also increased communication among the students.
4. Support of the school principal – the active involvement of the principal in the project provided the support necessary for integrating the project within the school's broader educational goals.
5. Whole school involvement – Beyond the classes directly involved in the COSMOS project, the project was designed to include dissemination among other students (e.g. the learning games). We feel that this approach contributed to the school's organisational culture regarding sustainable diets.
6. Flexible planning – Despite unforeseen challenges due to the war situation, we maintained flexibility. Despite that establishing the school orchard and food garden had to be postponed, work with the students on the project continued in a flexible manner; this contributed to the students' resilience.
7. Connecting the school and students' homes and families – Connecting sustainable diets to the students' lives – their eating habits, recruited their interest in implementing what they learned in their homes with their families, in turn, contributing to the relevance and interest

in the topic. This approach expanded the impact of the project beyond the school borders. The success of this project was beyond our expectations.

8. Utilising community resources – we supported the students' learning by cooperating with external professional and utilising community resources (such as the municipal dietician, and municipal learning centres).
9. Encouraging reflection and implementation – we created open discourse with all the participants, which enriched the perspectives and ideas. We encouraged implementation in several circles – personal, families and community. The students' enthusiasm contributed to inspiring and motivating the teaching team.

Successes and challenges in facilitating and supporting CORPOS

Below there are lists that summarise both keys of success in facilitating and supporting CORPOS as well as the challenges.

Successes:

1. Combining theoretical and practical learning.
2. Creating partnerships between disciplines and with stakeholders in the community.
3. High level of students' engagement.

Challenges:

The major challenge was coping with the war situation that affected everyone's wellbeing and necessitated postposing part of the projects (e.g. establishing the school orchard and food garden).

Crucial support factors:

1. The principals support.
2. Collaborating with professional groups in the community.
3. Creating a flexible learning framework that enabled us to adapt the process and progress according to the changing situation.

Successes and challenges encountered in facilitating and supporting CoP

Below there are lists that summarise both keys of success in facilitating and supporting CoP as well as the challenges.

Successes:

1. Creating a diverse community that included teachers of different subjects, students, and members from the community, specifically the municipality.
2. Developing mutual learning activities that contributed to participants' engagement
3. Knowledge flow from the community to the school.
4. Smooth and easy coordination among all the involved participants.

Challenges:

The main challenge was maintaining a continuous process in view of the war situation.

- The level of CoP member's participation was high, reflecting, to our understanding, the follow:
  1. The relevance and interest of the selected SSI.
  2. Integration between theoretical and practical learning.
  3. Possibility for creativity and individual initiative.

- Central success factors of CoP
  1. A clear mutual goal.
  2. Diverse participants who brought in different knowledge and experience.
  3. Opportunity for joint creativity and sharing knowledge.
  4. Institutional support – from both the school and community institutions.
  5. Flexibility and adaptiveness to changing needs.

Successes and challenges encountered in facilitating and supporting the co-design process of SSIBL-CoP units/lessons

Below there is a list of key factors for success as well as the challenges in facilitating and supporting the co-design process of SSIBL-CoP units or lessons.

Successes:

1. Successful integration of theory and practice in the learning process.
2. Creating practical learning activities and projects, such as the games and holiday packages.

3. Connecting the topic to the students' daily lives.

Challenges:

Adapting the program to unforeseen changing reality.

Reflections on the three SSIBL stages (ASK, FIND OUT, ACT)

Below there is a summary of the reflections on the three SSIBL stages and factors facilitating and inhibiting.

1. ASK – we enable rich discourse around global warming and its implications that led to raising relevant questions around sustainable nutrition/diets.
2. FIND OUT – The students explored the topic via lessons, active learning during visits to relevant local educational centres which included conducting experiments and conducting critical discussions around the controversial issue.
3. ACT – The students designed and created learning games which they implemented with other students; they made environmentally friendly and healthy holiday gifts, which they distributed among the school community. Additionally, they conducted initial actions (the survey) towards planning the school orchard and food garden.

Facilitating factors

- Support of the school management and of the community.
- Cooperation among teachers of different subjects.
- Flexibility in the planning and execution.

Inhibiting factors

- External factors, mainly the war, that influenced time resource and mainly wellbeing of all the involved.

The overall experience

The students that participated were enthusiastic and highly engaged. The teachers showed a high level of motivation and cooperation. In addition, the school management was actively involved and provided ongoing support during the implementation.

The school principal was involved in all the details and took part in many of the meetings. This contributed to creating the legitimacy of the project.

Despite the challenge confronting teachers of how to incorporate the topic in their subject such that they provide the students with practical learning and a positive learning experience, this proved to be a positive and enriching experience, with a high level of learning and engagement. The implementation took place during difficult times with the ongoing war and despite this we consider the processes and outcomes of the project as positive.

3.3. Lessons learned from Round 2 of implementation in Israel

The key lessons from the implementation in the secondary school on Israel are summarised in the following list:

- School leadership - Working with the school leadership including engaging the principal in the process: active engagement of the school principal is found to be significant in recruiting the teachers' full involvement.
- Student participation – The importance of students' active participation throughout all the process including the planning, development and implementation: it enhances their interest and motivation. Connected to this, from the perspective of student motivation, it is produc-tive to work with students' leadership groups when bringing in new topics and projects. Such student groups are inherently highly motivated, and this contributes to successful incorpora-tion of new projects and topics and increase the school's interest in its ongoing implementa-tion.
- Curriculum - In lower secondary schools (as opposed to primary schools), the inherent silo-ing of the curriculum into disciplinary subjects brings in challenges for developing and im-plementing an interdisciplinary learning community. We found that it was easier to work with a dedicated disciplinary team.
- Curriculum - From a curricular perspective, it is productive to select a SSI that in some way is connected to the existing curriculum or even an pre-existing extracurricular topic the school

is focusing on. This provides a productive platform on which to incorporate new projects/topic.

- Community collaborations – It is important to identify and collaborate with local (municipal) organisations that have educational experience in working with students on topics related to the selected SSI. The out of school learning experiences the students had in these organisations proved to be significant in breaking the conventional modes of learning science in school, and was, therefore, significant in connecting the science education to the COSMOS approach.

These lessons highlight the importance of school leadership, student participation, the challenge of working from an interdisciplinary perspective in secondary school level and the importance of connecting the choice of SSIBL theme to the curriculum. Finally, collaboration with organisations that are familiar with education was proven to be a successful approach during the implementation, stimulating Open Schooling.

4. The Netherlands Report (Partner 1/UU)

The implementation in The Netherlands involved two secondary schools, one of them continuing in the COSMOS project since the first round, the other one new. One of the schools chose to work with a SSIBL theme about Pigeons in the city and the other school worked with different themes related to sustainability and themes such as HPV vaccination, Crispr-Cas and dilemmas in sport. Different amounts of time were spent on each of the themes, from 2.5 hours up to 21 hours (on the theme about microplastics). Five teachers were involved and more than 600 students in the ages of 12-17 years. In addition, others were involved, which will be elaborated on further. In the following sections the process of the implementation in these secondary schools and reflections are presented.

4.1. SSIBL-CoP implementations in secondary schools in The Netherlands

Development of CORPOS and CoP in School 1 (new) in The Netherlands

At this school we worked in the CORPOS with three staff members from HEI and one science teacher who was the coordinator of 7 science teachers. The teacher coordinator informed the other teachers and the school manager. As the school is very bottom-up in organisation with shared governance, the teacher coordinator and manager saw no need for a representative of school management in CORPOS. Many innovative projects are ongoing at the school in collaboration with teacher training colleges or education departments of universities or other organisations. This is also one of the reasons that the teacher involved could not find another science teacher willing to participate in the CORPOS (or CoP). Biweekly meetings were scheduled with the HEI partner(s) since November 2023. Topics were process management, and co-development of teaching materials according to the SSIBL approach with specific focus on expanding the scientific inquiry to societal & personal inquiry (including assessment tools). The teacher also participated in the two-day TPD event organised by COSMOS in Prague (14-15 November 2023).

In relation to the CoP, the school already participated in a citizen science projects on Pigeons in the city, with societal partners from two different institutions: the Science Museum (UMU) and a research group on animal-human relations of Utrecht University (UU). There was one (hybrid) meeting with all

partners involved, other meetings were with parts of this group depending on the topic on the agenda: the organisation of the museum day or the development of the teaching and learning materials.

SSIBL theme in School 1 (new) in The Netherlands

An ongoing citizen project about pigeons in the city served as the foundation for the SSIBL theme. In the citizen science project students gathered data on the colouring and number of pigeons on various places in the city (and shared these data with the research group of Utrecht University). This was embedded in a learning trajectory on how to perform valid science research. Within the COMOS project, the educational goals were extended to learn how to research an SSI and the SSIBL approach was adopted for the whole learning trajectory. Students developed their own SSI-related research question and interviewed various stakeholders. The whole learning trajectory involved 14 lessons at school and a half a day of data collection on site (number and different species Pigeons; interviewing stakeholders such as local residence, tourists) over three months (April – June 2024) for all grade 7 and 8 students.

A kick-off day of the project was held at the UMU Science Museum. Students learned about scientific and social inquiry, and an interactive lecture of the UU researcher made students think about various historical and cultural perspectives on the relation pigeons-humans. Table 4.1 presents an overview of the SSIBL-CoP implementation in School 1 in The Netherlands.

Table 4.1 Overview of SSIBL–CoP implementation in School 1 (new) in The Netherlands. Theme: Pigeons in the city.

SSIBL dimension	Description including CoP role/participation	Duration Total: 24 hours
ASK	During a day at the science museum students learned about inquiry in the past and current research on science and social subjects, using different techniques. A researcher on animal-human relations from Utrecht University provided a lecture at the museum. This led to students' own questions in relation to the occurrence and number of different pigeons' species in the city, and question in relation to the various stakeholders of pigeons in the city (e.g., (dis)like of many pigeons in the city of local inhabitants, tourists etc.)	Half a day + 1 lesson. 5 hours.

