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EMPOWERING SCHOOLS AS ENERGY EMBASSIES IN THEIR NEIGHBORHOOD

BY JULIE VAN GELDER

Empowering schools as energy
embassies in their neighborhood

**An evaluative study of the effects and
factors of influence of the Action
Research Program 'Schools as Energy
Embassies in their Neighborhood'**

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Executive Summary

Societal context: Education and Social Innovation

A recent report on the future of education by the OECD (2018), noted that it is through education that we can prepare children to become active, responsible and engaged citizens that can make a contribution to a sustainable future. A new study performed by I&O Research (2018) found that two-third of citizens in the Netherlands thinks that the government should ensure sustainability to be more emphasized in education. But even though there is much speculation about the role that schools can or should play, only 4% of the primary schools in the Netherlands payed attention to sustainability in 2015 (Het Groene Brein, 2015). Also, not much systematic and empirical research has been performed in the Netherlands on what role schools can play in social innovation for more sustainable neighborhoods -that is to say, what contribution schools can make to a more sustainable neighborhood in interaction with the community.

Description of the SEE Program

This has been the starting point for an action research program, 'Schools as Energy Embassies in their neighborhoods', the SEE Program in short. This program explores what role schools can play in the local energy transition by means of the implementation and assessment of an intervention. This intervention aims to empower schools as energy embassies in their neighborhood that accelerate the local energy transition. Between 2017 and 2019, at seven primary schools and one high school, living labs were set up that consisted of one school and a network of stakeholder from the neighborhood that were identified based on their connection to the school or neighborhood. In these living labs, interventions in the form of various activities, that can be roughly divided into activities with pupils and stakeholders, were implemented.

The activities were aimed at three objectives: 1) to facilitate the process of co-creation of sustainable local initiatives with stakeholders, pupils and schools, 2) to strengthen the school's sustainability and science education and 3) to improve the environmental literacy and action competence of pupils

Research definition

As part of this overarching action research program, for this thesis I performed empirical research on the effects and working mechanisms of the SEE Program. It was decided to focus on the evaluation of the four primary schools that participated in 2019 (i.e. the second cycle of the program). An important aspect of the evaluation was not to focus only on program outcomes, but also on the factors that have influenced it. Based on this evaluation effort, 'Lessons learned' could be identified which can be used to improve the intervention for future application. The research question for this thesis was formulated as follows:

"What are the effects of the action research program 'Schools as Energy Embassies' on the school, its pupils and the surrounding ecosystem, and what factors influence the program outcomes?"

Methodology

To answer the research question, a case study analysis was performed for each of the four schools. They were first assessed individually, and in comparison to each other afterwards. In each of the cases, the program was evaluated on its implementation, outcomes, and context. The main sources of information were: 1) observation of pupils in the workshops, 2) observation of stakeholders in co-creation sessions, 3) Semi-structured interviews with school staff and 4) a survey among pupils of the participating schools. The analysis and discussion of results was structured around the three objectives as mentioned above.

Results

Co-creation of initiatives With respect to the co-creation of initiatives we found that in a short period of time (approximately four months), many new connections between the school and stakeholders had formed. Many new ideas for a more sustainable neighborhood were being created in the course of the SEE Program. At the moment of evaluation (end of the second program cycle, July 2019), no initiatives were realized yet, but around eight initiatives were still under development. We found that an important condition for successful co-creation is the level of engagement of stakeholders which is influenced by the following factors:

- The value the program can create for stakeholders and the school;
- Mutual expectations between stakeholders and members of the SEE Program team on time investment and role of participants;
- Professional background of stakeholders (stakeholders with a professional interest in the program are a stimulating factor).

With respect to the role of schools and pupils in these processes of co-creation it was observed that it can be challenging to let pupils make a real contribution to the co-creation of initiatives. The results highlight that the following factors are important:

- Many pupils find it difficult to come up with creative ideas that the stakeholders can use as input in the focus groups;
- The time schedule of the SEE Program does not allow the pupils to make a contribution to the realization of initiatives;
- Involvement of a member of the schools management staff is prerequisite for the co-creation of initiatives in which the school and pupils play a role.

Support schools with Sustainability and Science Education The interviews with school staff were the primary source of information used to gain insight in what ways the SEE Program supports schools with Sustainability Education, Science and Technology Education and the pedagogy of Inquiry and design based learning that is often used in this context. We found that by bringing knowledge and expertise to the school about these topics, the program was experienced to be of immediate value. On the other hand, the results of the research demonstrated that (elements) of the program were not integrated in the school's curriculum, and that not many teachers were involved in the program.

Improve pupils' environmental literacy and action competence To gain insight in the learning outcomes of the workshops, a survey was administered to pupils of the participating schools. The responses of pupils that did participate in the program were compared to pupils that did not participate. The survey measured the knowledge, attitude and behavior of pupils related to sustainability in their neighborhood. We showed that workshops had improved the knowledge of pupils on sustainability. Overall, the pupils showed a positive to very positive attitude towards sustainability but no significant difference were found between test and control group. With respect to behavior, some contradictory results were obtained which can be partly attributed to limitations of the questionnaire design. Therefore, it remains unclear whether the program affects sustainable behavior of pupils.

Conclusion

The main conclusions that can be drawn from this research is that in its implementation, the focal point of the program was the facilitation of processes of co-creation with schools, the pupils, and 'relevant stakeholders'. In this light, the evaluation might have come too early: the co-created initiatives did not reach maturity yet and were still under development at the moment of evaluation.

An important finding is that though the initial focus of the program was on the energy transition specifically, in practice, the program had a broader focus than energy. Both in the activities with pupils and stakeholders, there was not converged to ideas and initiatives that related to the energy transition specifically.

The evaluation demonstrated that participation in the SEE Program does indeed strengthen the eco-system of schools with people that have a shared interest in education and sustainability. To ensure realization of the initiatives though, it is important to involve the right stakeholder, manage both time and expectations properly, and motivate stakeholders to take ownership over initiatives. Also, to improve the contribution of pupils in the co-creation process, it will be important to think about how co-creation with children for local sustainable initiatives can be facilitated effectively.

Pupils indicated that they are very interested to learn about sustainability at school, and from the results it can be concluded that in terms of knowledge about sustainability, the program can satisfy their request. It can be expected that pupils have also improved skills related to inquiry and design based learning. However, an assessment of competencies was not part of this evaluation.

From this evaluation it is clear that the program has made a positive impact in many different ways already. But there is room for improvement too. With the SEE Program coming to an end, now is the time to reflect on what can be learned from previous experiences so that in a next phase, the impact of the program can be further increased.

keywords social innovation, co-creation, sustainability education, environmental literacy, action competence, primary schools, participatory action research

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Introduction

“Education is the point at which we decide whether we love the world enough to assume responsibility for it, and by the same token save it from that ruin which except for renewal, except the coming of the new and the young, would be inevitable. And education, too, is whether we love our children enough not to expel them from our world and leave them to their own devices, nor to strike from their hands their chance of undertaking something new, something unforeseen by us, but to prepare them in advance for the task of renewing a common world.”

– Hannah Arendt, *Between Past and Future*, 1961

1.1. Problem Definition

This perspective on education which Hannah Arendt wrote down more than half a century ago, shows to be timelier than ever. Already, we are experiencing the consequences of climate change. But what unprecedented environmental and ecological challenges the generations to come are going to be faced we don't know. We are struggling to answer questions on how we, as individuals and as society, must act in the face of climate change, what we can do about the depletion of natural resources for which we are responsible, and how we can make a transition towards a renewable energy system. Now and in the future.

Importance of Education Hannah Arendt suggested that it is education that can and should prepare the young for taking action, for a life of engagement and responsibility for renewing the world and for a life of transformation (Arendt and Kohn, 2006). A similar perspective on education is currently much heard. A recent report on the future of education by the OECD (2018), noted that it is through education that knowledge, attitudes, and competencies can be developed that will enable people to explore untapped opportunities and contribute to a sustainable future. Education, the report [p.4] argues, needs to prepare children to become “active, responsible and engaged citizens”.

Building Blocks for a more sustainable society New research that takes a more holistic approach to the creation of sustainable societies, is currently exploring how students, schools, and communities can become the building blocks for a sustainable society (Cook, 2019). Though education plays a central role in this research, the argument is made that to build a sustainable society together, the engagement of communities is also crucial. This research identified the empowerment of individuals and communities as one of the key principles for use as building blocks for sustainable societies. New approaches to social innovation and the prioritization of community-based solution are needed as people should have voice in the issues that affect them.

This ‘building block’ metaphor was also used by the C40 group (C40 Cities, 2017). They called sustainable neighborhoods the building blocks of sustainable cities. Not only in a physical sense, relating to the built environment, but also from the perspective of social

innovation, as they believe that it is through connection and empowerment of citizens that creativity and innovation will be able to flourish. From a governance perspective also, the level of policy-making and decision making closest to citizens is crucial (Hoppe et al., 2016). When looking at the energy transition for example, it has become clear that we can't be relying on technological innovation alone as many social and behavioral barriers need to be overcome also (Hoppe, 2018)

Problem statement It is on this intersection of education and citizen engagement that schools are increasingly started to be called upon. Wals (2007) argues that a prerequisite for pro-environmental outcomes is the embeddedness of schools in their communities, and a perspective on the role and sphere of influence of schools that includes not only its pupils but the community, policymakers and governments as well. Also, sustainability education has become an item on the agenda of the Dutch Government the past decade. A new study performed by I&O Research (2018) found that two-third of Dutch citizens thinks that the government should ensure sustainability to be more emphasized in education. One of the results of this increased attention is a comprehensive report on the current state of affairs regarding sustainability education in the Netherlands, commissioned by the Dutch ministry of Education. According to this report, in 2015 only 4% of the primary schools in the Netherlands payed attention to sustainability (Het Groene Brein, 2015, p.4). A consequence is that even though there is much speculation about the role that schools can or should play, it is not clear what schools can do to realize this. Not much systematic and empirical research has been conducted in the Netherlands on what the role of schools can be in making neighborhoods more sustainable in interaction with their neighborhood.

The SEE Program This has been the starting point for an action research program funded by de Rijksdienst voor Onderneming Nederland (RVO). The project is named 'Scholen als Energyambassade in de wijk: Actieonderzoek naar de rol van scholen in de energietransitie' (Topsector Energie, 2018). In English this translates to 'Schools as Energy Embassies in their neighborhoods', an action research program on the role of schools in the energy transition, the SEE Program in short. This thesis research is part of this two year action research program. On the one hand, the SEE Program aimed to explore what role schools can play in the local energy transition. On the other hand, the program aimed to empower schools as energy embassies that accelerate the energy transition in the school's neighborhood.

To that end, eight living labs were set up between 2017 and 2019. Each of these living labs consisted of one school and a network of stakeholder from the neighborhood that were identified based on their connection to the school or neighborhood. In these living labs, interventions in the form of various activities that can be roughly divided in activities with pupils and stakeholders, were implemented.

In broad terms, the program aimed to stimulate the co-creation of initiatives between stakeholders and the schools. As part of this process, the activities aimed to strengthen the schools ecosystem, support the school in science and sustainability education, and develop knowledge, attitude, skills and behavior of pupils with respect to sustainability related topics. As such, the program aimed to empower schools as 'energy embassies in their neighborhood' to accelerate the energy transition.

1.2. Research objectives and research questions

As part of this overarching action research program, for this thesis I performed empirical research on the effects and working mechanisms of the SEE Program. It was decided to focus on the evaluation of the four primary schools that participated in 2019 (i.e. the second cycle of the program). An important part of this evaluation is to take into account the wider context in which the program is set. This means that I will not only look at the program outcomes on the school and pupils, but also on the school's ecosystem and on the co-creation of sustainable initiatives. As can be noted, another important aspect of the evaluation is not to focus only on program outcomes, but also on the factors that have influenced it. By doing so, also the working mechanism of the different components of the interventions can

be evaluated. Based on these research objectives, the research question for this thesis was formulated as follows:

"What are the effects of the action research program 'Schools as Energy Embassies' on the school, its pupils and the surrounding ecosystem, and what factors influence the program outcomes?"

In the first place, the evaluation gives insight in the effects of the SEE Program, and makes explicit the causal linkages between program activities (i.e. the program intervention) and effects (program outcomes). It assesses what contextual factors influence program outcomes and as well as experience and valuation of the program by different participant groups. Based on these evaluation efforts, strengths and weaknesses of the SEE Program can be identified and 'Lessons learned' can be identified to improve the intervention.

Research questions

To answer the research question, a case study analysis was performed for each of the four schools. They were first assessed individually, and in comparison, to each other afterwards. In each of the cases, the program was evaluated on its implementation (sub-question 1), outcomes (sub-question 2), and context (sub-question 3 and 4). The fifth sub-question corresponds to the cross-analysis. The sub-questions are as follows:

1. How is the SEE Program implemented?
 - (a) How is the program implemented at the schools?
 - (b) How is the program implemented in the neighborhood?
2. What are the effects of the SEE Program with respect to:
 - (a) facilitating the co-creation of sustainable initiatives in the school's neighborhood?
 - (b) Supporting the school in Sustainability Education and Science Education?
 - (c) developing the environmental literacy of pupils?
3. How do different participant groups experience and value the program?
4. What factors influence the program outcomes?
5. How do the cases compare to each other in terms of implementation, outcomes and context?
6. What are the most important effects of the SEE Program and what factors determine these outcomes?
7. What lessons can be learned regarding program design and implementation?

Purpose of the evaluation

As can be noticed, this evaluation has both a scientific a practical purpose. In accordance with these difference purposes it follows that there are different audiences for the results of the evolution. The knowledge component of the evaluation aims to inform society as a whole about the role that schools can play in the energy transition. More specifically, it can serve as advice to local and national governments on how they can advance sustainability on a local level through schools, and on how they can support schools in this process. Also, the insights gained in processes of co-creation in the context of energy and sustainability, can guide policy-makers in their efforts to stimulate social innovation in the energy transition.

For the initiators of the SEE Program (Stichting Technotrend, TU Delft, Energie-U), the result of this evolution is important because it provides evidence-based insights on how the local energy transition can be supported through education. The results are of practical value, as these lessons learned on implementation, outcomes and factors of influence, can be used to further improve the program for future application.

1.3. Research structure and reading guide

Figure 1.1 shows the reading guide for this thesis. This reading guide also gives an overview of the research structure.

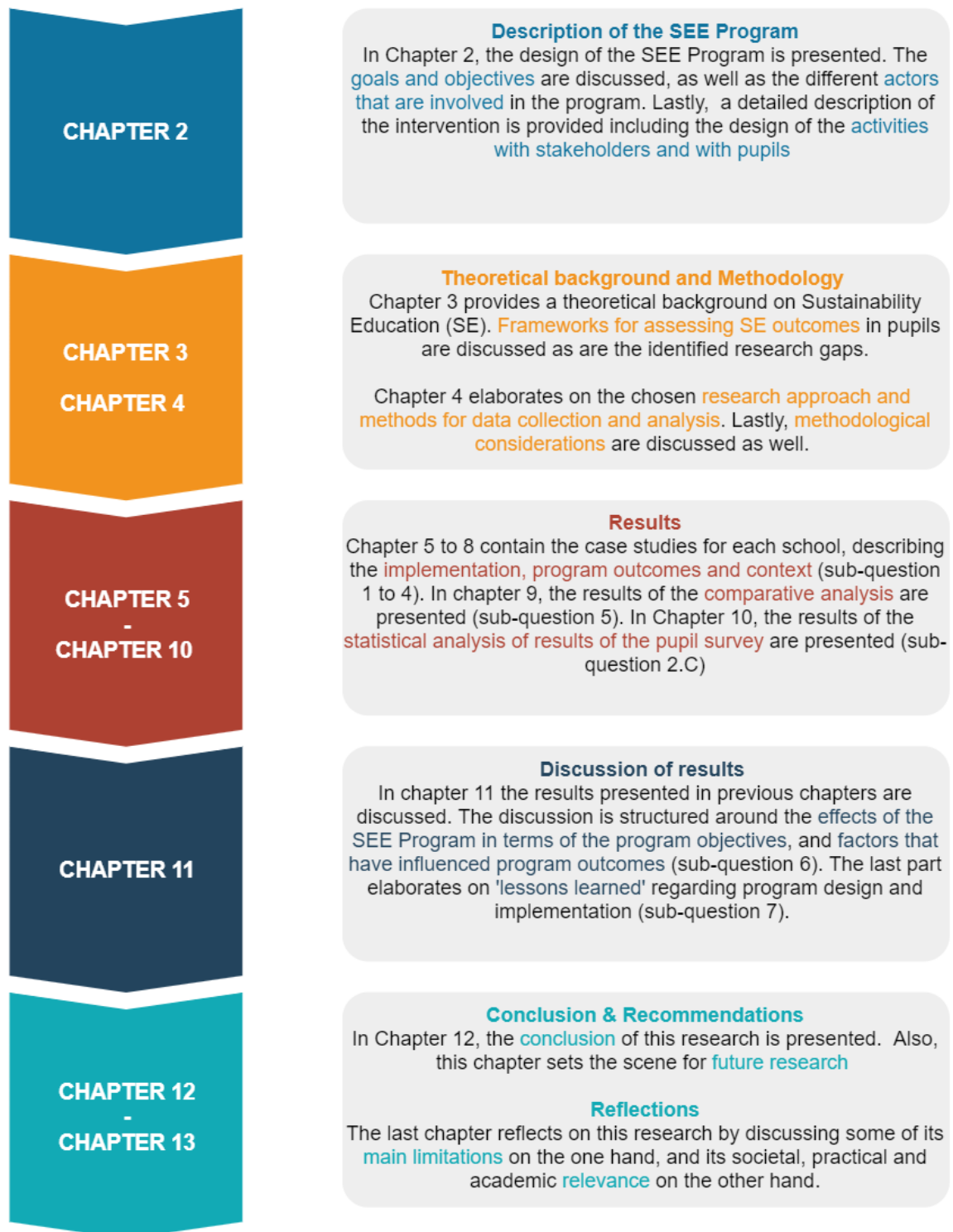


Figure 1.1: Research structure and reading guide

Program Description

This thesis is part of a participatory action research program on the role of schools in accelerating the energy transition in the school's neighborhood (i.e. a local energy transition). The program is called the 'Schools as Energy Embassies Program', the SEE Program in short. In this chapter, the SEE Program is explained in detail. The information presented in this chapter was based on the initial project plan (Stichting Technotrend, 2017) and the revised project plan (Stichting Technotrend, 2019) that was drafted for the second cycle of the program. In section 2.1, a short introduction to the program is given, followed by a discussion of the goals and objectives of the program. Section 2.2 provides insight in the different actors and participants involved in the program. The last section, section 2.3 elaborates on the program activities for different participant groups.

2.1. Program Definition

The design of the SEE Program has been built around the participatory action research (PAR) methodology. This methodology was chosen for its ability to unite research and action related objectives. Consequently, the goals of the SEE Program can be roughly divided into a 'knowledge' and 'action' component. What this means is that on the one hand, the SEE Program aims to explore what role schools can play in the local energy transition. On the other hand, the program aims to empower schools as energy embassies that accelerate the energy transition in the school's neighborhood.

2.1.1. Brief description of the intervention

In a two-year period (2017-2019), eight living labs were set up by the SEE Project. Each of these living labs consisted of one school and a network of stakeholders that were identified based on their connection to the school or neighborhood. In these living labs, interventions -in the form of various activities- were implemented. Ultimately, these interventions would have to lead to the co-creation of new initiatives that would accelerate the local energy transition. The interventions, or program activities can be split in two groups, based on their target population. There were program activities for pupils and program activities for stakeholders.

Program activities with pupils

The intervention at schools consisted of series of workshops that aimed to involve pupils as researchers and designers in the SEE Program. By challenging them to come up with their own ideas for a sustainable energy transition, they would be able to make a contribution to the co-creation of sustainable initiatives together with stakeholders, while at the same time learning about sustainability. These interventions also aimed to satisfy a third program objective: supporting schools in providing education in three interrelated areas, 1) Science and Technology education, 2) Inquiry- and design-based learning, and 3) Education for Sustainability.

Program activities with stakeholders

The interventions in the neighborhood consisted of a series of activities with a group of stakeholders connected to the school or neighborhood. The activities with stakeholders aimed to stimulate the process of co-creation of local sustainable initiatives. Throughout this process, emphasis was put on the (potential) role of schools and pupils in such initiatives. Also, people closely connected to the school (such as members of the management team, teachers and parents) were involved as stakeholders. In this way, the interventions also stimulated new collaborations between the schools and other stakeholders.

2.1.2. Program Goals and Objectives

Based on the program description and intervention, four distinct program objectives were identified that are shown in Figure 2.1. It can be noted that even though these goals and objectives are visualized as being distinct from each other, they are in fact closely related. The reason for this is that most interventions serve the realization of more than one program objective. This is explained in more detail in section 2.3. First, there is elaborated on the different actors involved in the program in the next section.

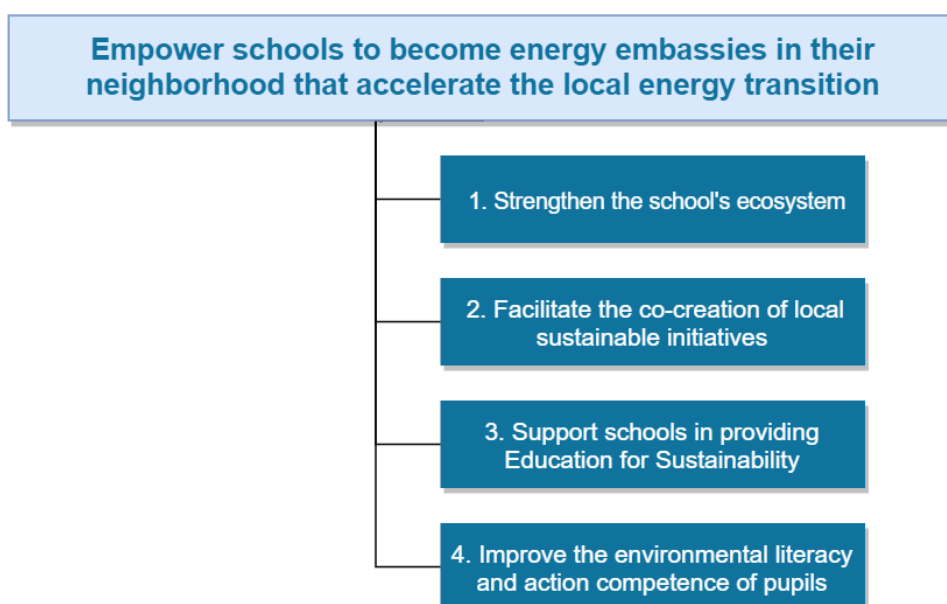


Figure 2.1: Program Objectives of the SEE Program

2.2. Actors involved in the program

As becomes clear, the program activities are not only aimed at schools -and a focus on education- but also at the involvement of 'stakeholders' in the schools' neighborhoods.

The actors that participate in the SEE Program can be divided in three groups: 1) the schools, 2) the stakeholders from the neighborhood, and 3) the members of the SEE action research team. Each of these actors can be identified as composed actors, which means that they are composed of different smaller units. The following section describes the different units of which the composed actors consist.

The School

The school is a composed actor for which the pupils, the school's management team and the teachers are its three distinct units. Each of these units is an individual participant group that was involved in the program in a different way.

Pupils The majority of pupils that participated in the program are 3th to 5th grade primary school pupils. They participated in a series of workshops on sustainability in the school's neighborhood (design of the SEE Workshop is described in the subsequent section). The workshops aimed to educate pupils about sustainability on the one hand, and challenged them to come up with ideas for a more sustainable neighborhood on the other.

The school's management team This unit was often represented by one member of the management team who played a double role in the SEE Program. They were the ones to decide if and under what condition the school as a whole would participate in the program. Also, they participated in the program as stakeholders, making a contribution to the co-creation of initiatives.

Teachers Involvement of teachers in the SEE Program varied per school. In some cases, a teacher participated in both the workshops and focus groups, in other cases, no teachers were involved in any of the program activities.

Stakeholders

'The stakeholders' are a diverse group of people that participated in the program either as individuals or as representatives of a company or organization. They can be people working for the municipality, people that work on local initiatives, parents of the participating schools and so on. In general, we can say that they are community members that were identified as 'relevant stakeholders' on the basis of their connection to the school or the neighborhood. An interest in sustainability related issues was regarded as a plus, but it was certainly not a strict requirement.

The SEE Project team

The SEE Project team itself consists of different units as well, though there is a fair degree of overlap between units as some members of the project team fulfill a double role. Roughly speaking, the project team can be divided in researchers from TU Delft, project employees from Stichting Technotrend, and an educational specialist who works for Stichting Technotrend as well.

TU Delft researchers From the TU Delft, two professors, Dr. T. Hoppe and Dr. G. De Vries, and one master student, the writer of this thesis research, have been actively involved in the program. The TU Delft researchers were responsible for the 'research component' of the SEE Program. This research component entailed conducting a literature review, selecting and implementing a research approach, leading the participatory action research activities and analyzing collected data.

Action research team from Stichting Technotrend The members of the Action Research Team (ART) of Stichting Technotrend fulfilled a role as action researchers and program facilitators at the same time. Their responsibilities comprised the identification of stakeholders, conducting interviews with them, engaging them in further program activities and facilitating these activities. The main goal of the ART was to facilitate the co-creation of initiatives with stakeholders to make local impact, using different participatory action research methods.

Educational Specialist Whereas the focus of the ART was on the stakeholders, the educational specialist of Stichting Technotrend has been working closely together with the (different units of the) schools. The educational specialist was responsible for the design and implementation of the workshops, and the alignment of the workshops to school specific requirements and conditions. In the workshop with pupils, she was the lead facilitator for which she was often assisted by one or two others. In most workshops she was assisted by a member of the ART who was also responsible for data collection and reporting of workshops observations. At some schools, a teacher was actively involved as workshop facilitator as well. Some of the stakeholders have also participated in workshop with pupils.

2.3. Program Activities

For each of the four program objectives as described in section 2.1, a set of sub-objectives was formulated as shown in Figure 2.2. This section expands on the design of the interventions used in this program to satisfy these objectives. As has been mentioned before, the program interventions can be roughly split up in a series of activities with pupils and activities with stakeholders.

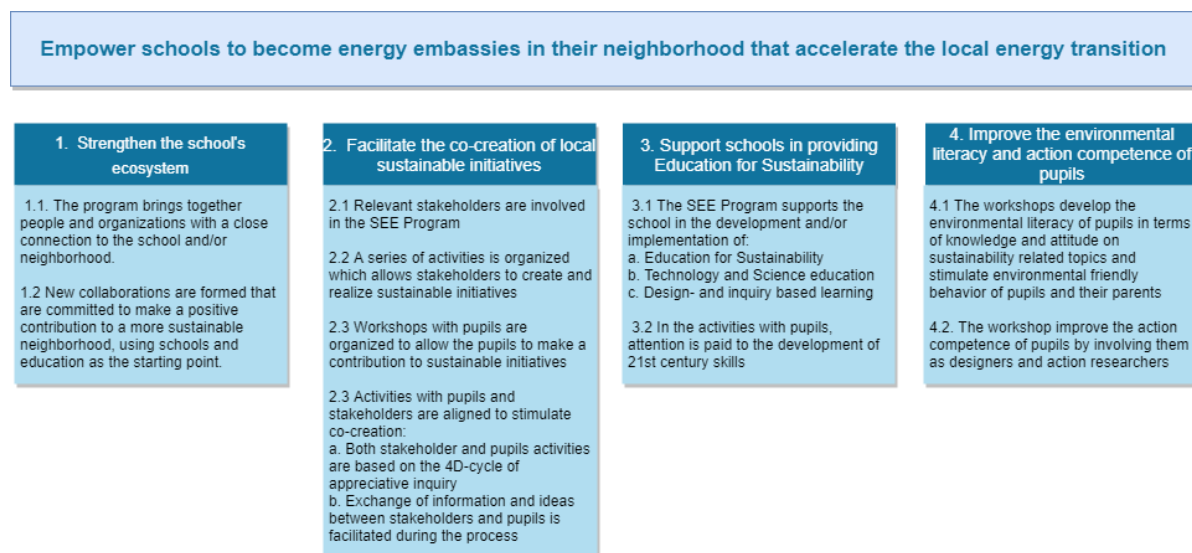


Figure 2.2: Program Objectives of the SEE Program

2.3.1. Appreciative Inquiry

The activities with stakeholders aim to satisfy objectives 1 and 2. The activities with pupils aim to satisfy objectives 2, 3 and 4. So, both activities with stakeholders and pupils were aimed at making a positive contribution to the co-creation of sustainable initiatives in the school's neighborhood (objective 2). To that end the 4D-cycle of Appreciative Inquiry, which is a typical PAR method, was used as starting point for the design of the intervention for both target populations. The 4D-cycle of appreciative inquiry (AI) is a methodology used to address processes of change using a positive and strength based approach. Cooperrider and Whitney (2001, p.3) define the practice of AI as follows:

"Appreciative Inquiry is about the co-evolutionary search for the best in people, their organizations, and the relevant world around them. In its broadest focus, it involves systematic discovery of what gives "life" to a living system when it is most alive, most effective, and most constructively capable in economic, ecological, and human terms."

The 4D-Model of Appreciative Inquiry A key assumption of the AI approach is that there is huge potential for positive change in each system. To realize this potential, a structured model consisting of the 4D's - discover, dream, design and deliver- representing different phases of a process can be used. According to Elderink (2017), who often applies AI in participatory action research, the first phase is about discovering what is going well in your neighborhood or community; in the second phase, people dream about the ideal situation, the central question here is 'what might be'; in the design phase a focus is chosen regarding 'what should be'; in last phase the 'how to' question is answered by specifying the actions that need to be undertaken to realize the design.

The 4D-Model as basis for intervention design This model is useful as it provides a good starting point for the design of a research and design cycles that aim to make a positive impact in the community. This clearly coincides with the program goals and objectives of the SEE

Program. Figure 2.3 shows how the 4D-cycle of appreciative inquiry translates in terms of the SEE Program. It should be noted that this road map contains one more phase, the ‘define’ phase, added for completeness. This phase is different from the others because the decisions made in this phase are program-led, i.e. this step only involved the SEE project team while the other steps also involved other actors. The process of appreciative inquiry that follows is participant-led (though facilitated by the SEE project team).

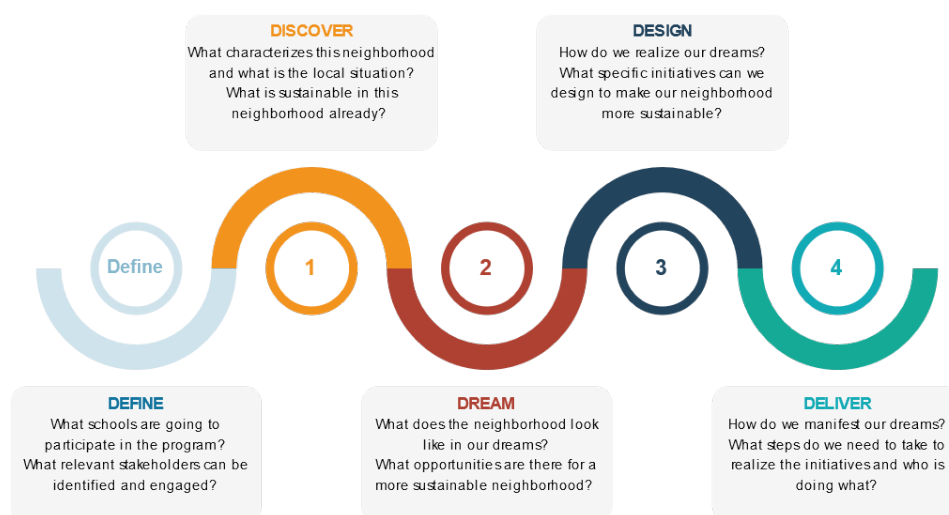


Figure 2.3: 4D-Model of Appreciative Inquiry

Design of activities with Pupils

The phases through which the pupils are guided in a minimum of four workshop of 60 to 90 minutes, are the same as the four phases of the 4D-Model of Appreciative Inquiry. Different working forms and assignments were designed and implemented for each of the phases. There was deliberately chosen not to strictly define the workshop activities for the design and deliver phase, as these had to be aligned with the stakeholder activities. For the dream and discover phase, two research approaches that are often used in participatory action research were used: photo voicing and village mapping.

Photo Voicing The photo voicing assignment in the SEE workshops consists of two parts: a discovery part and a dream part. For this assignment, the pupils are split in smaller groups. For the discovery part, the pupils are asked to walk around in the school’s neighborhood and make photos of things that they believe to be sustainable. For the dream part of the assignment, the pupils are asked to go outside and look for places and things that could become more sustainable in the future. Also, they are asked what ideas they can come up with to make these places and things more sustainable. Back in the classroom, the pupils present their research findings and ideas to the other groups.

Village Mapping For the village mapping assignment, the pupils work in smaller group. This assignment can also be used for both for the discovery phase and the dream phase. The discovery part of this assignment entails that pupils have to draw a map of their school and neighborhood. In this map, the pupils can also draw what they know to be sustainable in the school’s neighborhood already. For the dream part of the assignment, the pupils are asked to imagine how a more sustainable neighborhood could look like in the future and to draw this in the village map, or to write it down as well.

Design activities In the design phase, the pupils are asked to develop further their ideas for a more sustainable school or neighborhood. The activities for the design phase are not predefined beforehand as the actual assignment is expected to be highly dependent on the

results of the discover and dream phase. Pupils perform various creative tasks to visualize and communicate their ideas. Also, at some schools stakeholders and pupils worked together in the design workshops.

Deliver In the final phase of the program, ideally the pupils are offered the chance to make a real contribution to the execution of initiatives. As this depends on the actual initiatives created during the process, it again turned out to be impossible to design specific for this phase. In the end, it turned out that time-wise it was not feasible to realize this. This will be explained in more detail subsequent chapters that expand on the actual implementation of the program activities.

Design of Activities with stakeholders

The activities with stakeholders are also based on the 4D-cycle of appreciative inquiry. The specific activities that relate to each phase are described below.