	All societal (research group UU, UMU) and HEI partners participated in developing and executing the start day at the museum.	
FIND OUT	In this part of the learning trajectory science teachers coached the students in developing valid research questions and learned gathering data from reliable sources and how to gather experimental data. Students first performed the scientific inquiry and then the societal inquiry (using own research question, so the personal inquiry was interwoven). Students collected data on site (Utrecht city), counting number and occurrence of different Pigeon's species (scientific inquiry) and interviewing stakeholders such as local residence, tourists, bakers in the neighbourhood (social inquiry) on their appreciation of pigeons in the city. The learning trajectory and additional materials for students were developed by the teacher coordinator in collaboration with the HEI partner. The experimental data on the occurrence of pigeons in different parts of the city, was sent to the societal partners from the research institute.	10 lessons + half day research on the street. 15.5 hours.
ACT	Students wrote an email to the city council with an advice in relation to pigeons in the city based on their social & scientific inquiry. This was part of their personal inquiry. Teaching materials (assignment and assessment tool were developed by HEI partners in collaboration with the teacher coordinator).	3 lessons. 3.5 hours.

Development of CORPOS and CoP in School 2 (continuing) in The Netherlands

School 2 was a continuing school that also participated in Round 1. Due to practical issues in the prior school year (parental leave, time and curriculum issues) the CORPOS of 4 science teachers was reduced to 2 at the end of the school year and only one teacher implemented a SSIBL-CoP lesson series. However, all teachers indicated they really wanted to continue since they saw the added value of SSIBL pedagogy in linking the science curriculum to the community and students' daily life. So, we

started Round 2 with the original CORPOS from Round 1: 2 biology teachers, 1 physics teacher, 1 chemistry teacher and 3 staff members from HEI.

Since in Round 1, teachers only incorporated learning activities for students to inquire different stakeholder but not involved external partners in their lesson plan, this aspect was emphasised in the CORPOS meetings of Round 2. We organised four co-design session of 1,5-2 hours to work on SSIBL-CoP lesson plans between September 2023 – March 2024. HEI partners offered suggestions for stakeholders and used their network to link stakeholders to the school (e.g. young scientists, research groups from Utrecht University). Moreover, 2 teachers attended the Teacher Professional Development workshop in Prague organised by COSMOS (14-15 November 2023) in which the different SSIBL-inquiries (scientific, social, personal inquiry) were emphasised as well as the role of involving stakeholders (CoP) in the learning process. This resulted in a concept design of the physics teachers' 'Project Day on the Sustainable school for the future' with first ideas of involving different community members.

SSIBL theme in School 2 (continuing) in The Netherlands

The teachers all wanted to develop lessons linked to their own school subject, so next to the CORPOS co-design session individual face-to-face design sessions with the HEI partner were organised. Approximately six sessions of 1- 1,5 hours per teacher during the school year. Since one biology teacher got another role in the school organisation she didn't design and implemented a SSIBL-CoP lesson but did participate in most joint co-design sessions.

In the end four SSIBL-CoP implementations were co-developed and implemented on diverse SSIs. The SSIs were decided on by the CORPOS based on links to the science curriculum. Three modules were newly designed and 1 was continuing (Particulate matter).

1. The physics teacher designed a project day about the '*Sustainable school for the future*'
2. The chemistry teacher designed two implementations, one continuing on '*Particulate matter*' (slightly revised to emphasise the social inquiry more) and one new on '*Microplastics*'.
3. The biology teacher designed a *series of 3 lessons* on different topics during the school year linked to the curriculum: HPV vaccination, gender in sport, Crispr-Cas

In two of the four implementations the CoP was more than the CORPOS:

- The module on microplastics involved a young researcher, sharing her experiences and career choices with the students in the classroom; and a school visit to a lab of a research group on microplastics at Utrecht University.
- The project day on the Sustainable school for the future involved an architect (of sustainable buildings), installer (heat pumps and double glass), municipal councillor (with the sustainability portfolio), and the school headmaster. These experts were available for students' questions (interviews) during the project day and the students' groups pitched their advice on how to make the school more sustainable to the experts.

The HEI partner supported by searching for stakeholders and societal partners related to the SSIs. The teachers contacted them to ensure the sustainability of the contact/ network for the school. In these two units the CoP was mostly involved in the FIND OUT phase of the lessons, less in the ASK and ACT phase.

In the other two implementations, stakeholders were not physically present but were represented by their websites or information leaflets. Table 4.2A-D presents overviews of different SSIBL themes that were implemented in The Netherlands.

Table 4.2A Overview of SSIBL-CoP implementation theme: Sustainable school for the future

SSIBL dimension	Description including CoP role/participation	Duration Project day: 6 hours total
ASK	Key question: how can we make our school building more sustainable? Intro and exploration of the issue: • Teacher introduces the topic by showing a video clip 'Morgenland' about energy transition after which the students play the 'statement game' (Controversy line – taking a position for or against the statement in the classroom and explaining their position) to engage students with the topic of the project day by connecting the issue to their daily life. Statements are related to the (bad) climate	1 hour.

	in the school (draft, temperature & ventilation problems in classrooms). • Next, an extra dimension is introduced to the statements: whether they want to act or not & whether they think their actions would have an effect (Action Competence). It's a phase of initial opinion forming for the students After a phase of social inquiry (see below) in which the students explored the issue in more depth (perspective of the users of the building) the students **formulate their own question**.	
FIND OUT	**Social inquiry**: interviewing users of the school building: 'exploring the issue further': • In groups students prepare interview questions for different *stakeholders* (users of the building): teachers, students, principal, school development team and conduct the interviews • Students make an overview of the information gathered so far. They summarising their interview outcomes and formulate their own opinion about the subject. **Raise questions: (ASK)** • The students discuss which problem (they determined during the personal and/or social inquiry) they want to solve. They discussed which research questions would fit with this problem. **Scientific and social inquiry**: coached by the teachers and learning materials student conduct research: • They make a plan for their inquiry and carry out the inquiry (e.g. scientific data of temperature, CO2 concentration and temperature in classrooms is available in student material). • They interview 4 available experts: school headmaster, architect, installer, municipal councillor. • They analysed their data collections in their group.	1.5 hours. 1.5 hours.
ACT	**Decision making: Make an advice** Students used the outcomes of their personal, social and scientific inquiry to formulate a final advice (e.g. pitch with slides, poster) about how to make their school now and the future school building more sustainable.	1 hour. 1 hour.

	Groups of students pitched their solutions (advice) to one of the four experts: school headmaster, architect, installer, municipal councillor and answered questions of the experts about their advice. • Teaching materials (assignment and evaluation activities) were developed by HEI partners in collaboration with the science teacher).	

Table 4.2B Overview of SSIBL-CoP implementation theme: Micro-Plastics

SSIBL dimension	Description including CoP role/participation	Duration 15 lessons + half day excursion in research lab. Total: 21 hours
	The HEI partners developed with the science teacher a learning trajectory for a new topic in school curriculum on micro-plastics. HEI partner searched background literature for the teachers and the students, searched for stakeholders/ societal partners. Teacher contacted them. During the lesson trajectory, after the ASK phase students 'entered' three times the FIND OUT FASE for the scientific inquiry, societal inquiry (which also incorporated some personal questions) and personal inquiry. In the ACT phase input from the three inquiry lines came together and students had to write a personal essay.	
ASK	For the whole trajectory: start activity with *beweegredeneren* ('arguments in motion') on statements with lead to questions from students. In addition, a quiz giving some basic information with also triggering questions of students. At the start of each of the three FIND OUT phases (scientific, societal en personal inquiry), students chose, rephrased one of the raised questions or developed new questions.	4 lessons. 5 hours.
FIND OUT	Scientific inquiry: in this part of the learning trajectory the teacher coached the students in developing a valid research question, developing research tools (filters and sort of centrifuges) to gather microplastics from water.	10 lessons + half day excursion at research institute + guest lecture at school. 15 hours.

	Societal inquiry: students choose a topic within the theme micro-plastics (e.g. MP in cosmetics and health risks) and did literature research (start articles were provided by teacher). Research institute (combining scientific and social inquiry) organised excursion to lab at Utrecht University (organic chemistry and plastics) with lectures and room for questions. **Personal inquiry**: beside personal questions embedded in the other inquiry lines, a young researcher came to school giving an interactive lesson, including her journey from nurse to science researcher on Microplastics and helping answering their personal question. HEI partners & teacher developed learning trajectory. HEI partners searched for research institutes and researchers, and developed grading tool for SSIBL assignments.	
ACT	Students wrote an individual personal essay on a current topic in relation to micro-plastics, what need to be done and what they can do about it, using what they learned from the three inquiry lines. HEI partners & teacher developed assignment to assess students and a grading tool.	1 lesson. 1 hour.

Table 4.2C Overview of SSIBL-CoP implementation theme: Particulate matter from home to school

SSIBL dimension	Description including CoP role/participation *As it was a project already developed in previous year only aspects to emphasise SSIBL aspects were adapted or stressed more.*	Duration 2 lessons + school day Total: 9 hours
ASK	**Statement driving the investigation**: Fossil fuel cars and scooters should be banned from the city. The teacher introduced the statement and asked students to take a position in the classroom based on their initial opinion, and whether this opinion was more rationally backed-up or	1 lesson (70 minutes)

	more based on their feelings/ emotions about the statement: activity '*arguments in motion*'. The teacher asked some students why they were standing at that position. So, students expressed their initial opinion and heard (and saw) what their peers' opinion was and why (personal inquiry). The teacher summarised some arguments and indicated that one important aspect of air pollution is particulate matter. These activities led to questions on the topic.	
FIND OUT	Next, the class was divided in groups and filled in a worksheet with questions such as: • *Who would be in favour of the statement and why?* • *Who would be against the statement and why?* • *Possible solutions?* As such making a start with societal inquiry. As start of the scientific inquiry, the teacher explains the working of the particulate matter sensors. Every group gets a sensor and should do measurements in the city/ environment. Student groups (3 persons) need to formulate a research question or hypothesis they want to inquiry by means of the particulate matter sensor that can be attached to their bike. They need to plan who is doing the measurements in the upcoming day(s). Data gathering, uploading to national database (GLOBE NL) and data analysing using worksheets and the GLOBE NL database. https://globenederland.nl/docenten/18-globe-scholen-meten-fijnstof-met-snuffelfiets/ Data students collected with the sensors are stored (automatically) in an online data system of the national RIVM (linked the GLOBE NL).	1 lesson (70 minutes). 4 hours.
ACT	Students' groups developed a poster to showcase in school showing data they collected, conclusions drawn and advise they give based on their data-collection.	2.5 hours

Table 4.2D Overview of SSIBL-CoP implementation theme: series of three SSIBL lessons on different topics.