Stakeholder interviews The first intervention in the neighborhood is to conduct interviews with 'relevant stakeholders'. In each neighborhood, the aim is to interview ten stakeholders. In open ended interviews, the following topics are discussed: their connection to the neighborhood, their view on the local situation, challenges and opportunities with respect to the energy transition in the neighborhood, and their ideas about the role of schools in the energy transition. As shown in figure 2.4, these topics cover both the discover and dream phase.

Focus group After the interviews, a focus group with stakeholders is organized. In the focus groups, the stakeholders get to know each other, after which the results from the interviews are presented, giving an overview of 'what is' and 'what could be' in their neighborhood. Subsequently, a creative session follows where stakeholders have to brainstorm and discuss their ideas for a more sustainable neighborhood. At the end of the focus group, the stakeholders together decide what initiatives they want to continue working on. As can be seen, the stakeholder move through the dream phase, into the design phase during a focus group.

Follow up focus groups Additional focus groups are organized to continue the design process, which corresponds to the fourth and final phase of the 4D-model. In some cases, focus groups with all stakeholders are organized, in other cases the stakeholders continue working on initiatives in smaller project groups.

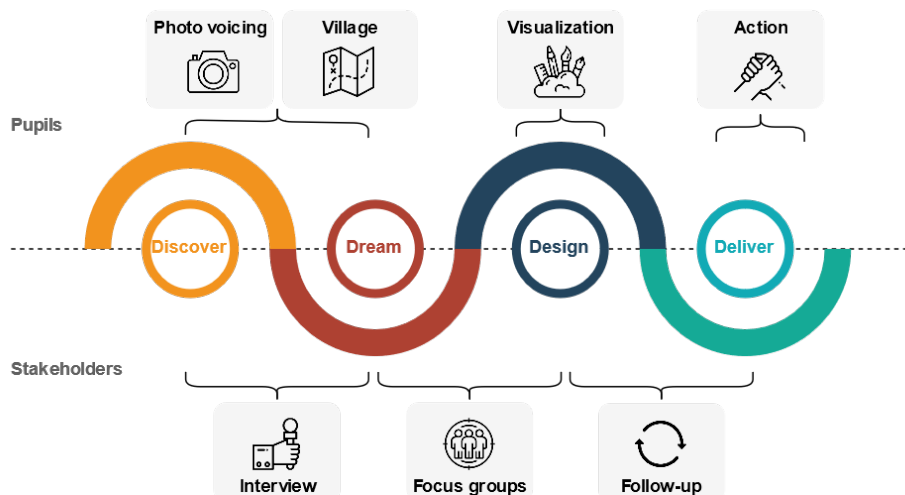


Figure 2.4: The activities placed in the 4D-Model

Theoretical Background on sustainability education

As the role of schools and education is the focal point of this research, a first step is to develop a knowledge base in field of sustainability education. This section presents a review of literature relevant to this research. In line with the research questions, the focus of this literature review lies on the evaluation of sustainability education in terms of learning outcomes and factors influencing these learning outcomes. Section 3.1 introduces the key concepts of sustainability education and frameworks used for evaluation. Section 3.2 explains factors that influence educational programs about sustainability. Lastly, in section 3.3 several subjects are identified that are left unanswered or that are not addressed by prior research. A summary of this chapter is provided in the box below.

Educational programs in schools to educate children in sustainability have already been the topic of scientific studies. In this field of research, a variety of terms is used to refer to educational programs related to the environment and sustainability. Many of these terms are used interchangeably. Commonly used terms are Environmental Education (EE) and Educating for Sustainability (EfS). In this thesis the term 'sustainability education' (SE) is used as generic descriptor.

Previous studies have proposed concepts that are key for the evaluation of learning outcomes of sustainability education. In summary, most frameworks used measure learning outcomes on four dimensions: knowledge, attitude, behavior and competencies. For this research, frameworks for environmental literacy and action competence provided the foundation evaluating learning outcomes in pupils.

Secondly, this chapter clarifies factors that affect sustainability education. From this discussion it becomes clear that the pedagogical approaches used can have a significant influence. A pedagogy that can lead to transformative learning is preferred such as inquiry based learning and co-operative learning.

The third contribution of this chapter is to clarify the state-of-affairs concerning research on sustainability education and, more importantly, to identify *knowledge gaps* that provide the foundations for this research. In this regard, it is found that previous research has insufficiently explored 1) sustainability education in a community context, 2) the mechanisms by which educational programs lead to program outcomes, and 3) implementation of sustainability education in existing educational structures at schools.

3.1. sustainability education

Educating on the environmental and sustainability in schools has been an active field of research for years (Wals, 2007). One of the main concerns of this research field was researching the outcomes of education on cognitive, behavioral and affective dimensions (DeWaters and Powers, 2013). This field of research fairly scattered. For one, not only do educational systems differ per country (or within countries), also the way environmental education is implemented within a curriculum tends to vary. Secondly, the terminology applied concerning education in sustainability is not consistent throughout different studies. Because of this indistinctness when it comes to putting research on sustainability education in the context of relating studies, this section firstly elaborates on how important concepts are perceived for this thesis. It also discusses the state-of-affairs for sustainability education in The Netherlands. What is more, conceptual framework proposed that are key for the evaluation of learning outcomes of sustainability education.

Some of the most often used terms to refer to educational programs related to the environment and sustainability are 'environmental education', 'education for sustainable development', 'education for sustainability', 'sustainability education' and 'learning for sustainable development'. It can be argued that conceptually the terms are all different from each other, and that they may have a slightly different focus. In practice, it becomes clear that the terms are often used interchangeably. In this section, I elaborate on two terms that are most commonly used, *Environmental Education* and *Educating for Sustainability*. In this thesis the most general term 'sustainability education' (SE) is used as generic descriptor.

3.1.1. Focal points of Sustainability Educating

Environmental Education is commonly used term in literature on education that focuses on the environment. Historically, it has been associated with different focal points such as nature and conservation, resource management and also with Sustainable Development (Heimlich, 2010). The Belgrade Charter (UNESCO, 1976, p.2) defines the goal of Environmental Education (EE) as follows:

"To develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones."

For Education for Sustainable Development (ESD) the following definition is widely accepted (UNESCO, 2014, p.12):

"ESD empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity."

It can be seen that there is much overlap between the two terms mentioned above. When assessing the learning outcomes associated with EE and ESD more closely, it becomes clear that in both cases the development of core competencies -such as collaborative and informed decision-making, critical thinking and taking responsibility- play a central role. Also, in the pedagogies used they share similarities with each other. Terms such as action-oriented, interactive and transformative learning are common in both strands of education. According to Pavlova (2016), even though conceptually, the two strands of education might have a different underlying emphasis, in practice, these strands of education cannot be easily distinguished from each other.

3.1.2. sustainability education in the Netherlands

Tauritz and Wals (2009) analyzed the development of environmental education (EE) and Education for Sustainability (Efs) in the Netherlands. Environmental education in the Netherlands emerged about a century ago as 'nature education' with a focus on knowledge about nature and conservation practices. Later, the links between the environmental and socio-cultural began to play a more central role, which they mark as a transition to Education for Sustainability or Education for Sustainable Development.

One of the central concepts in (education for) sustainable development is the interaction between ‘planet’, ‘people’ and ‘prosperity’ (Leicht et al., 2018). This focus is also visible in sustainability education in the Netherlands. For example, SLO published a practical guide on ESD for schools and teachers in the Netherlands (Haandrikman and Langber, 2009). The 3 P’s of people, planet and profit are used as basis for the definition of the learning outcomes for ESD. They state they ESD concerns learning about the trade-off that individuals and groups need to make between these three dimensions.

Citizenship and participation Tauritz and Wals (2009) argue that one of the factors that has been shaping EfS is developments of new forms of governance that emphasize the engagement of citizens in policy and decision-making. Having looked at the involvement of children specifically as ‘active citizens’, they found that from the 1990’s, people began to value the contribution of children more as well. In an educational plan on ESD the Netherlands, Remmers (2007) concludes that sustainable development and citizenship are closely related to each other, and that the links between the two should be strengthened even more. On the one hand, this entails the participation of citizens (and children) in policy- and decision-making, while on the other it is about the relationship between people and the planet.

What is more, Wals (2007) emphasizes the importance of multi-stakeholder participation and social learning in education for sustainability. He argues that educational programs should inspire new and fruitful interactions between the community and schools and stimulate different stakeholders to learn from each other in terms of perspectives, norms, values, stakes and backgrounds.

3.1.3. Conceptual frameworks used concerning sustainability education

To gain a better understanding of the effects that education might have on pupils, it’s important to have an idea of what different components a program is build up from. Researchers have proposed many different frameworks to describe the various aspects of sustainability education. Some of these conceptual frameworks are discussed below. They are useful for this research as they provide input on the different components of the program outcomes that will need to be evaluated.

Environmental Literacy

In the case of sustainability related educational programs, there is often referred to the development of *environmental literacy* (EL). According to Hollweg et al. (2011), environmental literacy is made up four components that interact with each other: knowledge, dispositions (or attitude), competency (or skill) and behavior components. This conceptualization assumes that ‘environmentally responsible behavior’ is the ultimate expression of environmental literacy, and that is the product of knowledge, dispositions and competencies, within a certain context. In Figure 3.1 these four categories of EL and the structure in which they interact with each other are shown.

Others have proposed frameworks that arrange the components of environmental literacy in three broader categories: cognitive, affective and behavioral (DeWaters and Powers, 2013). In such cases, the competency or skill related components are sub-divided over the other three categories, in which ‘cognitive skills’ would be arranged in the cognitive domain and action skills in the behavioral domain.

Variations on environmental literacy It’s interesting to note that variations on environmental literacy exist. For example, DeWaters and Powers (2011) developed an energy literacy scale to assess knowledge, attitudes, values, skills and behaviors related to energy specifically. Satchwell (2013) uses the notion of carbon literacy to explore children’s construction of knowledge about climate change. It can be noted that these variations are different mainly in content, rather than form.

Action Competence

Another often used conceptualization of environmentally responsible behavior emphasizes the importance of *action competence* of pupils, as originally described by Jensen and Schnack

(1997). They describe action competence as a person's wish and ability to take part in democratic processes on issues related to resource exploitation and dependency. It underlines the importance of the development of a person's capability to critically think, reflect and form an opinion based on incomplete knowledge (Schnack, 2000). According to Breiting et al. (1999) it comes down to developing pupils wish to act, confidence in their own influence, and knowledge of action possibilities.

Individual and collective action competence can be developed through participation and collaboration (Ferkany and Whyte, 2012, Stevenson and Stirling, 2010). According to Mogenssen and Schnack (2010), a connection with the local community -an expression of which can be citizen participation- is an important aspect of action competence . As can be seen, this resonates with the argument made before about the close relationship between sustainable development and citizenship.

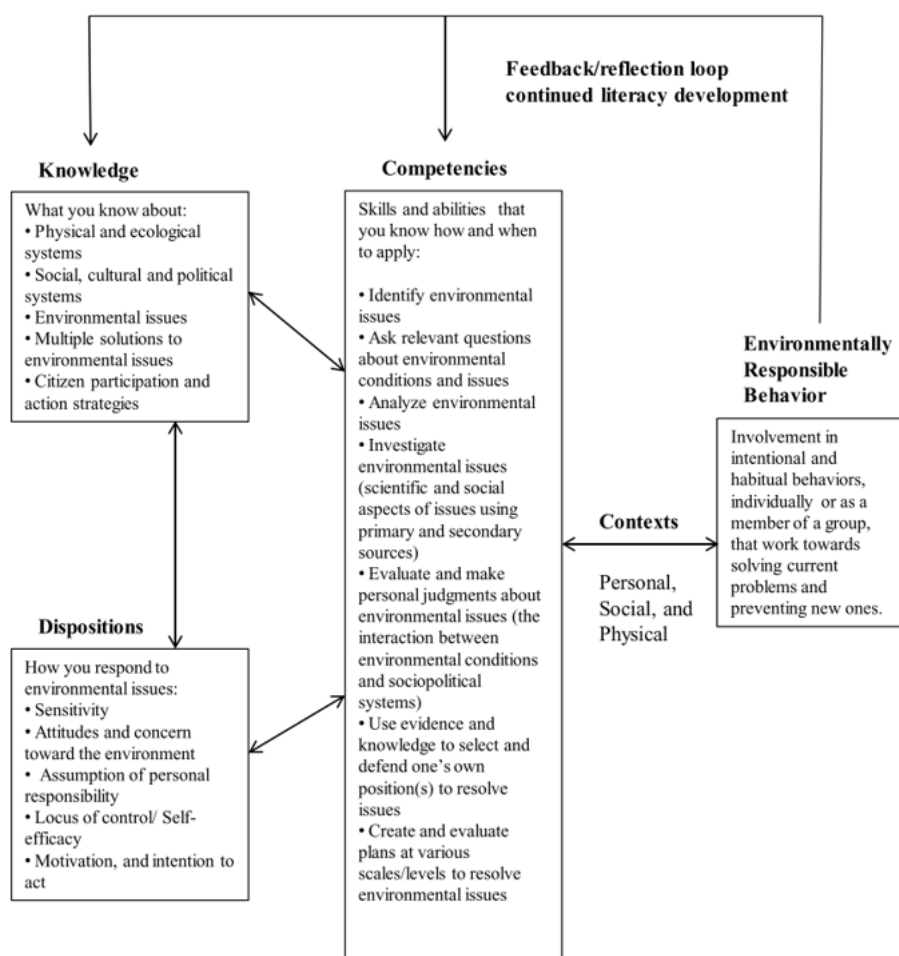


Figure 3.1: The Domain of Environmental Literacy as proposed by Hollweg et al. (2011)

3.1.4. Evaluation of sustainability education

An important strand of literature in the field of EE relates to the effectiveness of EE programs. The central question here is 'if and how the intended objectives of programs are reached, and what factors influence the outcomes or effects these programs'. What this means, it that many evaluation studies try to find evidence for the development of specific components of environmental literacy or action competence in pupils as a result of an educational program.

Based on the analysis of 86 evaluations of environmental education programs, (Stern et al., 2014) identified the following categories of outcomes of interest that were consistently being assessed in students across the programs: 1) change of knowledge on a subject, 2) awareness, which they define as 'the change in recognition or cognizance of issues or concepts' (p.585), 3) change in skills/abilities needed to perform a certain action, 4) change in attitude towards the subject or actions related to it, 5) intentions, which is defined as the 'the self-reported intent to change a behavior' (p. 586), 6) changes in behavior, either self-reported or observed and 7) enjoyment of or satisfaction with the educational experience.

Comparing these learning outcomes to the components of environmental literacy and action competence as described above, it can be seen that there is overlap in the categories used. For this thesis it was decided to use the four categories of environmental literacy as described by (Hollweg et al., 2011) as starting point, as most components can be sub-divided in one of these four categories. For example, awareness, can be seen as component of the attitude category and the action competence related component 'confidence in own influence' - which others might refer to as 'self-efficacy' - can be subdivided in this same category.

Program Objectives

An important step in every evaluation effort, whether it concerns a policy intervention or an educational program, is the clear formulation of program objectives (Dark and Holsman, 2002, Sollart, 2005). These program objectives are essential because they guide the identification of outcomes of interest of the evaluation (Carleton-Hug and Hug, 2010). With respect to the evaluation of environmental education programs (Rovira, 2000) found that a lack of clear program objectives can impede the evaluation process. Another related issue that can arise is that program objectives and activities do not match, in which the evaluation program effectiveness cannot be assessed properly (Smith-Sebasto and Semrau, 2004). For example, one could identify 'participation' to be a program objective. In that case a mismatch would occur when either the program activities or the evaluation would focus on knowledge acquisition. What this means in short, is that for the program and the program evaluation to be meaningful, 1) the program objectives, 2) the program activities and 3) the program evaluation design, need to match.

Quantitative assessment tools used in evaluation studies

For the evaluation of EE programs different research methods are used including qualitative, quantitative and mixed methods. In many cases a quasi-experimental design is chosen in which student surveys prior and after the educational experience are compared. With respect to tools for quantitative analysis it's interesting to note that statistically tested surveys have been developed for the evaluation of environmental education. Each of these surveys focus on a particular set of outcomes in participants. Examples are a survey used to measure the beliefs and intentions of students to bring about positive environmental change (Christensen and Knezek, 2015), a questionnaire used to measure students relations with energy knowledge, affect and behavior (Chiu and DeWaters, 2018), a questionnaire used to measure children's environmental attitude and behavior (Tucker and Izadpanahi, 2017) and a survey to measure action competence of pupils (Breiting et al., 1999). It can be seen that in each of these cases, the objectives of the educational program guide the selection of outcomes of interest that are being assessed. Important to realize is that these surveys were developed for a particular target population, which are either primary school or secondary school students. The validity of results cannot be guaranteed when using a certain survey for a different target population.

3.2. Factors of influence in sustainability education

Much research in the field of sustainability education has focused on the different factors that influence the implementation and effects of sustainability education as well as on the working mechanism through which different components of environmental literacy and action competence are being developed. Factors that are important in light of the SEE Program are discussed below.