SSIBL dimension	Description including CoP role/participation Teacher and HEI partner developed the lessons. Stakeholders are represented by their websites or information leaflets.	Duration 2x1 lesson Total: 2.5 hours
ASK	HPV vaccination or not: After showing a news item on the topic (low HPV grade amongst youth), students start with individually give their reaction to statements related to the topic (Likert scale 5). Plenary discussion follows, in which the teacher gathers questions posed by the students and needed to be answered. Crispr-Cas: What's the limit for you? After showing headlines of various Crispr-Cas implementations, students start with individually give their reaction to statements related to the topic (Likert scale 5), and formulate personal questions, teacher groups the questions. Dilemmas in sport: After news headlines on various current dilemmas in sport, students start with individually give their reaction to statements related to the topic (Likert scale 5), they formulate personal questions, then they physically take position using a variant of '*beweegredeneren*' (arguments in motion), and they revisited their questions.	15-20 minutes.
FIND OUT	HPV vaccination or not: the gathered questions are divided amongst the students' groups. Links with information from various stakeholders is giving to groups (in relation to the question). In addition, students can search more information. In plenary discussion: student teams present their outcomes. Crispr-Cas: What's the limit for you? In groups of 4 the students look for answers on the designated questions with sources the teacher had gathered, they can do an additional search, plenary discussion of group questions and answers. Dilemmas in sport: students watch various movie clips from various perspectives on the topic of transpersons and (various) sports.	40 minutes.

ACT	**HPV vaccination or not:** write an what's app message to some who also has received an invitation to HPV vaccine and give your informed based opinion. **Crispr-Cas:** What's the limit for you? Students in groups study the views of the political parties in NL on this topic. The individually write a 'vote' referring to the sources studied. **Dilemmas in sport:** write (to the teacher) a petition (with an informed based introduction) in relation to your own sports club and the participation of transpersons.	Last 10 -20 minutes of lesson and/or homework.

4.2. Reflections on facilitation, support and implementation within each participating secondary school in The Netherlands

Reflections on the facilitation of SSIBL-CoP in School 1 (new) in The Netherlands

In Round 1, we hadn't succeeded in meeting the schoolboard of the participating schools. So, at our first meeting at this new school, we walked into the school manager office and introduced ourselves. As the school is very bottom-up in organisation with shared government, the manager and teacher saw no need for a representative of the schoolboard in CORPOS. The school manager declared he was willing to support the COSMOS project and the teacher was allowed to go to Prague (TPD session COSMOS). So, the school was supportive but the CORPOS is very small: one science teacher and COSMOS members (HEI and SP), for one implementation.

As a consequence, the steps 1-2 (COSMOS framework) were taken rapidly in one meeting. In the first meeting after explaining COSMOS and SSIBL approach (using adapted COSMOS ppt), the teacher was interested and agreed on cooperation. There was already a learning trajectory on scientific inquiry with pigeons in the city as a topic for grade 8. The needs of the school were specific and within COSMOS framework:

1. to help the school transform the topic in an SSI, while implementing the SSIBL approach;

2. support and facilitate the partnership with the societal partner in organising a kick-off start in the science museum (UMU) for all students;
3. adapting the existing and new materials for grade 7 (in addition to grade 8).

Step 3 in forming a CORPOS appeared problematic (step 3: work with and engage local authorities, local government, region or municipality). There are a lot of initiatives going on in the school involving local government, region or municipality on e.g. students' health care or subject related other projects. There was no need or advantage felt in developing a CORPOS.

The experience with schools in Round 1 was that planning a meeting during the year took a lot of time and correspondence. This year we introduced from the start biweekly meetings (alternating in person or online) with the CORPOS (teacher and staff HEI partner) to co-design the SSIBL-CoP unit and organise practical issues. The CoP including also societal partners and stakeholders had one in person meeting, with a tour in the museum, discussing its' role in the learning trajectory and other changes for the coming year. One can consider this network as a pop-up CoP, as it is revived every year and only meets once in person with the whole group. Depending on the agenda the CORPOS meetings were visited by the different partners from the CoP.

Key factors for the CoP success are the personal relations between one of the stakeholders and the school, as the stakeholder is an ex-colleague. More important for the sustainability of the cooperation, there is a mutual dependence the students deliver the researchers data for the stakeholder (university research group), gathering data for a real research project gives students more motivation. The researcher's enthusiastic talk gives students a view on the work of a researcher, in addition the researcher shows various perspectives on the SSI, reinforcing the SSIIBL approach.

More important is that the implementation covers an important part of the curriculum and the mission of the school ('Lerend de wereld bewegen', translation: While learning changing the world). The implementation can be considered as an '*Add-in*'.

Weak aspect: we did not succeed to provide professionalization activities for the science teachers executing the 14 lessons only the coordinating teacher in the CoP, consequently the incorporation of the SSIBL approach with the (science) staff might be limited.

All members of the CoP want to continue next year, the hope is that the school can finance the school visit for the approximately 200 students.

Reflections on the facilitation of SSIBL-CoP in School 2 (continuing) in The Netherlands

This continuing school struggled in Round 1 with practical issues, such as time and curriculum constraints, resulting in only one SSIBL-CoP unit implementation. However, all four science teachers wanted to continue in Round 2 since they saw the added value of SSIBL pedagogy in linking the science curriculum to the community and students' daily life. So, we continued with the same CORPOS of Round 1 of 4 science teachers and the HEI partners.

Also, this time the teachers did not want to involve the school principal in the CORPOS. They indicated that the principle/ school leadership approves and applaud that they join the COSMOS project, but does not facilitate them (e.g., time in their schedule, less other tasks). Moreover, there were a lot of changes in management happening this school year. However, a staff member of the HEI partner scheduled a face-to-face meeting with the interim manager to introduce the COSMOS project, and in the end the head master served as CoP member in one of the SSIBL-CoP implementations ('Sustainable school for the future').

The time constraints the teacher experienced last year (overloaded curriculum, working on designing their lessons after school hours) couldn't been solved, but we supported the process by scheduling four 2-hour CORPOS co-design sessions before the start of the school year. Next to that we organised approx. 6 one-on-one co-design sessions with each teacher (online or in-person), to make the process, progress, and time investment as efficient as possible for the teacher.

The advantage of continuing schools is that the Open schooling process started last year in the mindset of teachers, and they already became familiar with SSIBL pedagogy. Involving external partners was a step to far for the teachers in Round 1, since changing their lessons according to SSIBL pedagogy was

already challenging. This school year, teachers were already familiar with the SSIBL phases and we were able to put more emphasis on the involvement of external stakeholders in the TPD and co-design sessions. HEI partners offered suggestions for stakeholders and used their network to link stakeholders to the school (e.g. young scientists, university research group). Two teachers attended the 2-day Teacher Professional Development workshop in Prague organised by COSMOS in which the different SSIBL-inquiries (scientific, social, personal inquiry) were emphasised as well as the role of involving stakeholders (CoP) in the learning process.

Since the teachers wanted to develop SSIBL-CoP units linked to their own subject curriculum four modules were co-developed on diverse SSIs. One unit on 'Particulate matter' was a continuing module of Round 1, slightly revised to emphasise the social inquiry more. In two of these four units the CoP was more than the CORPOS:

- The module on 'microplastics' involved a young researcher, sharing her experiences and career choices with the students in the classroom; and a school visit to a lab of a research group on mi-croplastics at Utrecht University.
- The project day on the 'Sustainable school for the future' involved an architect, installer, municipal councillor, and the school headmaster. These experts were available for students' questions (in-terviews) during the project day and the students' groups pitched their advice on how to make the school more sustainable to the experts.

The HEI partner supported by searching for stakeholders, the teachers contacted them to ensure the sustainability of the contact/ network for the school. However, the project day unit teacher indicated that contacting all these stakeholders and organising to get them to the school was quite challenging and stressful - he was not sure if it was worth going all out next time. Although the students enjoyed the project day and felt that their voices were heard (as they presented their advice for a more sustainable school building to the headmaster) they did not feel that it was part of the formal curriculum and therefore showed less commitment; which was frustrating for the teacher.

In these two units, the CoP was mainly involved in the FIND OUT phase of the lessons, less so in the ASK and ACT phase. Since most of these units are 'add-on' to the curriculum rather than 'add-in', there is a risk of a phase being omitted in the future.

The school has citizenship aspects in their motto 'Open your world' however implementing this sustainable in their school curriculum is still challenging and strongly depends on commitment and dedication of individual science teachers.

4.3. Lessons learned from Round 2 implementation in The Netherlands

Both schools we worked with in the Dutch context have citizenship aspects in their motto – 'While learning changing your world' (S1) & 'Open your world' (S2) - and are open to Open schooling projects and had some already running. However, school culture and context differed:

- The new school (S1) has been around for about 10 years, they use no textbook, are constantly working on the curriculum and designing their own teaching materials for school layers. The school organisation is very bottom-up with shared governance.
- The continuing school (S2) has a more conventional curriculum, struggled with management changes and low scores in national examinations. Putting pressure on teachers for better exam results.

The school culture and the nature of the newly developed modules in the context of COSMOS seem to make the difference in whether the approach seems sustainable and helped schools move to the more outward level of openness:

'Add-ins' are more sustainable than 'add-ons'

- The SSIBL CoP units that were woven into the regular curriculum for a longer period of time ('Add-in'), including an assessment activity at the end of the unit, seem to be more sustainable (e.g. 'Pigeons in the city' School 1, 'Microplastics' school 2). Teachers found it more worthwhile to invest in the implementation of SSIBL in these modules and in external contacts and stakeholders (CoP). These units were developed for, and implemented in, entire year layers that will be implemented again in the upcoming school years.

- The 'Add-on' SSIBL-CoP units (school 2) were developed based on the regular curriculum by linking SSIs to topics in the curriculum during the year. In this way, it felt like extra time and lessons were invested in an already overloaded curriculum, which made it vulnerable to unforeseen practical problems (e.g. teacher illness made these lessons the first to be dropped).

Sustainability of the network/ CoP

- One SSIBL-CoP unit at school 2 ('Sustainable school for the future') was developed in the context of a '*project week*'. Many students appear to take these weeks less seriously than the 'regular' weeks, which does not help the motivation of students and supervising teachers. The unit's teacher invested a lot of time in involving the CoP (with support of the CORPOS) during the project day, but he was not sure if it was worth going all out next time.
- The CoP in the unit ('Pigeons in the city) of school 1 on the other hand seems sustainable since there is a mutual interest: the researchers are interested in the data the students collect for their research program; the teachers are interested in the lectures of the researchers in the lesson module. Implementations are already scheduled for next year.