Pedagogical approaches

A wide range of pedagogical approaches is used in sustainability education. For instance, Eames et al. (2004) found that *transformative teaching modes* are more likely to promote action competence in students than traditional *transmissive practices* in which the students passively receive information from a teacher. The aim of transformative learning is to develop their understanding of the world but also to empower them to question and change their worldview (Leicht et al., 2018). In transformative practices, both students and teachers are expected to actively and collectively reflect on their learning process in support of the construction of knowledge, attitudes and values (Eames et al., 2004, Sterling, 2001). They found that effective pedagogies that can lead to transformative learning include experiential learning, inquiry-based learning, co-operative learning, reflective practices, student-centered learning and affective-aware teaching. In each case, the teachers have a facilitating role and should collaborate with the students.

Teachers

Research on the inclusion of sustainable development education in school curricula performed by Ocetkiewicz et al. (2017), showed that important conditions for successful inclusion of sustainability education at schools are awareness and knowledge levels of teachers. In terms of environmental literacy, this research finding suggest that a lack of environmental literacy on the side of the teachers impedes the development of environmental literacy in their students. In addition, another research by Schelly et al. (2011), found that role-models (including but not limited to teachers) can play an important role in inspiring and promoting positive environmental behavior in students.

Role of the school

Schelly et al. (2011) found that school-wide energy conservation programs have a synergistic relationship with environmental education in secondary schools. These program and the education offer the school a means to teach about sustainability and energy related topics in a real-world setting. This was found to promote sustainable behavior of students, teachers and staff. This corresponds with the positive influence of 'active and experiential engagement in real-world environmental problems' on EE outcomes found by Stern et al. (2014). Four channels through which schools can model sustainability are identified: individual role models, school facilities and operations, school governance, and school culture Higg and McMillan (2006)

The above mentioned findings suggest that for an effective implementation of sustainability education, a holistic approach should be considered, in which the school as a whole makes an effort to develop sustainable, energy conserving practices. This resonates with the argument of Sterling (2001) that including sustainability related topics in a curriculum alone is not enough. He argues that other aspects of education such as the schools' ethos, management, use of resources and relation with the community play an important role in developing environmental literacy as well. Similarly, Tilbury and Wortman (2005) promote the integration of sustainability principles and practices across all aspects of the school, known as the *whole school* approach to sustainability. This approach strongly promotes participation of students, teachers and staff, but also of community members Henderson and Tilbury (2004).

3.3. Research gaps in prior academic research

From this literature review it is clear that over time, an extensive literature has developed on sustainability education. This review also revealed a number of shortcoming and gaps in the literature. Three relevant research gaps in light of the SEE Program were identified that are described below.

Evaluation of educational programs in a community context *Community involvement* and *community learning* are often mentioned as important aspect of sustainability education (Mogensen and Schnack, 2010, Wals, 2007). However, the role of sustainability education on

the community -that is to say, the effects and factors of influence of an educational program on and in interaction with other members of the community are insufficiently explored (Varela-Losada et al., 2016). So, even though interaction with the community, collective action and the formation of committed groups and networks are often mentioned as promising ways to promote environmental literacy of participants (or ends in itself), the existing research has problems in representing these particular aspects of sustainability education in a community context. Accordingly, Tauritz and Wals (2009) note that not much research has been performed on the effects and effectiveness of educational programs that emphasize multi-stakeholder participation and social learning.

Identification of mechanisms by which programs come to have impact Stern et al. (2014) concluded that there is broad evidence for the effectiveness of EE programs in developing environmental literacy. However, they also found that a question that often remains unanswered is what the mechanisms are by which certain learning outcomes are produced. This notion is reflected in the concern of Rickinson et al. (2016) that sustainability education research is dominated by a focus on the evaluation of program impacts, addressing questions on whether a program works. They argue that what is lacking is investigations into program influence, concerning questions on how and why a program works. One of the reasons that can be indicated is that many assessments focus on the qualitative assessment of learning outcomes in pupils. The existing research has problems in identifying the learning processes through which outcomes are produced and is insensitive to the context in which program activities takes place.

Influence of existing educational structures As mentioned in the introductory chapter of this thesis, the majority of primary school in the Netherlands does not yet pay attention to sustainability (Het Groene Brein, 2015). Factors that can impede the integration of sustainability in the curriculum of primary and secondary schools are limited time and resources to realize integration, and a lack of knowledge and competencies of teachers (Green and Somerville, 2015). Additionally, sustainability education in the Netherlands is often outsourced to external organization (Wesselink and Wals, 2011). In the light of these findings, the question how schools can be reoriented towards sustainability and their communities within the context of fixed formal education structures, raised by Tauritz and Wals (2009), is an interesting one that remains unsolved. Therefore, more work is necessary to explore the role of existing school structures in effective implementation of sustainability education programs, in particular when community members are involved.

Research Questions

What is clear from this discussion it that one of the challenges for all researchers in this domain is that for meaningful evaluation of an educational program on sustainability, not only the effects of a program should be evaluated, but it should be investigate also why and how certain outcomes are produced. Clearly, the importance of context is closely related to this notion. More specifically, previous work has often not take into account carefully the school and community context within which a program is being implemented.

To fill this literature gap, this study addresses both the question on program impact and factors of influence. Furthermore, by assessing the effects of the program on the different groups of actors separately, it becomes possible to get insight in the effects of the program that reach further than the school building. Lastly, to take into consideration the importance of school and community context in this study -which will also give insight in the mechanisms through which certain outcomes are produced- the research approach and methods were chosen carefully. As will be explained in the subsequent chapter, a mixed-methods case study approach was chosen.

Methodology

”What are the effects of the action research program ‘Schools as Energy Embassies’ on the school, its pupils and the surrounding ecosystem, and what factors influence the program outcomes?”

This is the research question of this thesis as introduced earlier. In this chapter, I outline the research approach and methodologies used to answer these questions. Based on the data requirement for each of the sub-questions, an appropriate research approach and data collection and analysis methods could be decided upon. This section elaborates on the methodological choices made, and also on the limitations of the methods chosen in the final section

4.1. Case Study Approach

From the previous chapter, it is clear that it is important to account for the influence of contextual factors when interpreting data on the effects of educational programs. (Stern et al., 2014, Tauritz and Wals, 2009). The more so because we are investigating the implementation of the program at different schools. According to Yin (2011) a case study approach can be used to study complex phenomenon in their real-life context. The case study approach was therefore chosen to study the effects of the SEE Program, and the factors that influence the effects over varying context.

Yin (2011) also notes that a good case study benefits from multiple sources of information and that a construction of reality given by different participant can provide important insights in case studies. It was found appropriate to choose a mixed method approach in which both qualitative and quantitative methods are used to examine the effects and effectiveness of the intervention (Johnson and Onwuegbuzie, 2004). When performing case studies it is also recommendable to study a phenomenon from different perspectives with different methods, as the results can then be used for triangulation (Greene et al., 1989).

Overview of the cases

For this thesis, the SEE Program was evaluated at four primary schools. What schools participated and the number of participants per participant group can be found in table Table 4.1

Table 4.1: Overview of participating schools

School	Neighborhood, City	number of pupils	number of stakeholders
De Kaleidoskoop	Kanaleneiland, Utrecht	15	10
OBO De Gagel	Overvecht, Utrecht	16	14
De Hogeraven	Hoograven, Utrecht	12	9
De Rozemarn	H-Buurt, Amsterdam	12	13

One other school participated in this cycle of the SEE Program, the International School Utrecht (ISU). At this school, the implementation of the SEE Program was different than for the other cases. In the first place it was different because this ISU is a high school. Instead of series of SEE workshops as described in chapter 2, the students of the ISU participated in a program called 'Energy Challenges'. Secondly, the activities with stakeholders in this neighborhood were limited. As limited data was available for this case, and it was not comparable in terms of activities and context to other four schools, it was decided to omit the ISU from this study.

Sub-questions for the case-studies

So, for each of the schools a case study was performed which forms the basis of the thesis. A set of 4 sub-questions was formulated that should be answered for each of the four cases individually. These are the following sub-questions:

1. How is the SEE Program implemented?
 - (a) How is the program implemented at the schools?
 - (b) How is the program implemented in the neighborhood?
2. What are the effects of the SEE Program with respect to:
 - (a) facilitating the co-creation of sustainable initiatives in the school's neighborhood?
 - (b) Supporting the school in Sustainability Education and Science Education?
 - (c) developing the environmental literacy of pupils?
3. How do different participant groups experience and value the program?
4. What factors influence the program outcomes?

Comparative Analysis

After having collected and analyzed the information for each of the participating schools individually, the case studies were analyzed with respect to each other following the same structure as the case studies -i.e. in terms of implementation, outcomes and context. Similarities and differences between the cases were examined and interpreted. This part of the evaluation corresponds to sub-question 5:

5. How do the cases compare to each other in terms of implementation, outcomes and context?

Based on this comparative analysis, conclusions can then be drawn not only on the most important effects of the SEE Program, but also the conditions under which the SEE Program is able to generate positive outcomes. Because individual components of the SEE Program are analyzed both individually and in interaction with each other, the comparative analysis also allows deeper insight in the working mechanisms of specific program components that can be used as building blocks in the design of new interventions.

4.2. Research Methods

The research methods used for the case studies were chosen based on the data requirements for each of the sub-questions, taking into account the different participant groups. This means that on the one hand, data needed to be collected on the activities with stakeholders, and on the other hand on the activities with pupils. Following the mix-method approach discussed above, the research methods used are as follows: 1) observation of participants in program activities, 2) Semi-structured interviews with teachers and school-management, 3) survey for pupils, and 4) Content analysis. In this section the research methods are described in detail.

4.2.1. Workshops observation

Objectives The workshops with pupils are the core of the SEE Program. Observations of the pupils in the workshops was the primary source of information for answering sub-question 1 to 4 - those relating to the workshops. Analysis of the observations provides insight in implementation and participant and contextual factors, and how certain outcomes were produced.

Approach: unstructured observations Observation of pupils took place when they were participating in the workshops facilitated by the educational specialist of Stichting Technotrend. In the workshops, the specialist was assisted by a member of the Action Research Team. This person was responsible for observation and reporting. These observations were complemented by those of the educational specialist, and in some cases a stakeholder. As the person doing the observations was also a workshop facilitator these are not structured observations. During some of the workshops, there was also time to interview pupils to complement observations.

Documentation The workshop observations were documented following a format consisting of the following elements: 1) description of assignments and activities, 2) Results of the workshops, 3) competencies (what competencies were being trained and how did that go), 4) background knowledge, 5) Additional notes. The artifacts made by the pupils during the workshops were taken photo's of or taken to Stichting Technotrend. For each school, all information and data of the workshops was documented in one document.

Data Analysis The observations (i.e. the raw data) could be used straight forwardly to answer sub-question 1, which merely describes the workshops. To be able to answer the other sub-questions, qualitative analysis of the observations was needed, and the data needed to be interpreted. For example, how the pupils experienced the workshop is something that had to be deduced from the data. To be able to answer the other sub-questions, a mainly deductive approach was used. The data was re-organized, coded, and there was looked for patterns linking the intervention, participant and contextual factors to each other to reveal the working mechanisms of the intervention.

4.2.2. Focus group Observations

Objectives Whereas the workshops observation served as primary source of information for the pupil related sub-questions, the focus groups observations served as primary data source for the stakeholder related sub-questions. Observation and analysis of this data gives insight in the implementation, the effects of activities of stakeholders in terms of the three program objectives and their experience with the program. Analysis of this data gives insight in the intervention, participant and contextual factors that have influenced the program outcomes.

Approach The focus groups were facilitated by the director of Stichting Technotrend, and supported by two members of the action research team, one of whom made minutes of the meeting. A report of the focus group was made that was send to the stakeholders after the focus group and that served as important source of information for this thesis. The reports followed the same structure as the focus group program and consisted of the following elements: 1) introduction of the stakeholders present, 2) presentation of the interview results, 3) brainstorm on possible initiatives, 4) deciding which initiatives to continue with. Therefore, information on the following factors could be deduced from the focus group reports: stakeholder factors (e.g. population, interaction, values, interests, experience), in intervention factors (e.g. how did the activity influence the process of co-creation), and in effects (what were the results of the activity).

Data Analysis Analysis of the focus group reports gave insight in the effects of this activity on the the process of co-creation. Also, it showed how stakeholders received and used the ideas of pupils. Additional observations on the focus groups that were discussed in meetings

with the ART were also used as input. In some cases, the interview reports of individual stakeholders were used to get gain more insight in individual stakeholders. The collected data was analyzed quantitatively. It was reorganized, coded and there was looked at links and patters between different pieces of information.

4.2.3. Interviews with school staff

Objectives For this thesis I conducted semi-structured interviews with management and teaching staff. The goal of the interviews was to collect information on the current state of science and sustainability education and their perception of the SEE Program. The interviews gave insight in school factors (e.g. vision, curriculum's), participants factors (population, level), intervention factors, and the school's experience and valuation of the SEE Program. These data requirement follow mainly from sub-question 2, 3 and 4. The information collected in this interview puts the activities of pupils and stakeholder in that neighborhood in a different perspective.

Approach: interviewees For two schools, a member of the school's management team was interviewed as stakeholder already (see Figure 2.3.1, Stakeholder interviews). For this thesis, I conducted four additional interviews. Three of these interviewees were teachers. The other interviewee was a vice-principal that had been interviewed as stakeholder already. An additional interview was conducted as more information on education related topics specifically was needed.

Approach: Interview topics The complete interview script used, though adjusted for each of the interviewees specifically, can be found in appendix A. The following themes were discussed in the interviews: 1) The School: characteristics of the school, vision on education, population, 2) Sustainability Education: vision on SE, activities w.r.t. SE, involvement of teaching and management staff, challenges and opportunities, integration in the curriculum, personal interest, 3) Science and Technology Education and Inquiry and Design Based Learning: same sub-themes as for theme 3, 5) Experience with the SEE Program: value for the school and pupils, experience with the program, performance of pupils, 5) parents: how to involve parents, connection of parents with the school. Data from the interviews was complemented with open content the schools published on their website and schools and (multi-annual) school plans.

Data analysis For each school, 1 or 2 interviews needed to be analyzed, complemented with online content. The topics discussed per interviewee varied widely, as each of them played a different role in the SEE Program and the school. Therefore, a more deductive approach towards analysis of the interview data was chosen here. The data was initially categorized using in-vivo coding, which uses phrases used by the interviewee to structure the data. After having coded the two interviews for one school, the information could be re-organized using the research questions as basis, and complemented with online content where necessary.

4.2.4. Pupil Survey

To measure the effects of the workshops on the knowledge, attitude and behaviors of pupils in a quantitative manner, I administered a survey to pupils. The analysis of survey results provides in the learning outcomes of the SEE Program. It was not possible to conduct a baseline measurement as the survey was not fully developed yet on the start of the workshops. Therefore, effects of the workshop in terms of the learning outcomes are assessed relative to a control group of pupils from the same school and same grade that did participate in the workshops.

Development of the questionnaire

Developing a questionnaire consists of different steps that are discussed below. The consideration for developing this questionnaire are discussed as well.

Theoretical framework The theoretical framework on sustainability education and learning outcomes as discussed in the previous chapter (chapter 3), in combination with the workshops content and activities, formed the basis of this questionnaire. The approach taken was to first use theory on environmental literacy and action competence frameworks to create an overview of categories and constructs. Four broad categories can be discerned: knowledge, attitude, behavior and competencies. Though competencies are an important aspect of sustainability education, they are difficult to assess by means of a questionnaire (Remmerswaal and Voerman, 2016). Therefore, the questionnaire only assesses the knowledge, attitude and behavioral dimensions.

Construct and item selection The list of constructs that followed from the literature consisted of many elements that were not relevant in the light of the workshop content. The selection of relevant constructs and questionnaire items happened in consultation with other member of the SEE Program team and can be found in Table 4.2

Table 4.2: Overview of questionnaire categories and constructs

Knowledge	Attitudes	Behavior
What is (not) sustainable	Values education	exhibition of sustainable behavior
Action possibilities	Attitudes towards action	talking about sustainability
Environmental impact of CO ₂	Self-efficacy beliefs	
	Environmental concern	

Each of the constructs was operationalized into a set of questionnaire items. Examples of questionnaire found in literature were used as basis for item selection and formulation. Two questionnaires that were used as inspiration are the energy literacy questionnaire of DeWaters and Powers (2013), and the action competency questionnaire of Breiting et al. (1999). The following considerations were made:

Face Validity It is important that the questionnaire items are comprehensible, clear and appropriate for the target group and that they represent their corresponding constructs (Post and Walma van der Molen, 2019). The items were as much as possible linked to the workshops activities the pupils participated in. To ensure face validity, the items were discussed with the educational specialist and two pupils completed a pilot version the survey. Also, the questions were discussed with one of the teachers during the interviews on face validity. Some issues were identified in this process and the improvements with respect to face validity were made.

Test and control group To analyze the effects of the workshops on pupils attitudes, knowledge and behavior, it is preferable to conduct both baseline measurements for the test group and use a control group. When doing baseline measurements, the effects of the intervention can be identified by looking for significant differences in survey scores of pupils before and after the intervention. When comparing the scores of pupils that did participate in the workshop (test-group) and pupils that did not (control-group), significant differences can also give insight in causal effects of the intervention.

For this research, it was not possible to conduct a baseline measurement due to time-constraints. Therefore, the data analysis performed was based on a comparison of the test-group and control group alone.

Also, it was deemed valuable to ask some specific questions on the workshops as well. These question could not be answered by a control group. 13 of the 20 items in total were identical for test and control group. Three items were similar in content but slightly different in phrasing. The four additional items of the test group were questions on perceived knowledge, behavior changes and self-efficacy beliefs. These corresponds to question 11 to 15 of part two of the survey.

Energy transition vs sustainability Though the SEE Program has a focus on the local energy, the workshop have a broader focus on sustainability in general. To link the questionnaire to the workshops, it was therefore decided to ask questions about sustainability in general.

The questionnaire can roughly be divided in three parts: knowledge, attitude and behavior. Each part used a different measuring scale. An overview of the questionnaire is shown in Figure 10.1. The complete questionnaires for the test and control group are shown in Appendix B

Part 1 and 3 For the first two 'knowledge' questions, the pupils had to indicate for different items if they believed it to be sustainable or not. The third question on environmental impact of CO₂, had a true/false format and consisted of four items. Pupils could also indicate if they didn't know the answer to that question to prevent them from guessing to the right answer.

Part 3 on behavior consisted of one questions with five items which they had to answer with true or false. The control group was asked whether or not they did each of the items at home (e.g. turning of the lights when you leave the room). The test group was asked of they did any of these things more often as a result of the workshops. The pupils of the test group had the additional response option 'this is something we already did'.

Part 2: Likert scale The questions in part 2 consisted of 11 Likert scale questions. There was chosen for a 4-point Likert scale, with the response options: (1) strongly disagree, (2) disagree, (3) agree, (4) strongly agree. Post and Walma van der Molen (2019) recommend using a 4-point Likert scale for children, as the mid-point of an uneven Likert scale can be difficult to interpret for primary schools pupils. They may interpret it as a neutral or 'I don't know/understand' option. They also argue that it's advisable to use a minimum number of response options, as it becomes more difficult and time-consuming for pupils to make questionnaires with fine grained scales.

Smiley faces were used in part 2 to visualize the four different response options. The smiley faces ranged from looking very sad (if then strongly disagreed) to looking very happy (when they strongly agreed). Using smiley faces help pupils to answer the questions easily and enjoyable (Yahaya and Abdul Salam, 2008)

Approach

Paper-and-pen questionnaires were administered to the pupils and after the introduction, they were given 10 to 15 minutes to complete it. At each school, the format was different, depending on the other workshop activities in case of the test group or logistic considerations in case of the control groups. They either filled out the questionnaire all at the same time, in smaller group, or they could choose their own time during the workshops. In each of the cases, it was made sure that they could ask questions to me, the educational specialist or their own teacher.

The procedure for administering the surveys was explained to school management and teachers before administering it to pupils. Approval of the ethical commission of the TU Delft was obtained for this survey. The questionnaire did not include any personal information. The results of the questionnaires can not be traced back to individual pupils.

4.3. Methodological considerations

It should also be noted there are also limitations to the approach and methods chosen for this research. These are described in this section.

Time-consuming research approach With respect to the chosen mixed methods approach, is can be noted that the research design is rather complex and collecting and analyzing data from different sources is time-consuming. Even though information could be used that was collected for other parts of the overarching research, it was important to be very conscious about the research planning.

Resource restrictions For the survey with pupils, it was not possible to conduct a baseline measurement as the survey was not designed and tested yet on the start of the workshops. Therefore, effects measured could only be compared to a control group.

Bias in data collection With respect to the collection and analysis of the qualitative data it is important to note that this study design is prone to bias. Collecting data through observation is susceptible to objective bias of the observer: 'observer bias'. The risk of using this data collection method is that the observer records a subjective reality including those things that he/she finds interesting, expected to see, or wanted to see (Harvey, 2019). Making use of observations schemes would be more objective. However, there was not enough manpower available to this project to make use of such observation schemes in this research. The observer effect is another limitation to observation. This means that the presence of the observer may influence the behavior of those observed (Eelderink, 2017).

Interpretation of results With respect to the analysis of the qualitative data it should also be noted that the bias in interpretation of this data is a critical consideration for this research. Even though the data analysis was structured in a way that would ensure that different topics would be focused on, what receives much attention in each of the cases depends to a certain extent on what the researcher believes to be important and interesting. Qualitative analysis is therefore always prone to confirmation bias, which occurs when researchers look for supports of certain research findings, or omit data for the same reasons (Nickerson, 1998). To minimize interpretation bias, the interpretations made by the researchers should be verified by others, and triangulated with findings from other sources of information. However, given the duration of this thesis work, this was not feasible.

Ethical considerations in working with pupils Working with pupils and schools means that one has to be extra precocious with collecting sensitive and personal data. To guarantee the privacy of participants, no photos or videos of pupils were made without specific approval of pupils and parents to do so. Any visual material made as part of workshops assignment (e.g. for photo voicing or making a blog) was made with approval of a member of the school management as well, and was only used for educational purposes. This material is managed by the educational specialist, and if used for research purposes, explicit approval of parents and pupils should be asked first.

Case Study - Primary School De Rozemarn in Amsterdam-Zuidoost

5.1. De Rozemarn

The Rozemarn is a public primary school in the H-Buurt in Amsterdam-Zuidoost. This school is located across the street of primary school De Achtsprong, a school that participated in the first round of the SEE Program. The school has approximately 300 pupils of culturally diverse backgrounds, the majority coming from Suriname (45%) and Ghana (19%). Most pupils attending this school live in the H-Buurt themselves. According to the school De Rozemarn (2019) the H-Buurt is characterized by ethnic diversity, relatively much social-emotional problems among inhabitants, poverty and physical unsafety. For the Rozemarn, this is reason to value highly the core value of ‘citizenship’ comprising of democratic values, participation and identity.

The past years, the school worked hard to improve education in the core subject of reading, writing and math, which continues to remain a high priority for the school. A new focus for the coming years has also been included in the school’s plan: equipping the pupils with relevant skills to make the best of their future opportunities in the labour market (e.g. independence, critical thinking and problem-solving). In line with this ambition, the school wants to work towards a cross-subject integration of science and technology education in its curriculum in the coming years. This should also give a boost to inquiry and design based learning, and the development of 21st century skills. It can be noted that the objectives of the SEE Program coincide with the ambitions of the school, as it combines elements of citizenship, technology and science education, and inquiry based learning.

5.2. Program Activities in The H-Buurt

This section describes the program activities the pupils and stakeholders of de Rozemarn participated in.

5.2.1. Activities with pupils

At this school 14 pupils from grade 4 to 6 participated in the project. These pupils were members of the school’s student council.

Workshop 1 The educational specialist introduced The SEE Program by discussing with the pupils what they knew about sustainability and sustainable energy. In groups they started working on village maps in which they could draw things they knew to be sustainable in their neighborhood. In figure Figure 5.1 one of the village maps is shown. One of the stakeholders, who worked for the municipality of Amsterdam was present in this workshop, but he was not actively involved.



Figure 5.1: Village map made by pupils of De Rozemarn

Workshop 2 In the second workshop the pupils continued working on their village maps. With a green pencil they could indicate what was sustainable already, and they were asked to think about what could become more sustainable and indicate that with a blue pencil. This marked the transition from phase 1 (exploring what there already is) to phase 2 (dreaming about what can be).

Workshop 3 The pupils went outside for photo voicing. They made photos of places that could be more sustainable and had to think about different ways in which that could be realized. Next to the school, the pupils came across a lawn that was not being used. Pupils made the following suggestions: a gym for people and children from the neighborhood, a school garden, garbage bins made of the material the bin collects. The pupils also came across a recently established butterfly garden about which they wanted to learn more. Another thing the pupils discussed when walking through the neighborhood is that it does not feel very safe to walk outside in the evenings. Some places and routes they use are not lit properly. They would like to have more sustainable street lights. Other ideas included more bicycle racks and an electric boat free to use for everyone.

Workshop 4 At this last workshop, two stakeholders working for the municipality of Amsterdam were present. They are actively involved in the transformation plans of Amsterdam-Zuidoost. One of the stakeholders wanted to brainstorm with the pupils about how the tunnels in the neighborhood could be made safer and more pleasant to use. The other stakeholder wanted to discuss with the pupils how the new park which is part of the transformation of this area, can be made as attractive as possible to children. Both stakeholders and pupils were very enthusiastic about the workshop. The stakeholders said that the drawings the pupils had made with their ideas would be displayed in the information centre for

the transformation of the area. For this workshop the survey was scheduled as well. Not all pupils filled it out as they were too enthusiastically working on the assignment with the stakeholders.

5.2.2. Activities with stakeholders

Stakeholder Population

When looking at the stakeholders involved in the program in the H-Buurt, the following notions can be made:

Stakeholders working for the Municipality of Amsterdam Six of the stakeholders involved work for the Municipality of Amsterdam. Five of them are involved in development and transformation projects of Amsterdam-Zuidoost. One other stakeholder, the vice-president of a large housing cooperative, is also closely involved in these transformation projects. These people all share an professional interest in the H-Buurt and it's inhabitant.

Professional interests of stakeholders Some of these stakeholders have a clear professional interest in the initiatives that are being developed and they participate in the SEE Program driven by this interest. For example, one of the stakeholders working for the Municipality of Amsterdam noted that he was participating in the focus group because as the person being responsible for urban development in the H-Buurt, he believed it to be his job to be present. Also, he mentioned that he wanted to explore the possibilities of involving children in urban development projects. Another stakeholder mentioned that she had this idea for a repair cafe (initiative 4 in subsection 5.2.2) and that she wanted to explore if there were other people that would be interested in developing this idea.

Some of the stakeholders of De Rozemarn got engaged in the program after the project was pitched on a community event. Stakeholders wanted to participate in the program on their own initiatives. Most of these stakeholders were closely involved in the program.

Stakeholder involvement previous round The network of stakeholders had partly been growing forth from the network that had already been established in the first round in which De Achtsprong participated. Five stakeholders that had in some way been involved in the previous round, were active in this round again. Three of them have become 'active' stakeholders in the latest round.

Ideas from the pupils

The ideas the pupils came up with and that were later presented to the stakeholders during the first focus group included a wind turbine on the school's roof, generating electricity from the stream in the park nearby, lighting up dark tunnels by dancing, a small McDonald's where homeless people can get food in exchange for litter they have collected, a school garden, garbage bins made of the material the bin has collected, cycling to recharge your cellphone.

Results from the Focus Groups

1. Littering problems At De Achtsprong, the school that participated in the first round of the SEE Program, an initiative named 'Toffe Afvalplekken' was developed and realized. For this project, pupils from de Achtsprong decorated garbage bins that were later placed in the schoolyard. The pupils of de Rozemarn mentioned littering problems during the workshop as well and there was also talked about a project on talking garbage bins. The stakeholders were interested in exploring opportunities to develop a new initiative related to littering, and the organizations involved in 'Toffe Afvalplekken', who are also participating in the second round of the SEE Program, indicated they wanted to continue with this project as well. It has not been discussed (yet) what next steps need to be taken and who will take responsibility for initiating these next steps.

2. Tour through the neighborhood and area developments The stakeholders want to develop a route through the neighborhood for children and their parents to learn about interesting developments and transformations in the neighborhood. It's important to account for the interest of children from different ages. The project group agreed that as a first step, a map has to be drawn with potentially interesting stops related to sustainability. Then, the pupils can indicate what they find interesting and the school can indicate what school activities could be linked to the tour.

Three (types of) parties are involved in the project, the school, the Municipality of Amsterdam and organizations that are working on the area developments in this neighborhood. Each of these parties is represented in the project group that is working on this initiative. There will also be looked at involving new stakeholders that might be interested.

Another idea that was proposed is to involve pupils in the design of two tunnels that will be renovated. Funding for this renovating is already granted. The art collective that worked with the pupils on 'Toffe afvalplekken' could be involved again. Also, there can be looked at sustainable lightning.

3. Gas-free gastronomic tour through the neighborhood The idea is to organize a walking dinner through the neighborhood with food made on induction cooktops. As food is something that is much closer to the hearts of people than heating, stakeholders think such an event could be an excellent opportunity to show people that the gas transition is not as impactful as people tend to think. In the second focus groups, the stakeholders discussed what is needed to realize this idea. They did not decide on an exact format yet, but they identified to need at least the following resources: people that make food using induction, children and parents that will participate in the events, and funding. Also, the project group discussed the possibility of using social media to increase exposure. A suggestion was made for a kick-off activity for the pupils of de Rozemarn and their parents: going to the local city beekeeper for a workshop 'stir frying on induction'. The project groups now wants to know if a permit is needed for the organization of such an event.

4. Local education opportunities and a 'repair cafe' In the first focus group, one of the stakeholder representing makes the suggestion of a 'repair cafe', rooted in a circular approach for dealing with products that are old, broken, or thrown away as garbage. At the same time, the repair cafe can be a place where local people can find education opportunities if the form of practical experience. The stakeholders note that the neighborhood needs local technical education institutes, as there is a shortage of technicians.

In the second focus group, the project group settled on the idea of a repair cafe where local people can come to repair their broken stuff together with mechanically and technically inclined staff, which can be students, interns, locals, parents and people at distance from the labour market. Coaches are needed to educate staff, and there need to be looked at a reward system.

The stakeholders think it's best to start small: a repair cafe in the school's technology and science classroom, where parents and pupils can come to repair broken stuff. The stakeholders want to make flyers to raise awareness among pupils and parents and a bicycle mechanic will be involved as well. One of the stakeholders will pitch the idea at a local education institution to see if there is room for a partnership, and the school will try to involve parents.

5.2.3. Interaction between pupil and stakeholder activities

The interaction between the two program streams consists of the following elements:

Stakeholders involved in workshops Three stakeholders were present in the workshops of the Rozemarn, one in the first workshop and two in the last workshop. In the first workshop, this was a stakeholder working for the Municipality of Amsterdam, and focusing in urban developments in the H-Buurt specifically. He did not have an active role in this workshop as it was the first one, but it did give him an impression of what the SEE Program in the

school stream is about. This stakeholder has played an important part in the program by sharing his network with us. Three other stakeholders were involved in the program upon recommendation of this stakeholder. In the last workshops, two stakeholders, both working for the same housing cooperative and more specifically, on the transformation of Amsterdam-Zuidoost, came to the Rozemarn to discuss with the pupils ideas about the transformation of this area.

Involvement of school's representative Over the course of the project, the involvement from the school's representative grew steadily. The program delivered on its promise to make a connection to the neighborhood (through the involvement of stakeholders and photovoicing), and as this aligns closely with the schools core values 'citizenship' and 'participation' her interests in the project increased. She was actively involved in the focus groups and took the responsibility for the involvement of the pupils (and their parents) in the initiatives.

Pupils' ideas Some of the ideas the pupils came up with have been picked up by the stakeholders. For example, the pupils wanted to do something with waste separation (input for initiative 1) and the pupils talked about the problem of tunnels without lightning. This last point has also been brought up again in the last workshop by the stakeholder. This has again been used as input initiative 3.

Location of the focus groups Both focus group took place at the school building of the Rozemarn.

5.3. Education at the Rozemarn

As has become clear already, the objectives of the SEE Program coincide with the ambitions of the school, as it combines elements of citizenship and participation, science and technology education (STE) and inquiry and design based learning (IDBL). To find out more about the school's ambitions with respect to the last two elements (STE and IDBL) an interview with two teachers from the Rozemarn was conducted. The teachers interviewed for this school were not involved in the SEE Program. The member of the school's management team involved in the program put these teachers forward as they are currently involved in developing a science and technology curriculum at the Rozemarn. In addition, they are assessing the opportunities for implementing IBL in the classrooms. In this interview, the interviewees discussed the progress made so far and the challenges and opportunities the school faces in this project.

5.3.1. Science and Technology Education

Learning Material One of the things that the teachers indicated to be a challenge is deciding on what learning material is most suitable for the school and its pupils. It's especially difficult to judge what material is appropriate for the learning level of pupils from different grades. It often happens that the material the school purchases is too difficult for the grades it was purchased for, or that lessons take more time than indicated. Doing pilot lessons is the most sensible thing to do, but often there is no time to do this.

Towards interdisciplinary projects Also, the interviewees noted that time is an important factor that needs to be taken into account. Time-wise it's not feasible for teachers to teach an extra subject when it does not replace or integrated with something else. For this reason, it can be difficult to make other teachers enthusiastic about STE, because they don't know where to find time in their tight teaching schedules.

The only sustainable solution therefore seems to be to aim at an interdisciplinary (Dutch translation: 'vakoverstijgend'), project-based approach in which different subjects and themes can be integrated. When learning objectives from different subjects can be combined in one lesson or project, it would become appealing to teachers to give it a try. The interviewees note that language and math related learning objectives could be easily integrated in science and technology lesson. Eventually, there has to be looked at learning progressions as well.

Lack of time and expertise The interviewees indicate that even though they are much committed to realizing these plans and ideas, they don't have the expertise and time to organize and implement them on their own. They need advice and support from external organization on how to proceed and what material to purchase, but they don't have a clear view on what organization can provide this service.

Inquiry based learning Regarding IBL the interviewees note that in kindergarten ¹ and grade 1, IBL is the standard at the Rozemarn. However, from grade 2 onward, a subject-based curriculum is used. As a result, learning becomes more teacher-led than pupil-led. Pupils lose their inquisitive attitudes and do not learn to be responsible for their own learning process.