School culture and formal curriculum constrains

- Key factor for school 2 is available time: teachers struggle with having enough time. This time restraint is present in two ways. First, when they are working on the COSMOS project designing their lesson, which has to take place after school hours. Second, when trying to implement the designed lesson in their curriculum, which the teachers experience as already being overloaded.
- Although science teachers found SSIBL to be of added value to their students and indicated that they would continue to use this pedagogy after the COSMOS project, citizenship education is not part of the national final exam, making it the first to drop out when teachers lack time.

Working with schools for two years is of added value

- SSIBL-pedagogy was well internalised by the teachers of the continuing school. They reflected on their own lessons and those of colleagues through the lens of the ASK, FIND OUT, and ACT phase. Teachers indicated that the TPD activities were helpful in incorporating SSIBL

pedagogy in their teaching repertoire, including the different inquiries (scientific, social, personal). They used that lens now quite automatically when preparing for other 'regular' science lessons.

For schools that developed 'add-on' units, we can conclude: an open-school project is seen as adding value to the science curriculum, useful for students, but also complex and fragile in the organisation. Schools that are already more open seem to embrace the COSMOS approach with fewer obstacles, because the way of working is already more embedded in their pedagogy and organisational structure.

5. Portugal Report (Partners 5 & 10, IE-UL/Ciencia Viva)

In Portugal, we worked with two school clusters. Schools are organised in clusters: groups of schools from different levels of education that function under the same directive board and develop a common educational project they consider adequate for their social and cultural reality. So, in this case there are two clusters, and two secondary schools involved. These were also working within the project during the first implementation round, so they are continuing schools. Two secondary science teachers participated and 146 secondary school students in the ages of 13-17 years. In addition, others were involved, which will be elaborated on further. In the following sections the process of the implementation in these secondary schools and reflections are presented.

5.1. SSIBL-CoP Implementations in secondary schools in Portugal

Development of SSIBL-CoP in Schools' Cluster 1 (continuing)

This school cluster, represented in COSMOS by one primary school and one secondary school participated in COSMOS for the second year. The CORPOS did not suffer any change between the two years. The CORPOS was developed at the cluster's level, integrating teachers from both primary and secondary schools.

One of the CORPOS members is used to implement activism initiatives based on an inquiry-based science approach. She took a master degree at the IE-ULisboa (supervised by Pedro Reis) about the topic of students' activism (understood as a collective and democratic problem-solving process centred on socio-scientific or socio-environmental problems affecting their communities). So, she belongs to a CoP that the IE-ULisboa has been supporting for 14 years centred on students' and teachers' activism, and the SSIBL-CoP has a lot in common with the initiatives we have been developing. The CORPOS was developed based on the strong relations (personal and professional) existing between the IE-ULisboa team members and this teacher. In the school cluster, this teacher had a very important role in mobilising other teachers (from different levels of education) to the CORPOS. The fact that they work organised in school clusters, provided a context in which internal collaboration between different levels of education already existed.

Another important fact supporting both the CORPOS and the community of learning development was that the school cluster had one "Science Club", supported by Ciência Viva (our societal partner). This club is aimed at the development of collaborative projects between students, teachers, scientists, science centres' members, parents and other community members. The club is focused on the inquiry and resolution of local problems that the school community would like to address. This "Science Club" was an important pivot for all the activities and for the combination between COSMOS activities with activities developed by other projects proposed by the City Hall (local government) and several NGO organised in a group called SMILE).

The CoP was formed by identifying potential partners through a combination of stakeholder analysis and leveraging existing collaborations. For instance, the primary school's ongoing partnership with the SMILE project, a local initiative aimed at making the neighbourhood sustainable, played a crucial role. Communication was maintained through regular meetings where ideas and resources could be exchanged. The CoP's activities interactive workshops for students, focusing on shared interests in sustainability and environmental education.

While the overall structure of the CoP was maintained during the entire year, the participation of certain members evolved. For example, one teacher decided to step back from the project due to curriculum constraints and the demanding schedule associated with preparing ninth-grade students for exams. The topic of sustainable buildings, while valuable, did not align well with the curriculum requirements for her subject area, particularly in the context of the academic pressure faced by students in their final year of middle school.

SSIBL theme in Schools' Cluster 1 (continuing)

The theme of "sustainable buildings" was chosen as the focal point for the SSIBL project. This theme was selected based on the schools' existing initiatives, such as the use of solar panels and composting systems in the secondary school. The co-design process involved teachers working closely with students to identify relevant issues and develop practical solutions. For example, students were encouraged to explore ways to improve their homes' energy efficiency, leading to discussions on renewable energy sources and waste management. This collaborative effort not only enhanced students' understanding of the subject but also fostered a sense of responsible citizenship. Through hands-on activities, such as constructing models of sustainable houses and exploring the use of

sustainable materials and alternative energy sources, students gained practical knowledge about sustainability. This experiential learning was instrumental in boosting their confidence in their ability to make a positive impact on the environment. Students reported an increased awareness of how their actions affect the world around them and expressed a clear commitment to implementing sustainable practices in their daily lives. The project's influence extended beyond academic interests, instilling a sense of environmental stewardship. Students demonstrated a growing concern for the planet's well-being and a strong motivation to engage in actions that contribute to its preservation. This was evidenced by their willingness to reduce pollution, reuse materials, and take other steps towards sustainability.

Members of the CoP were actively involved in the learning process, particularly through the integration of interdisciplinary approaches. For example, students from the secondary school were tasked with creating educational games for their younger peers, explaining concepts such as sustainability and sustainable building materials. These activities allowed for a deeper understanding of the issues at hand and promoted peer-to-peer learning.

For these continuing schools, the focus remained on the same SSI, specifically the theme of "sustainable buildings." This decision was made based on the positive outcomes and the strong foundation established in the previous round. The co-design process, however, did undergo some changes. In the second round there was a deliberate effort to co-create new materials and adapt existing ones to better suit the evolving needs of the students and the objectives of the project. Additionally, hands-on activities were diversified, including more complex experiments and model-building exercises.

Development of SSIBL-CoP in Schools' Cluster 2 (continuing)

This school cluster, also represented in COSMOS by one primary school and one secondary school participated in COSMOS for the second consecutive year. In this cluster the CORPOS remained the same between the two years. The CORPOS was developed at the cluster's level, integrating teachers from both primary and secondary schools.

Similar as in Cluster 1, one of the CORPOS members is used to implement activism initiatives based on an inquiry-based science approach. He took both a master and PhD degree at the IE-ULisboa (supervised by Pedro Reis) about the topic of students' activism (understood as a collective and

democratic problem-solving process centred on socio-scientific, or socio-environmental problems affecting their communities). So, he belongs to a CoP that the IE-ULisboa has been supporting for 14 years centred on students' and teachers' activism, and the SSIBL-CoP has a lot in common with the initiatives we have been developing. The CORPOS was developed based on the strong relations (personal and professional) existing between the IE-ULisboa team members and this teacher. In the school cluster, this teacher had a very important role in mobilising other teachers (from different levels of education) to the CORPOS. The fact that they work organised in school clusters, provided a context in which internal collaboration between different levels of education already existed.

As with Cluster 1, another important fact supporting both the CORPOS and the community of learning development was the fact that the school cluster had one "Science Club", supported by Ciência Viva.

The schools established robust partnerships with parents and local entities, including the City Hall, and some NGO from the area of environment. These collaborations, together with the Schools' Directive Board, were considered essential for implementing the proposed improvements. The students developed detailed action plans and cost estimates, which were presented to these partners to secure support and resources. This collaborative approach ensured that the project had a real impact, beyond the classroom, fostering a sense of community engagement and practical action.

So, the CoP was established through a combination of existing partnerships and new collaborations. Stakeholders were identified based on their ability to contribute to the project's goals, with a focus on improving the school's infrastructure and promoting sustainability. The CoP included a wide range of participants, from teachers and students to local government officials and parents.

The activities within the CoP included interactive workshops – implemented by an Environmental Engineer from the City Hall and some volunteers from the Nature Protection League – where students learned about sustainable practices and explored creative solutions for their school environment. The shared interest in creating a more sustainable and pleasant school environment served as a unifying goal for all involved. Table 5.1 presents an overview of the SSIBL-CoP implementation in School cluster 1.

Table 5.1 Overview of the SSIBL-CoP implementation in School Cluster 1 (continuing) in Portugal

SSIBL dimension	Description including CoP role/participation	Duration Total: 24 hours
ASK	"What do buildings of a sustainable future look like?". The project aimed to explore sustainable architecture, focusing on energy efficiency, renewable materials, and the overall impact of buildings on the environment. The older students were tasked with researching these topics comprehensively, with the goal of sharing their findings with the younger students to foster awareness and understanding of sustainable development.	5 Hours in primary and secondary school.
FIND OUT	The older students explored various elements of green architecture, including the use of solar panels, sustainable insulation, and water conservation techniques. The students prepared detailed presentations and educational materials designed to be accessible and engaging for the younger students. The focus was on understanding the principles behind sustainable construction and identifying best practices that could be applied in future projects.	8 hours in primary and secondary school.
ACT	All students applied their understanding by constructing models of sustainable buildings. These models included features like green roofs, solar panels, and efficient water management systems. The culmination of this project was an exhibition at the schools from the school Cluster and the presentation at the Pavilhão do Conhecimento, where all COSMOS partner schools gathered to showcase their work. These events provided a platform for students to present their models and discuss their insights on sustainable architecture.	11 hours in primary and secondary school.

SSIBL theme in Schools' Cluster 2 (continuing)

The SSI for the SSIBL-CoP was chosen during a brainstorm session in Prague COSMOS meeting between the CORPOS members from both Portuguese School Clusters. Then, they decided to focus on sustainable buildings (e.g. sustainable school building and sustainable homes), with the aim of creating a sustainable project that could engage students across different educational levels and allow the collaboration between the two Portuguese School Clusters. Later, in this school cluster, the initial proposal from Prague was reworked to align with the specific context and needs of the schools in Almada. Upon returning from Prague, the educators realised that the original theme did not fully

resonate with their students, or address the immediate issues within their school environment. Therefore, they shifted focus towards practical improvements within their own school, using the theme of "the school of the future" as a catalyst for identifying and addressing current challenges.

This SSI allowed the synergetic collaboration between projects and resources proposed by different institutions: the COSMOS project proposed by the IE-ULisboa and Ciência Viva; the “Science Club” proposed by Ciência Viva; the project Agenda 21 from the City Hall.