The interviewees think that practicing IBL in higher grades can be very difficult. To allow for inquiry based learning and teaching, teachers need to become coaches rather than teachers and start asking the right questions. This can be difficult to do when it's one teacher on 30 pupils. Also, the interviewees expressed that they believe it is important to give pupils the opportunity to show their talents and excel in different forms, i.e to express what they like to do and what they are good at. These are the subjects they are going to take home and remember.

5.3.2. Integration of Sustainability in the Curriculum

The interviewees found it very valuable that the school has participated in a program on sustainability that also showed relevancy as science education project. Still, they argue that it would be better if there would be opportunities for the school to integrate it in the curriculum, and to turn it into project that can be done each year.

With regard to the group composition of the participants, the teachers noted that from a talent development perspective it is good that the school's student council was given the opportunity to participate in program. On the other hand, it can be argued that the working on such a project, and especially a chance to work on it in smaller groups with more mentors, is something that could benefit other pupils just as well.

Furthermore, if the workshops could take place in a teacher's classroom, with the teacher actively involved as coach, this would provide for an excellent opportunity of acquainting the teachers with the subject thought and the pedagogy used. This could inspire teachers too start doing it themselves as well. In the format currently used, the teachers of the school -the interviewees included-, did not get much information and insight on the project.

¹kindergarten is equal to 'groep 1 en 2' in Dutch primary schools

Case Study - Primary School De Kaleidoskoop in Kanaleneiland

6.1. De Kaleidoskoop

De Kaleidoskoop is a public primary school located in the neighborhood Kanaleneiland in Utrecht. The school has approximately 185 pupils, distributed over 8 classes. The Kaleidoskoop has many pupils from Turkish or Moroccan origin. This is a reflection of the general population in the neighborhood Kanaleneiland. It is not unusual that pupils have poor language skills on entering primary school. Consequently, the school pays much attention to supporting the development of Dutch language proficiency. The school's credo is "learn to dare...and dare to learn", which reflects the idea that it is important for pupils to develop the courage to deal with new and challenging situations. Seeing learning situations as opportunities to grow, rather than as something distressing, requires a positive mindset. The Kaleidoskoop is a so-called 'peaceful school', which refers to a school program for primary schools that focuses on social competencies and democratic citizenship (De Vreedzame School, 2019).

6.2. Program Activities in Kanaleneiland

The following section describes the program activities with pupils of De Kaleidoskoop and subsequently with the Stakeholders from Kanaleneiland.

6.2.1. Activities with pupils

The pupils that participated in the SEE Program at the Kaleidoskoop were selected from grade 3 to 6. This was done in consultation with the pupils themselves. Pupils participated in varying compositions, as attendance was not obligatory. Consequently, there were some variations in group composition from week to week. The same pupils from grade 3 to 5 attended most workshops. Approximately 16 pupils participated in at least one workshop.

Workshop 1 The workshops started with a conversation about sustainability and saving energy. It became clear that the pupils knew already quite a lot about these topics as a result of the IRIS project (a. In four groups (pupils of the same grade working together), the pupils worked on a village map of the school and the neighborhood in which they had to draw the things that were sustainable, or that could be sustainable in the future. One of these village maps is shown in Figure 6.1

Workshop 2 In this workshop, the pupils went outside for photo voicing. First they had to make photos of things that were sustainable. The results included electric cars and a charging station, solar panels, bike racks, vegetable gardens. Then, they were asked to go outside again, and make photos of things and places that could be more sustainable. The results included bicycles that generate energy; garbage bins in different colours to stimulate waste

Figure 6.1: Village Map made by pupils of De Kaleidoskoop

separation, electric ships, less gaming to reduce energy use and playing outside instead, and generating energy with the stairs.

Workshop 3 This workshop took place on Friday just before the start of the school holidays. Other activities had been planned as well that afternoon, so only 6 pupils participated (four pupils from grade 6 that had not been participating in workshop 1 and 2.) In this workshop, the pupils got the assignment to continue developing the ideas they had come up with in previous workshops in a more physical form. In this way, the ideas could be shown to the stakeholders during the focus group. One group started making a scale model of the school and the school yard. Another group went outside to record a vlog in which they discussed their ideas for a more sustainable school.

Workshop 4 In workshop 4, the pupils got to work three different assignments in rotation. At table 1, the pupils continued working on the scale model of the school that had been started with in workshop 3. The scale model included bike racks, a bike and stairs that generates electricity, garbage bins for waste separation.

For the second assignment the pupils were asked to discuss in what ways an artist would be able to help them realizing their plans for a more sustainable neighborhood and school and to visualize this. The pupils came up with the following ideas: an artist could help them decorating garbage bins and wind turbines, help them with a design for a playhouse that has solar panels, designing warm winter clothing that people could wear in stead of turning up the thermostat to maximum.

At table 3 the pupils brainstormed about how they could help their parents, other family and neighbours with using a smart thermostat. One group recorded a video in which they explained in different languages that they could help people using such a thermostat. This idea sparked from an discussion on the language to use in their video as their grandparents would not be able to understand Dutch very well. Then they realized the four of them all spoke a different second language as well. Another group made information flyers that could be distributed in apartment buildings.

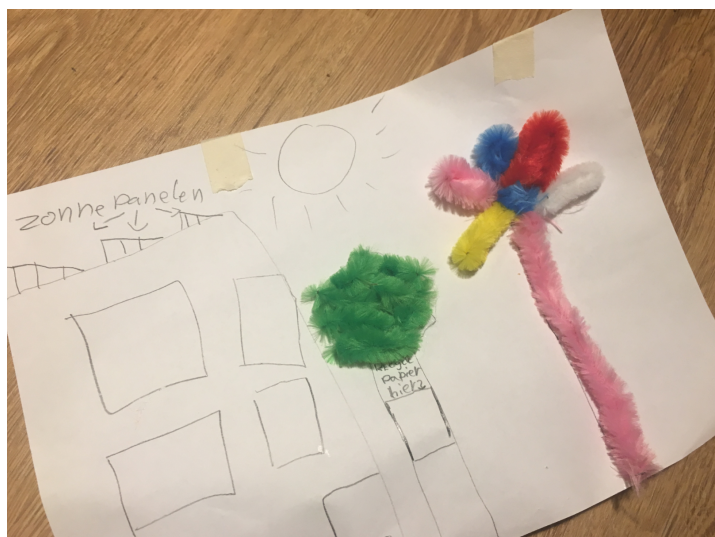


Figure 6.2: Drawing made by pupil of De Keleidoskoop

Workshop 5 In workshop 5, the pupils discussed some of the issues that had been brought up in the focus group. The first topic was environmental stewardship from an Islamic world-view, the second was inclusiveness and integration, and the third topic was a potential sustainable tour through the neighborhood. The pupils had many ideas about these topics, most of which were a result of the activities of previous workshops such as the photovoicing assignment in WS2. Thinking about the larger context, such as the opportunities that lie in a cooperation with local businesses or different communities in the neighborhood proved to be more difficult. Also, the concept of environmental stewardship was something that had to be explained first before the pupils could come up with their own ideas.

Workshop 6 The last workshop started with a wrap-up of the whole program. The pupils were asked what they had learned which they later used as input for the assignments. They worked on two assignments and filled out the survey. The first assignment was to make flyers with tips for people how to save energy and live more sustainable at home. The second assignment was to make a video on what they had learned.

Pupils' competencies

In WS4 and WS5, the pupils of the Kaleidoskoop worked on assignments inspired by input from stakeholders. It was important to deliver this in a way that the pupils could still relate to it as they were not to easiest of topics. What became apparent is that it is definitely possible to discuss more conceptual topics with the pupils, but that such discussions need to be facilitated carefully to get pupils involved. In this case, working in smaller groups with a facilitator that can get a discussion started and going by asking the right questions is prerequisite. Also, the attention span of the pupils must be taken into consideration. When pupils lose their attention and interest in a topic, there is no point in forcing them to continue.

6.2.2. Activities with stakeholders

Ideas from the pupils

During the workshops the pupils came up with different ideas for a more sustainable school and neighborhood. A selection of these ideas was presented during the focus group. The following ideas were presented: asking artist to help them design interactive garbage bins, recording a video in which the pupils can explain in different languages that they can explain to people how to use a smart thermostat and bicycles, chairs and playing equipment that could generate electricity. Also, the scale model of the 'sustainable dream school' and other artifacts the pupils made (such as drawings, photos and the village maps) were exhibited

during the focus group. The focus group had a very tight schedule, and there was not much time and interest (on the side of the stakeholders) to have good look at these artifacts.

Results from the Focus Groups

Based on the results from the case-study of Kanaleneiland and the input from the pupils of the Kaleidoskoop, in a creative session the stakeholders came with four ideas for new sustainable initiatives in Kanaleneiland. There was not enough time during the session to make these ideas more concrete. The

1. Littering problems and environmental stewardship As Kanaleneiland has a large Muslim population, it would be interesting to see how an Islamic worldview can serve as a model for sustainable development. The stakeholders think that it would be much more effective to use Islamic core values to change peoples' behavior, than framing it as sustainability, as this is something many people can not relate to. An example is that the Islam views humans as stewards of the world, which gives them the responsibility to overcome an environmental crisis. Attaining harmony between human and nature is key to this religion. Stakeholders think that involving key figures in these Islamic communities, kan have significant impact.

2. Integration and sustainability Sustainability could serve as a means to bring people with different backgrounds together. The school hopes that making sustainability a central part of education at the Kaleidoskoop, will have a positive effect on the inflow of native Dutch pupils, a group that is presently underrepresented at this school. Also, the stakeholders note that young, highly educated parents are moving to Kanaleneiland, and that these people could be reminded of the fact that they do not only have to take responsibility for the environment, but also for the community they want to live in.

In a follow-up meeting, the project group for this initiative elaborated on this idea by defining the long term goals for this project and assessing the current situation, and formulating an action plan. In 2030, the school wants to be an ethnically mixed school that is rooted in the neighborhood, with parents and pupils that are proud to be part of the school's community, and haven an open mind to things and people that are 'different'. Even though the school has a good reputation right now, it often happens that parents choose a school for their children that is close, rather than a school that is good. Some first steps than can be taken to improve the situation is to communicate the good results of the school to parents to stimulate parents to make a conscious decision about the school they choose. The good results of the schools can be communicated through the social school network, the city magazine, parents, social media and 'het wijkbureau'. First, the project group is going to think about contact persons and the format in which school results can be communicated.

Also, the school does not have a close connection to the neighborhood right now. People that live close to the school could be involved in language lessons or workshops related to sustainability. The todo's that have been formulated to set this into motion is that a vacancy will be drafted to find someone who would like to do this. A next meeting is scheduled in September 2019, at the start of the new school year.

3. 'Tour of the future', a sustainable tour through the neighborhood To increase awareness about sustainability, the stakeholders wanted to design a tour through the neighborhood showcasing sustainable initiatives in Kanaleneiland. Pupils could go on this tour with their parents, or might even be able to be the tour guides. Information should be provided at each stop so that people can learn something about what happens.

4. Involving local businesses

6.2.3. Interaction between pupil and stakeholder activities

The interaction between the two program streams consisted of the following elements:

Content alignment After WS3 it was decided to schedule an extra workshop just before the focus group. The main reason behind this decision was that more input from the pupils could benefit the creative process of stakeholders and more specifically the generation of initiatives in which the pupils would be able to participate in later workshops. The ideas that the pupils had worked on in the first three workshops were not regarded as very useful input by the project team, as they did not touch upon issues that were specific for Kanaleneiland as mentioned by stakeholders in the interviews. Therefore, in the fourth workshop, the pupils worked on three different assignments, 2 of which were inspired by ideas from the interviews (involving an artist in the workshops and the use of smart thermostats). In WS5, the pupils worked on two topics brought up in the the focus group: environmental stewardship and integration.

Focus group The focus group took place at the school building of the Kaleidoskoop. The artifacts the pupils had been working in the first four workshops were showcased in the room where the workshop was given. Also a video was shown that a group of pupils had recorded about the use of smart thermostats.

Pupils' ideas Even though extra effort was put into the generation of useful ideas from pupils during the workshops, this did not have the intended result. During the focus group, the ideas the pupils had come up with were discussed shortly, and the stakeholders did not seem to be particularly interested in these ideas. Only for initiative four, a possible role for pupils was explicitly mentioned (i.e. being tour guides for a 'sustainability tour').

During this focus group, I observed that not much emphasis was put on the presentation of ideas of pupils. Also, none of the stakeholders had been involved in the workshops and only one stakeholder had a direct connection to the school. Consequently, in the brainstorm phase, the stakeholders had no real starting points to continue with ideas of pupils.

Involvement of school's representative At de Kaleidoskoop, one staff member of the school has been closely involved in the program. This was a member of the school's MT and the one responsible for implementation of the school's vision regarding science and technology education and education for sustainability. This person was present at some of the workshops (WS5), the focus group and also at the follow-up meeting for initiative 2 'Integration and sustainability'.

6.3. Education at De Kaleidoskoop

6.3.1. Education for sustainability at De Kaleidoskoop

The Kaleidoskoop puts strong emphasis on Science and Technology Education. An important consideration for doing so, is the good employment opportunities in science and technology related fields. The school had to deal with a decreasing school population in recent years and it hopes that by emphasizing technology education in their curriculum, it will attract more pupils in the future. A similar argument is being made for sustainability education: a focus on sustainability in the curriculum could possibly attract another pupil population. In that way a focus on technology and sustainability could decrease segregation.

The IRIS Project: Kanaleneiland as lighthouse demonstration neighborhood

The Kanaleneiland area is currently taking part in the European project 'IRIS Smart Cities'. Supported financially by the European commission, the neighborhood is transformed to a lighthouse demonstration city in terms of improved urban life through sustainable solutions. In the context of the IRIS project, Stichting Technotrend and the Utrecht Sustainability Institute have been developing an educational program for schools in Kanaleneiland. The Kaleidoskoop is one of the two pilot schools at which the program was offered in 2019. Two workshops, on electricity and warmth respectively, were given to pupils from class 7 and 8.

Citizen participation and parent involvement Another central theme of the IRIS project is citizen participation and co-creation. One of the goals of the IRIS project is stimulating citizen

participation of parents through schools. The hypothesis is that pupils talk about what they do at school with their parents, and therefore can play a role in informing parents and raising awareness about the importance of topics such as energy saving behavior and sustainable renovations of apartments.

Also, a direct connection with parents was made with parents at an information meeting about the IRIS project being held at the Kaleidoskoop. During this meeting parents were informed about the activities their children had taken part in. They also participated in workshops themselves. Many parents and pupils attended the evening, and people were very enthusiastic about it. At this meeting, no clear distinction was made between the workshops that had been given as part of the IRIS project, and the SEE Program. At this meeting, pupils presented results from WS 1 and 2 of the SEE Program.

Cooperation with Stichting Technotrend As part of the IRIS project, Technotrend will continue the development and facilitation of science and technology education at the Kaleidoskoop in the coming three years (2019-2022). The school's multi-annual policy plan states that for sustainability and technology education, and IBL learning, the schools cooperates with Stichting Technotrend. As part of this cooperation, the school can also use Technotrends' learning material (i.e. 'de leskisten', autorefleskisten).

6.3.2. Science and Technology Education

IBL As part of Science and Technology education, the school has started experimenting with IBL in the school year 2017-2018. By doing pilots, they found out that for IBL, skills to work independently as well as good language proficiency -good reading comprehension skills in particular- were a prerequisite. Consequently, carrying out research independently turned out to be too big a challenge for both teachers and pupils. Therefore, the school decided to go for a world orientation curriculum which includes learning progressions for science and technology education, and which makes use of the IBL pedagogy.

Case Study - Primary School De Hogeraven in Hoograven

7.1. De Hoge Raven

De Hoge Raven is a public primary school with approximately 280 pupils, located in the neighborhood Hoograven in the city of Utrecht. According to the stakeholders interviewed, this neighborhood can be split up in two parts. Most people with average to high incomes live in one part. Here, most houses are owner-occupied. In the other part, the average income of residents is much lower there is a lot of social housing. More elderly people live there, and there is a large Moroccan community. The same trend of segregation is also being reflected in the school population. Most pupils at De Hogeraven live close to the school and it's the 'whitest' school in this neighborhood. 'Learning with and from each other' is the most important pillar of the school's vision on education. Cooperative approaches to learning therefor play a central role. Peaceful School program which De Hogeraven is part of, aims to develop civic engagement of the pupils.

7.2. Program Activities in Hoograven

In this section, a detailed description of the workshops is given first. Then, there will be elaborated on the initiatives that were developed during the focus groups.

7.2.1. Activities with pupils

At De Hogeraven 14 pupils from grade 3 to 6 participated in SEE Program. These pupils are part of the school's 'V-klas', and are the top-performing pupils of each group. The school would like to see that the pupils get acquainted with performing research and different research methods such as village mapping and photo voicing.

Workshop 1 In this introductory workshop, the goal was to introduce the project to the pupils and make a start with the cycle of inquiry and design-based learning. The first activity was to get to know each other. Everyone had to introduce themselves and tell what they do at home that is sustainable. This can be seen as a simple form appreciative inquiry. Then the group was split it up in smaller groups of 4 to 5 pupils and they got the assignment to draw a map of their school and the direct neighbourhood, as well as the things that were sustainable in their neighbourhood (i.e. village mapping). To draw the school, they used the satellite view on Google Maps. Examples of topics that the pupils discussed are: 'how sustainable is Albert Heijn', 'going to a second-hand store', 'having solar panels on your own roof, or at a community building', driving on electricity'.

Workshop 2 In the second workshop the focus was on research competencies and familiarization with different phases of doing research. In groups of 4 and 5 the pupils got the assignment to come up with a research approach consisting of a research question, the time

and resources needed to find the answer and a hypothesis. Then they got the assignment start conducting their research. For each of the three groups the results of these activities are summarized in Table 7.1

Table 7.1: Results workshop 2

Research question	Output
How can we help make the Albert Heijn more sustainable?	An appointment for an interview with the local manager of the Albert Heijn later that week
What percentage of busses in Utrecht drives on electricity?	Telephone call and an email to the public transport authority in Utrecht
Which stop at the local shopping mall is most sustainable?	Ranking of shops based on three criteria: 1) cost of plastic bags, 2) solar panels and 3) waste separation

Workshop 3 First, the groups were asked to give a short presentation about their research activities of the previous week. Then, the groups got the assignment to decide upon a topic they wanted to continue working on. They were asked to focus more on what contribution they could make themselves. At the end of the workshop they had to present their ideas to each other. This assignment resulted in the following ideas: organizing a swap meet at school, organizing a fashion show with ‘up-cycled’ clothing, making a short video clip for Albert Heijn to motivate people to buy unusual shaped fruit and vegetables (‘buitenbeentjes’) to decrease food waste.

Workshop 4 In this workshops, the pupils were asked to come up with ideas for a sustainability week that would be organized next school year. One group had a brainstorm and in which they discussed how they and other pupils of the school could make a contribution. Ideas they came up with were: organizing a swap-market and fashion show. The second group started making plans to make an artwork of plastic litter. The third discussed their plans for a social media canal on which vlogs could be posted about sustainability related topics. In this workshop, one of the stakeholders working for municipality at the community centre in Hoograven was present. She told the pupils about the community fund which only funds projects initiated by inhabitants of Hoograven.

Workshop 5 For workshop 5, one of the stakeholders was present to help the pupils with their projects. As he had a background in media, he assisted the group working on the sustainable vlogs and Youtube canal (De Duurzame Raven) with an action plan. At the start of the workshop, he showed the class a video his company had made about a 10-year old girl that was fierce about helping to clean her neighbourhood from plastic litter. Also, he explained something about the impact such a video can make when people start sharing it. The other two groups, one working on the sustainability week, and the other on the plastic litter artwork, were assisted by the education specialist and teaching assistant respectively. All groups got the assignment to think about three questions: ‘what is your plan’, ‘what do you need’ and ‘when’. At the end of the workshop, the groups presented their ideas and plans to each other. These presentations were filmed so that it would be able to show them to the school’s management team.

Next steps

In five workshops, the pupils were able to make plans that could potentially be realized. However, more time was needed to execute them. In the last workshop, pupils indicated that they would like to continue working on their projects next school year. If and in what form the pupils will be able to do that is not clear yet. The school’s principal and Stichting Technotrend need to discuss if and how this collaboration will be continued next year. To enable the pupils to continue working on these specific ideas, the school and Technotrend also needs to look at what additional resources are required to realize the pupil’s plans.

Pupils' competencies

Coaching of pupils In the workshops at this school, the pupils have been brainstorming a lot. In most cases, the starting points for the groups was a set of questions and a topic. In the first workshop, they started with village mapping, which also be seen as a form of brainstorming. The groups needed some help and coaching to get going. They found it difficult to do different things at the same time: drawing the school and neighbourhood on scale, coming up with ideas about what is sustainable and drawing this. Asking them questions about some initial ideas they came up with worked very well to stimulate them to come up with more. With some help, ideas about what is sustainable started flowing.

In the workshops that followed, assignment followed in which the students had to think about research plans and ideas about how they could help to make the neighbourhood more sustainable. A format that worked very well for these assignments, was to have one adult actively taking part in this process by asking questions. So, not coming up with ideas, but being the person that listen to what the pupils come up with, and ask questions that stimulate them to think some more about it.

Background knowledge From the start of the project, it was clear that these pupils already knew a lot about sustainability and did a lot of 'sustainable things' at home (e.g. separating waste, timing how long they take a shower, having solar panels, not eating meat and much more). In a discussion on electric driving, one of the pupils noted that you have to be aware of the fact that you need to drive an electric car for at least 2- years before it becomes profitable, which gives some indication of their knowledge levels. Also, one of the pupils noted that they had been doing an assignment on their carbon footprints in their own class with one of the teacher-trainees at their school. Pupils indicated that they often watch 'het Jeugdjournaal' at school, and that there are often sustainability related topics in this newscast.

Research competencies With respect to research competencies, it was very clear that these pupils could handle a lot. With some guidance, the pupils were able to come up with different ideas and work together smoothly and relatively independently. For example, in the second workshop, pupils managed to organize an appointment with the manager of the local super market, which they interviewed with their group without further supervision of an adult. The teacher of the V-klas noted that she thought that with these pupils, the bar could be set a higher; that these workshops should really challenge them in in the assignments they do.

The teacher attending the V-klas noted that that this class does not reflect the school's population as these are the top-performing pupils of each class. Most pupils have highly-educated parents, which might explain why they knew so much about sustainability already, their interest in this topic, and their well-developed research skills.

7.2.2. Activities with stakeholders

Two focus groups have been organized with the stakeholders from Hoograven. In this section, the different ideas that have been discussed and the initiatives that have crystalized around these ideas are described.

Ideas from the pupils

The following ideas from pupils were presented to the stakeholders during the first focus group:

1. Organizing a swap market emphasizing the importance of reusing goods;
2. Informing people about the possibility of up-cycling clothing;
3. Organizing a fashion show with up-cycled clothing;
4. Making you-tube videos about such activities;
5. Making an artwork of litter and displaying this in the neighborhood to raise awareness;
6. Collaborating with the local supermarket to inform people about unusual shaped fruit and vegetables (buitenbeentjes), for example by making a video that can be shared via social media;

Results from the Focus Groups

1. 'Ontspullen' or 'Stuffocation' The stakeholders recognize that in general, people have too much 'stuff'. Pupils should be stimulated to think about what possessions they value highly and what not. This can be linked to ideas from pupils such as organizing a swap market and up-cycling clothing. These ideas were chosen as starting point in the second focus groups. Stakeholders said that pupils first need to learn more about these topics. Someone should be involved that can give workshops on these themes. Stakeholders suggest collaborating with the repair café. Also, elderly people could be involved with time and skills in tailoring cloths.

2. Media Project In the first focus group, stakeholders discussed the effectiveness of visual language for communication purposes. This idea could also improve social cohesion in this school and neighborhood, as videos are accessible to all parents. In the second focus groups this idea was developed further. Pupils should get workshops on media related topics such challenges and opportunities of using social media, the power and use of visual language and practical skills related to making movies. Then, the pupils are going to produce content about sustainability related topics themselves. This content will then be distributed via different content distribution channels.

In the second focus groups, it was discussed what additional resources are required to realize this project. On the one hand teaching staff and people that can guide the pupils in this project are needed such as. parents with a relevant background or students/interns from e.g. the HKU University of the Arts Utrecht. Educational institutions may also be able to make available material needed to produce content. There should also be looked at acquiring additional funding. One of the stakeholders voiced the ambition to develop this as an educational project that can be offered to other schools as well.

3. Reaching parents through homework assignments During the first focus group the stakeholders talked about the possibility of involving parents by giving pupils homework assignments that they can do together, such as inspecting the fuse box and recording meter readings. The results could be discussed in class as well as measures to decrease energy use at home. In this way, activities at home and education at school can increase awareness about energy and water use and saving of parents and pupils alike. In the second focus group the stakeholders continued brainstorming about this theme. They came up with all kind of interesting ideas such as using heat cameras, testing different energy saving methods, involving elderly people from the neighborhood and so on. They realized that it was not very clear yet what the role of the pupils and the school should be exactly, but they saw great potential in the fact that pupils can be powerful in stimulating cohesion.

stakeholder population

Parent involvement For the focus groups at de Hogeraven, parents were invited to join the focus group as well. This resulted in two parents, that participated as stakeholders in the rest of the program. One of these stakeholders played an active role in the generation of new initiatives, and also opted for helping the pupils with their media project.

7.2.3. Interaction between pupil and stakeholder activities

The interaction between the two program streams consisted of the following elements:

Content alignment From the third workshop onwards, focus was put on the sustainable aspect of re-using goods. This topic had been brought up by several stakeholders in the interviews. The second-hand shop called 'De ARM' in Hoograven was well known amongst pupils and stakeholders alike, so this provided a good starting point that the pupils could relate to.

Involvement of teacher The teacher attending the V-klas was present at all program activities. In the workshops she has been actively involved in guiding pupils with different assignments

and she took part in the focus group as ‘stakeholder’. During the focus group, this person was able to give further explanation on the ideas from pupils that were presented during the focus groups. The focus group facilitators observed that this person had a positive impact on focus group session. Other stakeholders became enthusiastic about the ideas of the pupils, and the creative session became more focused on these ideas.

stakeholder involvement in the workshops Two stakeholders volunteered to come to the workshop to help the pupils with their project. In WS5, this stakeholder was someone with a background in media and movie-making. In previous workshops, the pupils had already shown great interest in things that had to do with media, so they were enthusiastic about working together with someone who knew a lot about the topic.

7.3. Education at De Hoge Raven

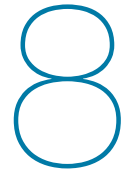
7.3.1. Science and Technology Education

De Hoge Raven make use of the Davinci curriculum (DaVinci academie, 2019) which provides thematic education for Science and History education. Thematic education means that subjects such as geography, biology, history and physics are not taught separately, but are integrated in thematic projects. According to one of the interviewees, the DaVinci curriculum provides a good basis for science and technology education and is also well suited for inquiry-based learning. However, most teachers at Hoge Raven do not have the competencies yet to realize the full potential of the curriculum. Consequently, no structural focus is being put on IBL. That is to say, pupils do not practice with doing research following a structured research cycle on a regular base. According to the interviewee, a starting point is to give students more responsibility regarding their own learning. Teachers should become the facilitators of the pupils learning process. This requires coaching skills that teachers should be thought themselves first to be able to bring into practice. She notes that competencies of the teachers are determining to a great extent the success of inquiry-based education.

7.3.2. Integration of sustainability

The principal of de Hoge Raven voiced the ambition to make sustainability part of education at Hoge Raven. This is partly driven by parents urging the school to include sustainability in the curriculum. On occasion, attention is paid to sustainability related topics at de Hoge Raven. When solar panels were installed at the roof of the school, a presentation was given to students. Also, a project is running (school year 2018-2019) about waste separation, in which pupils are informed as well as actively stimulated to take action.

De Hogeraven is currently searching for ways to integrate sustainability in its curriculum. However, the school indicates that it has many different roles and tasks to fulfill already. Trade-offs must be made what to prioritize. Both interviewees working at this school pointed out that the collaboration with Technotrend is valuable in this light. They bring knowledge and expertise and increase awareness about sustainability related issues. The initial plan for the Energy embassy project at De Hogeraven was to link the workshops to the DaVinci Curriculum. This would provide a starting point for making the energy embassy project a recurring and integrated project at the Hogeraven. However, no workable starting point for such an integration was immediately found as the curriculum Da Vinci has a focus on history. Integrating sustainability in a history project seemed to be a bit far-fetched. Consequently, there does not seem to be a straightforward way the school can realize this integration on the short term.



Case Study - Primary School De Gagel in Overvecht

OBO Overvecht is a public primary school in the neighborhood Overvecht in the city of Utrecht. The school has four locations, one of which is De Gagel. The pupils attending this school are a reflection of the multi-cultural population living in this neighborhood. As many pupils come from families that don't speak Dutch as their mother tongue, the school has a strong focus on language. This focus is enshrined in the school's vision on education that states that the first pillar of this vision is a focus on spelling, grammar and math skills. The second pillar is to support the development of 'good citizenship' to create people that later in life can make a positive contribution to a democratic society. The latter corresponds to the vision and approach of the 'Peaceful School' as described in 7.1

8.1. Program Activities

This section describes the workshops with pupils from De Gagel first, and subsequently the activities with the stakeholders from Overvecht.

8.1.1. Activities with pupils

At de Gagel an entire grade 4 class of 16 pupils participated in the SEE Program. This class participated in five workshops. The teacher of this class used additional teaching material from Stichting Technotrend material about sustainable energy for 2 additional lessons.

Workshop description and results

Workshop 1 In the first workshop the topic of this project was introduced by asking the pupils what they believed to be sustainable. Their answers related to different sources of energy such as fossil fuels, and one of the pupils referred to a hydropower installation. Then, the group split up and went outside to 'photo voice' their neighborhood. At the end of the workshop the groups presented to each other what they had come across. The results from the photo voicing assignment included a charging station for electric cars, solar panels, an electric step, and litter left behind in the park.

Workshop 2 The main activity for this workshop was village mapping in groups of 3 to 5. Most groups found this a difficult assignment. They had problems with working together as group and performing different sub-tasks such as brainstorming and drawing the map at the same time. One of the groups solved this problem by writing their ideas on the canvas instead of visualizing them. Also time management was a problem (some pupils focused too much on neatly drawing each and every solar panel on the school's rooftop). Ideas the groups came up with included electric busses, formula 1 cars (not sustainable), hybrid cars, street lights working on solar panels, saving energy by turning off the digiboard.

Workshop 3 The pupils worked on three different assignments. One group went outside with the teacher of this class to discover what they would like to learn more about. This resulted in the following topics and questions: 1) solar panels: why they are so expensive and how they generate electricity, 2) trees: how they make oxygen, 3) plastic: why it doesn't brake down, 4) electric bicycles and cars -why they are 'good', and where the electricity for charging stations comes from. The second group got the assignment to make a vlog about how to make the neighborhood more sustainable, which could be shown to residents of Overvecht. The third assignment was to make flyers about things people can do to live more sustainable at home. An example of one such flyer is shown in Figure 8.1



Figure 8.1: Flyer made by a pupil of De Gagel

Workshop 4 The pupils went on a 'field trip' to Gasvrij Thuis, an energy efficient model home in Overvecht where people can discover what measures can be taken to make a house more energy efficient. The pupils got a tour through the building and were shown the heat pump, ventilation system, the solar panels. The pupils explored different insulation materials by looking and touching, which they were excited about as it was something new and tangible. In the garden the pupils discovered how to deal with water in the garden in a sustainable way, and talked about the carbon footprint of different kinds of food. In that context, the pupils were asked if they wanted to taste fried insects, which everyone did.

Workshop 5 As the pupils had indicated that they wanted to learn more about solar panels, the educational specialist decided to work with existing teaching material from Technotrend on solar energy. The pupils made a sunflower which starts rotating when the solar panel catches light. First the pupils could play around with a battery and a propellor. This made them very enthusiastic from the start. In this workshop, they also filled out the questionnaire.

Pupils' competencies

The workshops require skills that relate to inquiry and design basis learning. In some of the workshops, it became clear that pupils had some difficulty with doing some assignments. An example is that for these pupils, working in groups is something they find very difficult as they are not used to it. Deciding on a role division for each group beforehand can make it easier for the pupils.

Another competency that is important in the SEE workshops is creative thinking, as some of the assignments include brainstorming sessions. This is something that these pupils need help with. If the goal is creative thinking, the teachers suggested that it may be better to let them to that individually instead of in groups, as this makes the assignment much more complex. In this way, you really need an adult that can help and coach the groups in this creative process, but when you have to give a lesson on your own, this probably wouldn't work.

8.1.2. Activities with stakeholders

For Overvecht, twelve stakeholders were interviewed and two focus groups were organized. Eight stakeholders participated in the first focus group, only 2 stakeholders participated in the second one. This section gives a short summary of stakeholders' perception of Overvecht, followed by description of the results from the focus groups. This information was deducted from the interview results and the focus group reports.

Overvecht according to stakeholders

The stakeholders describe Overvecht as a neighborhood with many different faces. The neighborhood has a large immigrant population. It's one of the poorer neighborhoods in Utrecht and many people live in social housing. The image that is being portrayed is that for large parts of the community, sustainability or the energy transition is not a priority. Taking part in the energy transition is perceived as something that can cost a household a lot of money. On the other hand, it became clear from the interviews that there many people that are very committed to make the neighborhood more sustainable. Still, it's not something being borne by the whole community. Stakeholders think that there is not much social cohesion in Overvecht. Also, when focus group are being organized with residents of the neighborhood, the participants do often not reflect the actual population.

Results from the Focus Groups

In the first focus group, much time was spend a discussion on the approach taken in the SEE Program. One of the stakeholders noted that she would like the connection between the school and the stakeholders to be more demand-driven. Some stakeholders believed it would be more fruitful to take the pupils' and school's aspirations and ideas as a starting point for action (as apposed to that of the stakeholders). Other stakeholders argued that for schools and teachers it might be better if there are ready-to-use activities the pupils can participate in. When it is crystal clear what organization can offer, it's easier to make schools enthusiastic and to get people on board. Also, for teachers it's important that preparation time for a lesson is low.