The project engaged students in a comprehensive examination of their school's current state and its potential for improvement in terms of sustainability. The older students (11th grade) conducted interviews with younger students from the different school levels, trying to identify their desires for a future school and assessing current issues such as sustainability, temperature control, the presence of greenery, and water drainage. These interviews revealed a range of concerns and aspirations, forming the basis for subsequent project activities. Then, based on a discussion process of the collected data, both age groups (from primary and secondary schools) proposed their visions for a future school. These visions were shared and discussed between the two groups of students in common sessions. The secondary school students created digital representations using Minecraft and prepared implementation plans focused on concrete proposals – with a study about the materials and costs involved in each one of them. The primary school students constructed physical models of the school, exemplifying the proposals to be presented to external stakeholders.

The decision to focus on "the school of the future" as the SSIBL theme was driven by the need to address the specific issues faced by the schools. The co-design process was highly participatory, involving students and teachers in brainstorming sessions and practical activities. The project leveraged both traditional and digital tools, with older students using Minecraft to design digital models of their ideal school, while younger students created physical models. This dual approach allowed for a rich exploration of ideas and facilitated a deeper understanding of architectural and environmental considerations.

The project had a strong impact on students, fostering a sense of responsible citizenship. Students were not only encouraged to think critically about their environment but also to take practical steps towards improvement. They identified specific issues within their school, such as inadequate green spaces, poor temperature control, and water drainage problems. By proposing concrete solutions and collaborating with local authorities, they gained a strong sense of agency and responsibility.

Students' proposals included practical measures such as installing photovoltaic panels to provide shade and generate electricity, planting more trees, growing plants in the fences around schools and improving water drainage systems. These initiatives were supported by detailed cost plans and action strategies, which were presented to the School's Directive Board and to the City Hall (local government). This active involvement in real-world issues reinforced the importance of civic engagement and demonstrated the impact that young people can have on their community. Some of these proposals were already implemented in the school or in the local community, with the help from the City Hall: several trees were planted in the schools' areas; other plants were placed at the fence that separates the two schools trying the increase the green area and the available shadow; organic composters were distributed by the schools and the houses from the community; vases with plants were placed in the majority of the buildings.

CoP members, including students and teachers, played an active role in the learning process. The collaborative nature of the project allowed for a rich exchange of ideas and fostered a deeper understanding of the issues at hand. The older students' involvement with the younger students exemplified peer learning and mentorship. This iterative process ensured that the project remained relevant and engaging, providing a dynamic and impactful learning experience for all participants. Table 5.2 presents an overview of the SSIBL-CoP implementation in School Cluster 2.

Table 5.2 Overview of SSIBL–CoP implementation in School Cluster 2 (continuing) in Portugal.

SSIBL dimension	Description including CoP role/participation	Duration
ASK	"What is the vision for the school of the future, and how can the current school environment be improved in terms of sustainability?" This question emerged from the need to align the COSMOS project with the local realities of the participating schools. The activities leading to this question included initial discussions with students about the current state of their school environment. This activity helped raise awareness among students about the environmental aspects of their school and set the stage for proposing practical improvements.	Primary school, 8 hours. Secondary school, 3 hours.
FIND OUT	Older students conducted interviews with younger students, asking them to describe their ideal school and identify	Primary school, 11 hours. Secondary school, 8 hours.

	shortcomings in the existing facilities. These discussions focused on aspects like sustainability, temperature regulation, green spaces, water drainage, and overall comfort. The personal, social, and scientific inquiries conducted by the students involved a comprehensive analysis of the school's current state and potential areas for improvement. The students worked together to identify issues such as lack of greenery, inefficient temperature control, and inadequate water drainage. The older students played a crucial role in this process, as they were responsible for designing and conducting the interviews with younger students. These interactions provided valuable insights into the students' perspectives and highlighted areas where changes could be made. The CoP, which included teachers, parents, and local authorities such as the City Council and Parish Council, supported the students in this endeavour. They provided resources, guidance, and expertise, enabling the students to deepen their understanding of sustainability and its practical applications.	
ACT	The younger students focused on creating physical models, incorporating elements such as gardens, better temperature control, and sustainable materials. The older students divided their efforts between creating digital representations using Minecraft and building physical models. These projects showcased their vision for a more sustainable and environmentally friendly school. In addition to creating models, the students, with the support of the CoP, developed a detailed action plan that included cost estimates and implementation strategies. They presented these plans to the City Council and other stakeholders, advocating for real changes to the school environment. Some of the proposed actions included installing vertical gardens, improving water drainage systems, and introducing composting initiatives. The involvement of parents and local authorities was crucial in these efforts, as they provided the necessary support and resources to turn the students' ideas	Primary school, 11hours. Secondary school, 8 hours.

	into reality. Some of the proposed ideas were already implemented with the help of the City Hall. The culmination of this project was the presentation at the Pavilhão do Conhecimento, where all COSMOS partner schools gathered to showcase their work. This event provided a platform for students to present their models and discuss their insights on sustainable buildings.	

5.2. Reflections on facilitation, support and implementation within each participating school cluster in Portugal

Reflections on the facilitation of SSIBL-CoP in Portugal

The CORPOS was the same from last year. We involved groups of teachers with a long experience of collaboration in the implementation of activism initiatives based on an inquiry-based science education approach. The communication was established through our previous channels: video conference, phone calls and visits to the schools.

The CORPOS was created, maintained and supported by the strong collaboration and the shared culture/interest (between the IE-ULisboa team and the main teacher from each school cluster) in terms of the importance attributed to inquiry and activism initiatives implemented by students and teachers. As already mentioned, this culture has been developed during a long process of collaboration associated with a community of learning centred on that kind of initiatives. So, we were quite successful approaching school staff who: a) have been involved with us in previous projects; b) were motivated to work with us; c) already shared a common repertoire with us regarding the implementation of inquiry and activism initiatives in schools; d) have positions of leadership regarding pedagogical innovation and project implementation in schools.

We also faced some obstacles to CORPOS development: a) time constraints and a work overload experienced by many teachers; b) only a reduced number of teachers were motivated to participate in the project; c) during each school year, teachers are invited to participate in a large number of projects, causing some limitations in terms of their availability to participate in all of them (they had to choose according to the demands of each project and their personal time constraints).

The CoP was created with a small, but adequate number of members. Compared with the first year of COSMOS, the teachers from the School Clusters showed a remarkable capacity to combine/articulate people and resources from different projects offered to the Cluster. The activities were planned by the teachers in order to integrate in a coherent way the different proposals and requirements from several projects. This allowed a much better involvement (than last year) from external members from those projects and a much better use of resources. This second year, teachers had less difficulties planning and establishing collaborations with external groups/institutions. However, the initial idea developed in Prague, of sharing initiatives between the two school clusters, didn't happen due to time constraints and difficulties to articulate the agendas of both school clusters.

The CoP development was possible due to the previous personal and professional relations between the teachers and the IE-ULisboa team and also between the teachers themselves. Without these previous successful experiences between different elements, the CoP would become much more difficult to achieve. The CoP was facilitated by the previous experience of collaboration between different school levels and between schools from the same cluster. It is always difficult to find other teachers willing to participate. The teachers involved in the CoPs have in common a strong willingness to innovate (and to promote different activities each year) in their classes.

Reflections on the SSIBL-CoP design and implementation

The SSIBL-CoP design and implementation were facilitated by last year's COSMOS experience and the previous experience/involvement of some teachers in a CoP (created by IE-ULisboa) centred on students' and teachers' activism: the SSIBL-CoP has a lot in common with the initiatives we have been developing. The community of learning in each School cluster was quite effective in promoting collaborations between school levels and with external institutions or groups from other projects. Compared to last year (affected by a teachers' strike), the ACT phase was implemented in a much better way, with some impacts at school and community level.

All the SSIBL stages were accelerated by students' enthusiasm, in spite of the implementation of the majority of COSMOS' activities at the end of school year, when they have a lot of work and are already tired.

Overall experience

The COSMOS implementation was received quite well in both schools' clusters. Students enjoyed a lot the activities focused on real problems and the learning component was evident. Teachers mentioned

that they always appreciate collaborating in this kind of projects because they allow them to learn more pedagogical knowledge and to continue implementing activities combining science education, citizenship education and school activism.

The leadership of each school cluster had the important role of supporting teachers and students' involvement and participation in COSMOS. They were not directly involved, but they did not create any obstacles. And they were quite effective in recognising and celebrating students' and teachers' achievements within the COSMOS activities.

5.3. Lessons learned from Round 2 implementation in secondary schools in Portugal

Compared with the first year of COSMOS, the teachers from the school clusters showed a remarkable capacity to combine/articulate people and resources from different projects offered to the cluster. The activities were planned by the teachers in order to integrate in a coherent way the different proposals and requirements from several projects. This allowed a much better involvement (than last year) from external members from those projects and a much better use of resources. This second year, teachers had less difficulties planning and establishing collaborations with external groups/institutions. However, the initial idea developed in Prague, of sharing initiatives between the two school clusters, did not happen due to time constraints and difficulties to articulate the agendas of both school clusters.

Compared to last year (affected by a teachers' strike), the ACT phase was implemented in a much better way, with some impacts at school and community level. This year, all the COSMOS process began much sooner than last year (affected by teachers' strikes), allowing a much calmer and better planned implementation of COSMOS activities.

One of the most significant lessons was the importance of flexibility and adaptability in project planning and execution. The schools faced different challenges and had to tailor the initial project proposals from Prague to fit their unique circumstances and the specific needs of their students. This adaptability allowed the projects to remain relevant and engaging, particularly by focusing on practical and locally relevant issues like sustainable building practices.

Another lesson confirmed was **the value of collaboration between different age groups and disciplines**. In one group of schools, older students researched sustainable building practices and shared their knowledge with younger students, fostering a collaborative learning environment. This approach not only enhanced the learning experience but also promoted a deeper understanding of sustainability among students of different ages.

The successful execution of SSIBL-CoP projects heavily relied on the engagement and initiative of the involved teachers. **Engaged teachers act as catalysts for the project**, generating innovative ideas and motivating students to actively participate. They are essential in maintaining enthusiasm and direction, ensuring that the project's objectives are met. In the context of the schools the dedicated teachers played a crucial role in adapting the initial proposals to the local realities, customising the content to meet the specific needs of the students and the school environment.

Moreover, the **support of the school management is vital for the sustainability and continuity** of these projects. School administration not only facilitates the allocation of resources, but also creates an environment that values and prioritises innovative educational initiatives. This support is particularly important to ensure that the projects and their outcomes do not regress after the departure of key teachers or other significant team members.

The implications for the Open School approach include the need for increased community involvement and the **integration of real-world issues into the curriculum**. The projects demonstrated that when students engage with topics that directly impact their lives and communities, they are more motivated and invested in their learning. The partnerships with local entities, such as the City Hall and NGOs, were crucial in providing resources and support, showing that strong community ties can enhance educational projects. Moreover, the inclusion of **external stakeholders**, such as environmental groups and local experts, **enriched the students' learning experiences** and provided practical insights into sustainability issues.

6. Sweden (Partners 4 & 11/KU & Alma Löv)

The implementation in Sweden involved two secondary schools, one of them continuing in the COSMOS project since the first round. The other one being new. Four teachers and 106 students in the ages of 14-15years participated. In addition, others were involved, which will be elaborated on further. The continuing school decided to work with a SSIBL theme about snuff and the new secondary school chose to work with GMO, copying the process made by the continuing school during the first round. The idea was to make this as a pilot and then work with another theme about the question of having tax on sugar further on. In the following sections the process of the implementation and reflections are presented.

6.1. SSIBL-CoP Implementations in Sweden

Development of CORPOS and CoP and choice of SSIBL theme in School 1 (continuing) in Sweden
In this school CORPOS remained almost the same as during Round 1 with two teachers taking a main responsibility and with support from 1 partner from Karlstad University. However, during this second round the societal partner was not involved because of changed conditions at the museum and no exhibition relating to the chosen SSIBL theme that was about snuff. The choice of this theme was made by the teachers because it fitted well with what was included in the curriculum, learning about drugs. In addition, the teachers had noticed that it had become even more popular for young students to use snuff and especially the new white kind attracting more girls. Hence, the choice of SSIBL theme made the work an integrated part of the curriculum, or put in other words, an "add-in" instead of something extra put as an "add-on" in the school activities. The school class involved has some students with study difficulties so an extra teacher resource was also involved. Since the use of snuff also can affect health, the school nurse also became involved in the theme. This was the CORPOS evolved to a CoP.

The teachers wanted the students to have a lot of control and that they would NOT primarily use the textbook. Together they brainstormed how we could find information. Suggestions that came up were: look for information online, ask the school nurse, ask various organisations, ask questions in town.

The students worked in small groups to suggest "organisations" that could help us with information, what came up were: "the snuff factory", 1177 (website for health care in Sweden), drug therapist and doctor. Each group had to write at least five questions to the agency they were to contact. The school nurse participated in some lessons so the students could ask her questions. The science teacher then helped the students to email organisations. Unfortunately, it was very difficult to get a response. Some referred to their websites and that was it. Both students and the science teacher found this sad because they would have liked more interaction with other bodies.

The teachers and the students decided that they would present what information they found in the form of a poster. To facilitate this work, the science teacher decided that the students would produce information cards from each lesson. This is because at the end there would only be a mounting of the poster with these cards. Each lesson had a theme (here the science teacher was more active in directing what the lesson would be about:

- *The snuff box.* What does snus contain and what is in the warning text. Here I had lots of (empty) snuff boxes. The students had to read the packaging and supplement with what they could find online. Here, there was a bit of source-critical examination of whether these "sources of information" agreed. Two cards were produced - Content and Warning text.
- *Tobacco – Nicotine.* Is it the same thing? What is it? Where does it come from. A card was produced.
- *Health* - What happens in the body if we snuff? Here, the students also had to look for illustrative pictures that we printed out. A card was produced.
- *Addiction* - What happens in the body? What consequences can it have? A card was produced.
- *Cost* - The students had to find out what a snuff box costs. They then had to calculate how much the cost would be in a year if you snuff 1 can/day, 2 cans a week. After that, they had to look up examples of what they could buy for these sums. Examples of everything from Playstations and phones to foam machines appeared.
- *Survey in town.* In the smaller groups, the students decided which questions to ask (at least five questions). Teachers and students discussed a lot how many people they needed to ask, and the students came to a certain realisation that the result could be skewed if they did not ask enough people, at the same time we had limited time. Here the science teacher thought it was a big win in that they understood that it is difficult to pull too high gears on a result with few people. One lesson they were out on the town and asked questions, one lesson they compiled

the results in text and diagram form (the requirement was at least one diagram). Here we had a discussion about what makes sense to make diagrams of, as well as how to make the diagrams more clear. Two cards would be manufactured here.

- *For and against*. In conclusion, the students had to compile the pros and cons of banning snus, based on what they encountered during the work. A card was produced. As a conclusion, they would try to agree in the group on a stand, it was ok to think differently in the group. The opinions would then be reported on a final card.
- *Assembling the poster*. Students wrote the ASK question on a piece of paper and then mounted their various cards on the paper. (It was good that everything was almost ready and that it was "only" assembly in the last lesson.)

Figure 1 shows an example of the students' work during the Snuff theme and Table 6.1 presents an overview of the SSIBL-CoP implementation in School 1 in Sweden.

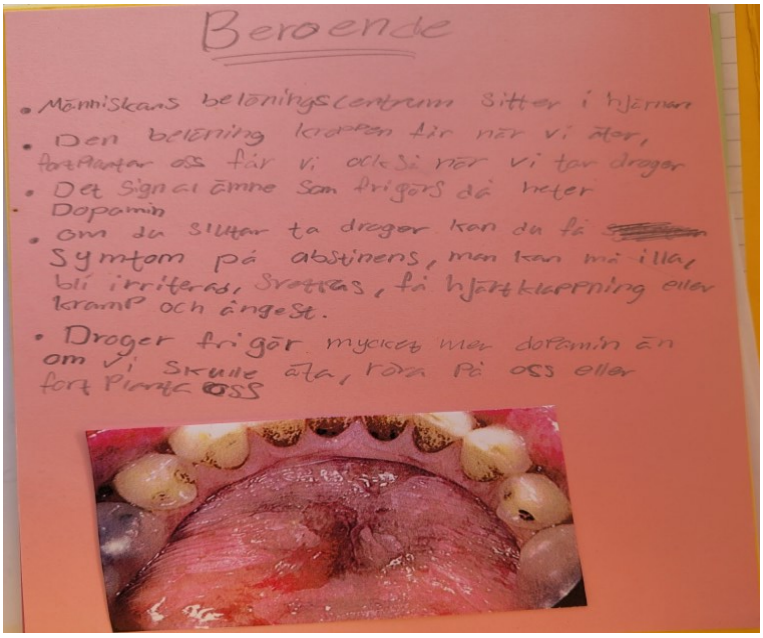

Figure 1. *Example of student work on the SSIBL theme about snuff.*

Table 6.1 An overview of the SSIBL-CoP implementation in School 1 (continuing) in Sweden.

SSIBL dimension	Description including CoP role/participation	Duration Total: 12 hours.
ASK	Should Sweden ban snuff, sales Yes or No? With an additional question: Is white snuff less dangerous than brown snuff? Decision of the ASK phase was made by the science teacher. Other teachers informed and discussion about how to collaborate on this. School nurse also involved after the students thought of how to find information.	2 hours.
FIND OUT	See the explanation in the text with different focus during the lessons and how the students worked in small groups to find information by writing emails to organisations, searching on the Internet, asking the school nurse and a public survey in the town.	9 lessons of 1 hour.
ACT	Final discussion in the small groups, taking stand for or against banning of snuff. Assembling their posters for exhibition at the school.	1 hour.

Development of CORPOS and CoP and choice of SSIBL theme in School 2 (new) in Sweden

As already mentioned, the new school wanted to work with GMO as SSIBL theme and to copy paste the process made by School 1 during the first round. This as a way of testing how to work this way. The CORPOS consisted of a science teacher and a technology teacher (interested in new teaching approaches and collaborating with partners out of school), 1 partner from Karlstad University and 1 partner from the Alma Löv museum. Although there were discussions with teachers at the beginning of the project about the possibilities of involving even more partners in the project, this did not happen.. The process followed similar steps and amount of time as within School 1 during the first implementation round. First a meeting was held with the teachers and the partner from Karlstad University to discuss how to work, what kind of SSIBL would be suitable for the teachers and students, within possibilities provided from the societal partner. Since genetics and GMO is part of the curriculum this was decided as theme. Another reason for this being that it would be possible to use the experiences from Round 1 made by School 1. So, after the first meeting with the partner from Karlstad University, another meeting was held with the teachers and the societal partner (Alma Löv).

The FIND OUT part of SSIBL included five lessons with some basics, what is DNA, what is a gene and what is meant by GMO. This was followed by a whole day at Alma Löv for the students and the teachers. During this day they worked with GMO using art-based inquiry methodology. This iwas followed by a full day at the school when the students created art-objects related to GMO with some of the objects portraying positive aspects while others presenting more critical outcomes. The concept of working with GMO using art-based inquiry as a strategy is explained more in depth in a research publication by Raaijmakers and colleagues (2021)*. Finally, the ACT part of SSIBL was organised as lessons where the students had debates about the good and bad about GMO. An exhibition was made in the school with the art-works created by the students to share the students' perspectives on GMO with other students and teachers at the school.

During the meeting in Prague in November 2023 the teachers from both of the secondary schools participated and together they made plans of working with a new SSIBL theme, maybe even in collaboration with partners from another country. During one of the activities in Prague the four teachers from Sweden together made a conceptual map with ideas of how to work with a theme about tax on sugar since this was something they thought would engage their students and that could be included as part of the curriculum. However, returning to Sweden an email was sent from the teachers at School 2 that they would not be able to work with the COSMOS project during the spring 2024. The reason for this being that spring time is the time of the school year with many national tests and holidays. Therefore, no further work was made with School 2. Table 6.2 presents an overview of the SSIBL-CoP implementation with the GMO theme worked on in School 2.

** Harald Raaijmakers, H., Mc Ewen, B., Walan, S., & Christenson, N. (2021) Developing museum-school partnerships: art-based exploration of science issues in a third space, International Journal of Science Education, 43:17, 2746-2768, DOI: 10.1080/09500693.2021.1986646*

Table 6.2 An overview of the SSIBL-CoP implementation in School 2 (new) in Sweden.

SSIBL dimension	Description	Duration Total: 10 hours
ASK	Are GMO something good or bad?	Introduction lesson with students 40 minutes.
FIND OUT	• Basics about DNA and genes. • Examples of GMO – discussions • Tour to Alma Löv museum working with art-based inquiry and art related to GMO. Both discussions about already existing art at the museum and art-work creation activity together in small groups. • Art work creations at school related to GMO	Three lessons of 40 minutes. One lesson of 40 minutes. Whole day (6 hours). Whole day (6 hours).
ACT	Final discussions in class with arguments pro and con GMO. Plan for exhibition at the library in the municipality to be conducted after summer holiday.	One lesson of 40 minutes.

6.2. Reflections on facilitation, support and implementation within each participating school in Sweden

Reflections on the SSIBL-CoP implementation from School 1 (continuing school)

Collaboration had previously been going on with Karlstad University and the science teachers at the school are very engaged and open to development of their teaching. They also have a strong support from the principal both in practical issues, but also in interest. The CORPOS is working and teachers often collaborate. However, at the end of this implementation round the main science teacher had private difficulties (death in family) and could not work during the last two weeks. Her presence is important, but still a colleague (the mathematics teacher) covered up and supported and took care of the last lessons and follow up with students as good as possible.

The choice of the SSIBL theme was good since it could be part of the curriculum and the lessons that were supposed to be about drugs. This time with the particular focus on snuff because of the situation at the school with many students starting to use the snuff. The choice of the theme was therefore positive because it became an “add-in”, but also because it engaged the students. The CoP included

an extra teacher, but above all the school nurse as sort of an expert in the field. However, a challenge and disappointment was that it was difficult to engage other partners. Most of the search of contact was via email and this was not a successful approach. There are no organisations in the municipality with expertise or interest in the field except for health care.

Still, the project was considered as positive, especially because of the student engagement and that they took a more active role than usually. Hence, even though the initial idea was to elaborate community collaboration, student participation was a major development that was identified. A final comment was made by the science teacher:

"This group is very hard worked and I really felt like I was throwing myself into deep water when there wasn't much steering to begin with. Those of us who were involved agreed that almost all students worked better in this way than they normally do. Of course, it requires some thought effort to achieve something else, but in this case it was worth it. I can definitely imagine us testing it in some more area. A bonus in the current class was that last academic year I had a resource in the class during the science lessons, it made things easier. The pleasure of the news can certainly contribute to the commitment, but it doesn't matter when it works. The survey part in particular was also something that created more discussion and reflection among the students than I expected. Really fun and something I think they carry with them. Both the students and I were satisfied after the work, they would like to work in a similar way again."

Reflections on the SSIBL-CoP implementation from School 2 (new school)

Collaboration with School 2 was new. A previous contact had been with the technology teacher participating in a STEM competition with students during some years. The competition taking place annually at Karlstad University. The technology teacher had reached out and asked for collaboration in projects and joined the project together with a science teacher at the school. The principal only said that it was fine to participate, but otherwise not involved in the project.

The teachers first wanted to try a pilot and follow the example made by School 1. This first SSIBL-CoP resulted in similar outcomes as for School 1. It was difficult to reach out to more partners/experts in GMO even though this was emphasised from the partner from Karlstad University also providing the teachers with contacts. It is unclear why this did not happen, but possible lack of time. Still, the outcome

was positive in terms of engaged students and the teachers did feel that they had started to develop community collaboration, which they had, with the university and Alma Löv.

As already mentioned, the teachers in this school wanted to elaborate even more on community collaboration and during the meeting in Prague they made plans for the future. However, returning to their school reality they found that it would be difficult to manage to do anything "extra" in the upcoming spring due to national tests and many holidays

6.3. Lessons learned from Round 2 implementation in Sweden

Summarising the lessons learned from the second implementation round in Sweden the following lessons were learned:

- Good choices of SSIBL theme engage students.
- Choices of SSIBL theme affects the possibility to create a CoP, not easy in small municipalities.
- Difficult to get engagement from partners out of school except for the ones involved in the COSMOS project (HEI and societal partner).
- Time of year affects engagement. Spring time is not a good time in Sweden.
- School leaders' engagement and involvement varies.
- Teachers and students are positive to the COSMOS approach, especially working with SSIBL and have some collaboration with partners out of school.
- Student participation developed with a class that was considered as "difficult", with many students with special needs. Still, the outcome was exceptional positive. Hence, teachers should not be afraid of trying new teaching strategies even with "difficult" classes. Maybe that even is a successful way to overcome the "difficulties".
- Flexibility in planning and adapting to unforeseen circumstances (like teacher absence) is vital.

Both of the participating schools did take steps to develop in Open Schooling and then are still steps to be taken to make the COSMOS approach even more of an “add-in”, being a natural part of the way teaching and learning in the schools.

7. UK Report (Partners 2 & 9/SOTON & WSC)

During Round 2, we worked with a new Secondary School to develop and implement a SSIBL-CoP implementation with one female secondary science teacher and her Year 8 class (26 students, 12-13 years old). The secondary school we worked with during Round 1, decided not to continue with Round 2, due to the lead teacher's workload, and ability to commit time to the project. In the following sections the process of the implementation in this secondary school and reflections are presented.

7.1. SSIBL-CoP Implementations in a secondary school (new) in the UK

The collaboration with the new secondary school was initiated during the University of Southampton's Science & Engineering Day in March 2023, where the teacher was taking part showcasing the work she was doing at her school in collaboration with other University researchers. In June 2023, the HEI partners attended a recruitment meeting with Science and Geography teachers, to share the aims and scope of the COSMOS project and explore a potential collaboration. The meeting was also attended by the school's Headteacher, who asked questions and was involved in the decision-making process for recruitment. As a result of this meeting and follow up discussions, it was agreed with the school that only one science teacher would participate. This initiated the formation of our CORPOS team, consisting of two HEI partners and the science teacher, who collaborated closely over the 2023-24 school year. We arranged two TPD workshops following the COSMOS TPD handbook provided by WP5.

The first workshop focused on community learning and science education and was followed by the focus group discussion on school openness dimensions. The second workshop focused on SSIBL and led into the initial co-designed unit outline for our chosen SSI. We communicated weekly by emails and text and attended after-school meetings to develop our CoP, and co-plan our lessons. We created a shared Google Drive where all the co-designed resources for the SSIBL-CoP implementation were stored and shared.

The CoP was established in close collaboration with the science teacher. First, we agreed on the SSI to be investigated; whereas during recruitment meetings (March 2023) we discussed the possibility to focus on climate change, which would allow cross-departmental collaboration between Science and Geography, eventually the issue of vaping was chosen by the teacher, with the school leadership's encouragement and support. Vaping was an issue on the news at the time due to media reports on its environmental impact as well as health implications on young people and adults. Vaping was also a localised SSI, as the school was at the time (June 2023) installing new toilet cubicles to discourage students from gathering in the restrooms to vape. Many vapes were confiscated by the school at the time as students would bring them into school and vape against school rules. The CORPOS team identified the key issues surrounding vaping (health, legislation, environment, social media influences) through controversy mapping (Figure 2) and put together a unit outline that would address these issues.

The CoP was initiated by identifying various stakeholders from the CORPOS team's networks that would be interested in support our SSIBL-CoP implementation. The science teacher took a lead in contacting such stakeholders and introducing the project aims and objectives, and arranging joint meetings with stakeholders and CORPOS to discuss the issue in order to gain more in-depth knowledge and consider how to transform that into a lesson for students as part of the SSIBL sequence. Some of the potential stakeholders involved were able to provide information on the phone but did not wish to continue collaboration as a CoP member. For instance, the teacher talked with local police officers, dentists, and local shop owners that sold vapes, all of whom offered useful information but were not further involved. Three CoP members attended or delivered part of our SSIBL-CoP implementations in school with students, either through online A&Q (Question and Answer) sessions, or talking to students about specific topics (e.g. addiction, process of stopping smoking and the role of vaping in this). One CoP member took part in person in a lesson about the chemical composition of vapes confiscated by the school. This meant that students met a range of scientists and experts on the topic and interacted with them as part of the SSIBL-CoP implementation, which was a strength of the approach taken. The CORPOS team engaged more extensively with the two Biochemical specialists that supported the analysis of the vape contents, in order to explain and simplify complex scientific data into a form appropriate for Year 8 students and to support the planning and co-design of resources for the lesson.

Figure 2 shows a controversy map that was created by the CORPOS team during the project. Table 7.1 presents an overview of the SSIBL-CoP implementation in the UK.

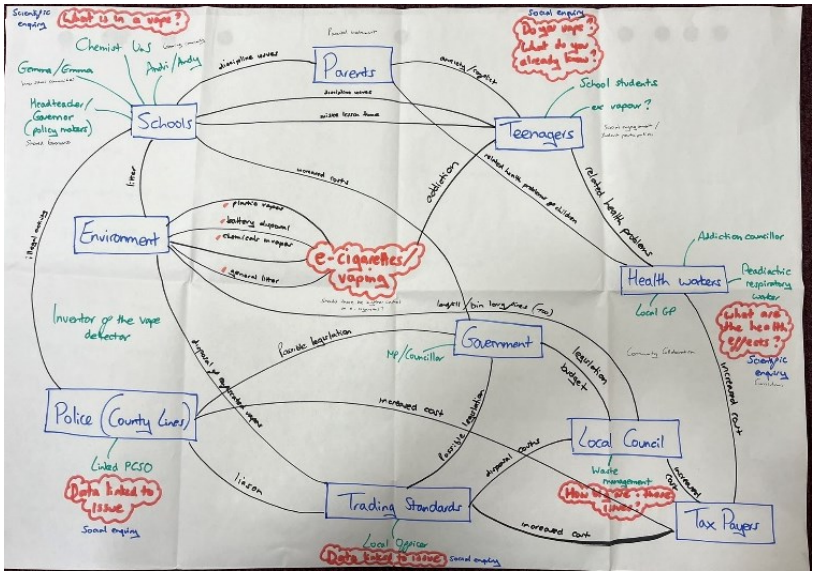

Figure 2. Controversy map of vaping conducted by CORPOS team.

Table 7.1 Overview of SSIBL – CoP implementation in a secondary school (new) in the UK.

SSIBL dimension	Description including CoP role/participation	Duration
ASK	**Is vaping an issue in our Hounsdown community? What should we do about vaping at Hounsdown?** Lesson 1: the teacher introduced the issue showing a YouTube video were a talent show contestant was using vapor from vapes to create shapes; she asked students to make the controversy and list questions they have about it.	3 hours.
FIND OUT	**Social inquiry** lessons: Lesson 2: students created a survey to investigate the key question in their school context; paper copies of the survey were given out to all students (699 were collected) Lesson 3: students review work so far and asked to consider individually the key question (personal inquiry); students analysed the data with support from CORPOS and identified key issues)	11 hours.

	Science inquiry lessons: Lesson 4: smoking cessation nurse (CoP member) attending online discussing the use of vapes as a tool for quitting smoking and explaining the process to students Lesson 5: History of smoking; modelling data on vaping and discussing potential implications (CoP member/medical doctor and Lifelab member supported in the design of the materials) Lesson 6: Learning about the environmental impact of vaping (CoP member supported with information about lithium batteries; stakeholder from waste management company supported with information about vaping recycling process) Lesson 7: Learning about addiction and the science behind it Lesson 8: students investigated vaping legislation in different countries and compared it to the UK legislation (CoP member/Trading Standards Agency supported with the design of the lesson) Lesson 9: Respiration/Asthma specialist nurse (CoP member) discussed the impact of vaping on respiration with students Lesson 10: Review of addiction key facts and Q&A online with Psychologist researcher (CoP member) specialising in addiction Lesson 11: Learning about the chemical composition of vaping contents and their impact on health, with support in the design from Biochemical lab technician, and in the teaching by another Biomedical researcher (CoP members)	
ACT	Lesson 12 (empowerment lesson): teacher presented four different case studies of young people that took action and made a different to their local context (e.g., Greta Thunberg); students are asked to research one of the four case studies and make a poster presenting their findings; students encouraged to consider actions they can take. Lesson 13: university visit focusing on actions (remapping controversy, discussing possible solutions, starting work on actions such as videos, posters, emails and letters to influencers); CoP member/researcher on lithium batteries visited to show students lithium batteries and talk about the risks of using them in disposable vapes Lessons 14-17: students continue working on actions; writing and sending letters to social media influencers, the Headteacher, creating infographics and presentations to share	9 hours.

	with their school community; individual positioning on the issue (social inquiry)	

7.2. Reflections on facilitation, support and implementation within the participating secondary school in UK

This section includes our reflections on the ways we have facilitated, supported and worked together with other CoP members to implement the SSIBL-CoP activities in our participating secondary school.

Reflections on CORPOS work

The science teacher we have collaborated with as part of the CORPOS we established at this secondary school has more than 25 years of teaching experience, and extensive networking and collaboration skills; at the start of the school year she took on the role of University-School liaison as she had extensive links with the University of Southampton and was keen to innovate in her teaching by bring into her class researchers and new scientific developments. This openness attribute of the lead teacher facilitated the development of a close working relationship between the CORPOS members and created a *productive and equal* relationship between HEI partner members and the teacher; the two HEI observed all lessons, and in some cases were involved in co-teaching the lessons taught as part of the SSIBL-CoP implementation. We collaborated in co-designing all resources needed, and the use of an online sharing platform and weekly check-ins by emailing and text, facilitated further this process. Overall, all stages of the CORPOS development processes as outlined in Section 1 of the COSMOS framework (WP2) were followed.

A key challenge in our CORPOS work we encountered early on was the request by school leadership that only one teacher could be involved in COSMOS, which limited opportunities for extending CORPOS to include other science teachers. Despite this challenge, a key success, facilitated by the collaborative relationship developed with the science teacher, was the expansion of our COSMOS approach into the Geography department. Towards the end of the school year, the science teacher initiated a collaboration with the Geography department in order to adopt the COSMOS approach and the SSIBL framework for teaching about climate change through the Year 9 Geography curriculum. This

showcases the positive impact of COSMOS at the teacher level, and the fact that the work done through CORPOS has sustainable outcomes. A planning meeting between the CORPOS team and the geography teacher has already taken place in June 2024, and the SSIBL-CoP implementation is due in October 2024 (beyond the project's timeline).

Reflections on SSIBL-CoP implementation work

We succeeded in creating a CoP that was interested, invested and willing to support the SSIBL-CoP implementation on vaping. The CoP created consisted of a range of medical professionals, and researchers that covered the key controversial areas of vaping (health implications for adults and teenagers, environmental impact of disposable vapes, lack/clarity of legislation in the UK context). A key success factor that facilitated the successful creation of a CoP was the teacher's leadership and established experience of working with University researchers and existing networks, which allowed for a wider range of stakeholders to be approached by the teacher herself rather that requiring the HEI partners to instigate those connections. This allowed the HEI partners to focus on the co-design and support with SSIBL stages, and also to draw on our own existing networks rather than attempting to create a completely new network. This also leveraged issues of time constrains and busy workloads as the HEI CORPOS members were able to use their time resources in supporting the co-design process with a more focused approach on how to incorporate community engagement and involve stakeholders in each of the SSIBL stages.

Another key success was the direct involvement of CoP in the teaching of lessons on vaping making them *active participants* in the SSIBL-CoP implementation. This was done either in person (e.g. lesson on chemical composition was co-designed and delivered by the biochemical researchers, the teacher and HEI partners) or online (e.g. the smoking cessation nurse did a presentation on Teams for students, who then had the chance to ask questions). Involving CoP in the teaching of vaping-related lessons created the conditions of a joint enterprise strengthening the CoP formed. A key concern expressed by some of the CoP members was their ability and skills in interacting with young people; the CORPOS supported by providing advice about how to do so, by being present in the classroom with CoP members to support in person and by having meetings to co-design the lessons rather than involving them in the delivery of the lessons. Some of the CoP members were more peripheral participants, such as the member from the university's Lifelab project, and the Trading Standards Agency officer; these

members met with the CORPOS to share advice, experience and their expert knowledge with the CORPOS and this information helped shape the lessons co-designed and taught in this SSIBL-CoP implementation.

All three stages of the SSIBL framework were successfully co-designed and implemented with CoP members, and it was a success to have a class of students engaging consistently in this SSIBL-CoP implementation across two semesters. The strongest participation of CoP members was in the FIND OUT stage, but CoP was also involved in the other two stages. The SSI was identified by the teacher in consultation with the Headteacher and school leadership, but opportunities for students and other CoP members to take part in ASK were also provided (e.g. students designed a survey and then analysed data collected on the issue within their school community). During the ACT stage, students were encouraged to use the information learned with the support of CoP members, in order to take action; they created posters, infographics and videos to share their findings and conclusions on the key question, and they wrote letters to people of influence asking them to support them in spreading the message about the issues surrounding vaping and the impact it can have on the environment and health.

The leadership's role to the facilitation and support of SSIBL-CoP formation and implementation was more peripheral, but positive, in that they offered support for the COSMOS project taking place at their school, and they participated in the SSIBL-CoP implementations as part of ACT (e.g., the students wrote to the Headteacher explaining what they had learned and what they thought the school should do to address the issue of vaping within their school community) but they were not active participants in the implementation process as CoP members. The school was going through an external quality assurance and evaluation process at the time, that possibly did not allow school leadership to be more involved as their priority was to focus on this quality assurance process.

7.3. Lessons learned from Round 2 implementation in the UK

Our SSIBL-CoP implementation during Round 2 with this new secondary school indicates the strong interplay between two factors that were critical in the success of our SSIBL-CoP implementation: (a)

the key role that the teacher's interest and motivation plays in the successful development of CORPOS and CoP and (b) the need for sustained engagement and integration of SSIBL-CoP into the curriculum. As discussed above, the teacher was intrinsically motivated to participate in COSMOS and this we found, also supported the integration of key curriculum concepts with the SSIBL-CoP implementation lessons. The teacher's confidence and skills in networking, which facilitated CoP development, allowed more time for the HEI partners to support further how to embed SSIBL-CoP into the curriculum. The need for the integration and embedding of SSIBL-CoP into the curriculum was a lesson learned from Round 1, which we worked on in Round 2, showing how this can be achieved in the UK school context.

The key role identified in Round 1 of school leadership is again present in Round 2; we engaged with the school leadership early on in Round 2, and send some update emails to them informing them about the progress of the project. We also shared the outcomes of the study survey on vaping within the school community with school leadership including them informed of developments. As with Round 1, an implication for the Open School approach of COSMOS in our national context is that the school leadership's support is needed but their active involvement is not a requirement for successful SSBIL-CoP development and implementations.

8. Summary of the lessons learned from round 2 of implementation in secondary schools participating in the COSMOS project

Summarising the lessons learned from each of the participating countries in the second round of implementation of the COSMOS project, there are some common themes.

First of all, teachers and students have appreciated participating, and their motivation and engagement have led to positive experiences. Student participation, being more involved in decisions during lessons and activities, has been emphasised by all participating countries as a factor of success.

Second, when school leaders have been involved, this has also been considered a strength, supporting the teachers in working in an Open Schooling approach as described in the COSMOS project. Thus, in most cases, engaged school leaders are important for developing Open Schooling. There were also some examples where teachers did not want their principal to be involved, though the reasons were unclear.

Third, when schools have integrated the SSIBL-CoP approach into the curriculum, making it an "add-in" instead of an "add-on", it becomes more sustainable and motivating for both teachers and students. However, in some countries it has been evident that exams remain the primary focus, and many teachers still seem to believe that the best way to work is as usual to ensure students perform well in exams. This is despite the many positive effects of participating in the project and working with SSIBL-CoP implementations.

A fourth perspective is that community collaboration has been a focus in all participating countries, and this has been appreciated by the schools. However, there are also challenges that need to be considered regarding community collaboration. A mutual interest in this collaboration was emphasised as important for successful outcomes. In addition, in Israel it was found that it is important for collaborating organisations to have educational experience working with students. In Sweden it was difficult to create CoPs due to lack of interest from organisations or lack of expertise within the chosen SSIBL theme in the local community. However, with one unique exception when a company reached

out and wanted to collaborate based on their own initiative. In total, local connections has been mentioned as an important factor for success in terms of positive outcomes and sustainability.

Fifth, it has been concluded that in some countries that it is important to have flexibility and adaption in planning and implementation since many unexpected events may occur, such as teachers' illness, strikes, or, as in the case of Israel, war. Nevertheless, achievements were made in all schools in some ways to develop the process of an Open Schooling approach.

Finally, working in new ways and make changes takes time. More collaboration with partners takes time, especially at the beginning when something new is to be implemented. Teachers have busy schedules, and it is hard for them to find extra time for development, such as community collaborations. Still, steps have been taken in all countries and all participating schools.