In the discussion that followed it became clear that the stakeholders had high ambitions when it came to new initiatives for this neighborhood. They were not necessarily interested in short-term solutions and initiatives, but rather in initiatives that could have long-term impact on the neighborhood. Later, some stakeholders informed the project team that they were somewhat disappointed that the project had not yet resulted in concrete ideas and plans. When a second focus group was organized to talk further about the ambition of stakeholders and to think about concrete initiatives, they did not come, from which it can be concluded that they did not want to take responsibility for further action themselves.

In the second focus group, two stakeholders and two members of the project team participated. They talked about setting up an initiative to bring people from the neighborhood to the classroom to give lectures on sustainability related topics. The ultimate situation would be that there would be guest speakers on a regular basis at different schools in Overvecht,

for the years to come. Interestingly, when it was discussed who should be involved in further development and implementation of such an initiative, the stakeholders were surprised to find out that it was expected of them to actively stay involved. The stakeholders noted that up till then, they believed to be participating in the Program as local experts and advisors. They thought that Technotrend would use the input resulting from the interviews and the focus groups to realize the plans. Consequently, it seems that there are no stakeholders in Overvecht right now, that want to be actively involved in initiatives.

Stakeholder Population

One of the stakeholders noted that as everyone present at the focus group was highly educated and native Dutch, this didn't reflect the actual population of Overvecht. This stakeholder acknowledges that it's not an easy thing to include people with a migrant background in such projects, especially because there are different smaller and very close communities that have to be addressed individually. One of the biggest challenges for such projects is to get people involved when they are not intrinsically interested. Now, only a very small part of the population of Overvecht is being involved. We have to rethink how to make people enthusiastic about topics related to sustainability.

8.1.3. Interaction between pupil and stakeholder activities

With respect to the interaction between the two project streams, the following remarks can be made:

Content alignment Output from the stakeholder stream of the program that served as input for the the workshops consisted of two elements. Firstly, in the first focus group it was mentioned that it should be assessed what pupils would like to learn more about in the context of sustainability. One of the assignments the pupils worked on in WS3 was to go outside and discuss what they wanted to know more about. Secondly, a field-trip to Gasvrij thuis, an energy efficient model house (WS4), was being organized in collaboration with one of the stakeholders.

School's representative One person working at the Gagel was involved in the SEE Program. This person is the teacher of the class participating in the workshops. He was present at the first focus group, but informed the project team that as a full-time teacher he did not have the time to participate as a stakeholder in the process of developing new sustainable initiatives for the neighborhood.

One other stakeholder has close connections to the school as this stakeholder works for 'De Brede School Overvecht', a network of organizations aiming to improve the life prospects for children in this neighborhood of which the Gagel makes part. Via this stakeholder, the SEE Program was first introduced at the school.

Focus group location The first focus group took place in the school building of De Gagel.

8.2. Education at de Gagel

Participation of this school in the SEE Program was a result of the personal interest of one of the teachers of this school in the program. The program was brought to the attention of teachers by someone from OBO Overvecht (De Gagel is one of the locations of this school). This teacher wanted to participate with his class, because he had a personal interest in sustainability, and he still had time in his annual teaching plan still allowed for it. This teacher has been actively involved in all workshops, and also in the first focus group. A interview with this teachers was conducted to gain insights in the school's vision on education and his experience with the SEE Program. The insights gained from this interview are discussed below.

8.2.1. Education for sustainability at De Gagel

The teacher interviewed for this school noted that not much attention is being paid to sustainability related topics at De Gagel in a regular manner. It does happen that the school -that is to say, someone from the school management team (SMT)- is approached by organizations to join in sustainability related projects. Teachers are then asked if they want to participate with their class. It depends primarily on teachers' personal interests and time schedule (and also time investment on the teachers' side) whether or not they choose to participate in such projects. According to the interviewee, teachers at de Hoge Raven are not particularly motivated to pay more attention to sustainability in their classrooms. He believes this is rather due to a lack of time than due to lack of interest. Full-time teachers don't have the time to prepare lessons and collect the materials needed. To make sustainability more important at de Gagel, the interviewee believed that it is important to have someone -preferably not a full-time teacher- that will lead the way, that can put the topic on the agenda, and can make other people enthusiastic as well.

The teacher that opted for participation in the SEE Program indicated that he has a personal interest in sustainability. He has been teaching his pupils about organic and biologic food, so to make them aware of the differences and of the fact that people can make personal decisions on what they buy and eat. A challenge in this respect is that the pupils have not learnt any of these things at home. Consequently, the teacher felt that the awareness of the pupils at this school on issues related to the environment and climate change is very low. Small steps should be taken with these pupils to get them on board.

8.2.2. Science education and Inquiry based learning (IBL)

De Gagel has a specialized science and technology teacher that gives lessons and workshops in each class. This teacher uses IBL approaches in her lessons, but this approach to learning is not used on a regular basis by other teachers. The school wants to focus more on IBL. They want to make a contribution to the development of pupils' inquisitive attitude towards things they don't know and understand yet, and the skills to inquire these things independently. Therefore a project group consisting of teachers and school staff is currently looking for a world orientation curriculum, that also covers science education and makes use of IBL.

The teacher of this class noted that it's important to keep in mind that the pupils that have now participated in the SEE Program do not yet master some of the basic skills required for IBL. When doing pilot lessons for a new world orientation curriculum, teachers experienced that especially in higher grades, some lessons were too difficult for the pupils. This is due to the fact that a curriculum assumes that pupils have been working with that curriculum from grade 1 onward. When this is the case, it can be expected that pupils meet the required standards for IBL set for each grade, but at de Gagel, they don't.

8.2.3. Integration of Sustainability in the Curriculum

As the school is not very far yet with integrating IBL, science education and themes related to sustainability, the new curriculum is expected to be a good starting point. It provides projects related to energy and sustainability for all grades and integrates IBL approaches. The interviewee believes that when sustainability becomes part of world orientation, and pupils start working on sustainability related projects from the first grade onward, this can make a real difference. He thinks that it is unrealistic to expect that sustainability becomes a subject taught at schools on a weekly basis. Spreading a sustainable message is important, but not a first priority for this school. What they value highly is their role as connecting factor in this neighborhood. With all kinds of activities the school tries to build a strong community of school staff, pupils, parents and local organizations.

Comparative analysis of the Case Studies

Having performed a case study for each of the schools, the most interesting part of this thesis research was to perform a cross-analysis on the four cases. This analysis corresponds to the third phase of this thesis as described in item 4.1. The aim of this analysis was to assess how the SEE Program at the four schools compared to each other in terms of execution of the program, effects, the experience of participants, and the factors that have influenced this. The analysis was split up into three parts. In section 9.1 the activities with pupils (i.e. the workshops) are analysed. In section 9.2 the activities with stakeholders are discussed. The last part, described in section 9.3, consists of a comparative analysis of the school's view on education for sustainability and the role the SEE Program plays. An overview table with factors of influence per school is presented in the last section.

9.1. Program activities with pupils

A comparative analysis of the design and implementation of the workshops sheds light on the intentions of the SEE Program, the extent to which these intentions have been realized and the experience of the pupils on particular elements of the program. First, the workshop activities were analyzed and compared in the light of the 4D-cycle of appreciative inquiry. This analysis is discussed first, followed by the insights this analysis revealed.

9.1.1. 4D-Cycle of Appreciative Inquiry

As discussed in the description of the SEE Program (chapter 2), the basis for the SEE workshops was the 4D-cycle of Appreciative Inquiry which in part coincides with the research cycle of inquiry based learning. The four phases of this cycle are: 1) discover, 2) dream, 3) design and 4) deliver. The first step of this analysis was to compare the workshop in the light of this 4D-cycle.

Dreaming and Discovering

For the 'dream' and 'discover' phase, several research methods that are frequently used in participatory action research were used as basis for the workshops. The primary methods were 'village mapping' and 'photo voicing'. Also, introductory group discussions were facilitated in the first workshops. In these discussions, pupils explained what they already knew about sustainability and what they did themselves that was sustainable. This can be regarded as a simple form of the 'appreciative inquiry' exercise which is done in the focus groups with stakeholders as well. It's important to realize that employing photo voicing and village mapping for 'discovering' or 'dreaming' is a different exercise. In case of 'discovery', it's about exploring what 'is'. In the 'dream phase', pupils are expected to think about 'what could be'.

Village Mapping At De Rozemarn the pupils worked on the ‘discovery phase’ of village mapping in WS1. In the first part of the workshop, the pupils were asked to draw the school’s neighborhood. Then, they had to indicate what they knew to be sustainable. In the second workshop, they continued working on their village maps, but now the focus was on ‘dreaming’. They were asked to think about what the neighborhood could look like in their dreams. In this workshop, the pupils managed to come up with different creative, out-of-the-box ideas. The pupils enjoyed this exercise and seemed very enthusiastic about their own ideas. At the other three schools, the pupils did both the ‘discovery’ and ‘dream’ part of the village mapping assignment in the same workshop. No clear emphasis was put on either of the two phases.

In each of these cases, the pupils did not seem to be particularly enthusiastic about the village mapping assignment. Many of the groups and pupils had difficulty in understanding what exactly they had to do, and how to approach it. They needed help to get going and, in several cases, the pupils got stuck in drawing the school and neighborhood very precisely. Some of the aspects of the assignments the pupils struggled with were: group work, drawing (on scale); time management, and ‘dreaming’. Consequently, the results from the village mapping assignment were in many cases not from particularly high quality. The majority of the village maps was rather ‘empty’, and not so much new information could be extracted from the maps.

Photo Voicing At de Gagel, the pupils went outside in the first workshop for photo voicing, in which the emphasis was on ‘discovering’. They were asked to look for things they related to sustainability. At de Rozemarn and the Kaleidoskoop the pupils went outside for photo voicing in the third and second workshop respectively. For these groups, the assignment was structured clearly in a ‘discover’ and ‘dream’ part; first they had to look for things that were sustainable, then they had to indicate places that could become more sustainable, and come up with ideas on how to achieve that.

Photo voicing has been very successful at each of these schools. The pupils were very enthusiastic about going outside, but also about the assignment itself. Looking for things that were sustainable in the neighborhood was something that could easily be understood as it related to the physical environment. The assignment made the pupils curious about why some things are sustainable and other not so much. A good example was the curiosity of pupils about a fast sports car they came across. They were interested to find out more about this car; why it was sustainable or not. They also wanted to know if sustainable sports cars exist. Other examples were a lawn next to one of the schools. When pupils were asked what they would like to do with that lawn they suggested turning it into an open gym or a vegetable garden.

The ideas from these workshops have been valuable inspiration for later workshops and assignments. When asking pupils what they liked about the workshop, most of them said it was going outside. One pupil noted: it’s much easier to come up with ideas outside than in the classroom. Having analyzed the results from different workshops, it is indeed noticeable that for most pupils, it’s easier to come up with new and out-of-the-box ideas when they have some source of inspiration. The neighborhood around the school has shown to serve very well as a source of inspiration.

Brainstorm session At the Kaleidoskoop, WS5 also focused on the ‘dream’ phase. In this workshop the pupils were asked to think about topics brought up by the stakeholders. The pupils worked with a large poster and posted on it, on which they could write their ideas. Even though the topics were sometimes very abstract, the method itself worked relatively well. Pupils could write down their ideas and post them on a large poster. They didn’t have to work together for this assignment and could write down their ideas instead of drawing them. The fact that it was clear what they had to do had a positive influence on the execution of the assignment.

Designing

The design phase of the program has taken different forms at each school. The reason is that the design phase builds on the discovery and dream phases, and at each school, the progression of the workshops varied. The artifacts that resulted from the various 'design' related assignment include among other things a scale-model of a sustainable dream school, some videos and vlogs on topics related to sustainability, flyers with tips about what people can do at home to save energy and plans for sustainable initiatives.

At De Hogeraven, the pupils worked on the plans for various sustainable initiatives. WS3 still had a focus on 'dreaming'. In workshop 4, a gradual and natural transition to the design phase was made, as the pupils were asked to make their ideas more concrete. Workshop 5 fully focused on design. The pupils had to make action plan which elaborated on the steps to be taken to realize their plans. At the end of the workshop they presented their plans. Their presentations were recorded so that they could be shown to the school's management team.

The design phase for De Rozemarn entailed working with the stakeholders in the last workshop on ideas for the renovation of the tunnels and the park nearby. In this workshop it was a combination of 'dream' and 'design' as pupils came up with new ideas, or visualized and further developed ideas they already had. At De Kaleidoskoop and De Gagel, the pupils worked on several craft works for the design phase. In some assignment the elements 'dream' and 'design' were intertwined

Delivering

One of the objectives of the program is that the pupils also participate in the realization of the initiatives that come forth from the SEE Program. For the pupils, this would mark the final phase of the 4D cycle, 'deliver'. In none of the cases this has been realized. The simple reason is that when the last workshops took place at the schools, none of the initiatives that were being developed were yet in the implementation phase. When comparing the progress the pupils made in the design phase at the different schools, it can be noted that in case of De Hoograven, the pupils successfully finished the design phase and were ready to enter the 'deliver' phase with their own initiatives. The pupils noted that they would like to continue working on their plans, and realize them, in the next school year. However, this needs to be facilitated.

Workshop on doing research

Only at De Hogeraven, one of the workshop was dedicated specifically to research practices. In this workshop the pupils practiced with making a research plan and conducting it. For this workshop, some basic IBL skills are required such as working together in a group effectively and autonomously. This workshop is not a standard part of the program and the educational specialist did not try this assignment at other schools. Based on the first workshop, the educational specialist believed that the pupils of De Hogeraven would be able to cope with a higher level of autonomy. This workshop was a great success from different perspectives. The pupils clearly enjoyed doing the assignment; they were enthusiastic to work on their own research questions. Also, the workshop had high output; many ideas the pupils and stakeholders continued working on in the course of the program originated from this workshop. Lastly, one of the interviewees from this school that had attended this workshop indicated that she believed it to be very valuable that the pupils worked through a full research cycle.

9.1.2. Aligning workshop to stakeholder activities

One of the objectives of the SEE Program was to stimulate the process of co-creation of initiatives by asking pupils to give input on relevant issues. Relevant issues in this context were points of interest raised by the stakeholders in the interviews and workshop. To that end, various workshop assignment for pupils were designed that incorporated stakeholder input. At each of the schools, this has turned out differently, both in form, in it's aims and and content-wise.

De Gagel One of the outcomes of the first focus group in Overvecht was that the stakeholders wanted to know what the pupils would like to learn more about. The stakeholders wanted

to use this as starting point for new initiatives. This outcome resulted in an interesting assignment at De Gagel, in which the pupils went outside with their teacher to discuss what they found interesting.

De Kaleidoskoop At this school, in several workshops and assignments topics were introduced that had been points of discussion in the interviews or focus groups. The aim of these exercises was to generate input from pupils on specific topics that were interesting to the stakeholder (see WS4 and WS5 in Figure 6.2.1. The aim was to stimulate the process of co-creation of new initiatives. From the workshop observations it can be concluded that even though some of the assignments resulted in interesting discussion, most of the topics were too abstract for the pupils to give relevant input. Also, it should be noted that in the case of De Kaleidoskoop, it was not at the request of the stakeholders that input from pupils was collected for the development of initiatives.

De Hogeraven At this school, it was noticed that the input from stakeholders resonated with the ideas the pupils had come up with themselves (see subsection 7.2.3, first paragraph). What was observed in this case, was that this resonance of ideas positively influenced the process of co-creation; both the pupils and the stakeholders became more enthusiastic about the ideas and more committed to realize them. An important stimulus during this process has been the teacher of this school that formed the link between the pupil activities and stakeholder activities. Having been present in the workshops, she was able to translate and transmit the ideas of the pupils in way that appealed to the imagination of the stakeholders as well.

De Rozemarn Together with two stakeholders, the pupils of this school worked on a brainstorming and visualization assignment in the last workshop (subsection 5.2.1, WS4). The assignment was inspired by ideas initially brought up by the pupils, and taken up in the focus groups by stakeholders (concerning topics of area development). This was positively experienced by both the stakeholders and the pupils, as it concerned topics that they were interested in both.

Factors of influence

Contribution of pupils in co-creation processes One of program objectives of the SEE Program and workshops, is that pupils come up with ideas for a more sustainable neighborhood themselves. The comparison of the four cases shows that especially at Hoge Raven, this has been very successful. In this case, the pupils did come up with new and authentic ideas and these ideas were used by the stakeholders in the focus group. Some factors that have influenced the results are the level of the pupils in terms of IDBL related competencies and background knowledge on sustainability. Comparing the implementation and context of the schools revealed another pupil related factor that contributed to the positive results at De Hogeraven.

Assertive behavior The workshop observations of De Hogeraven showed that the pupils participating in the workshop were very assertive. For example, when the pupils had to make a research plan and conduct it (WS2), the pupils choose data collection methods for which they had to approach adults for information. They did not have any problems with approaching these people.

Sources of Inspiration The interview the pupils arranged with the manager of the Albert Heijn as a result of this assignment, provided much input and inspiration in later workshops. In this interview, the topic of food waste was brought up, as well as the idea of making a video which could be shared on social media to raise awareness. Comparing what sources of inspiration pupils had in each of the cases, it can be seen that in the other cases it was the photo voicing assignment that served as inspiration and input for later workshops.

Interest for plastic littering and waste separation Both the pupils and the stakeholders of different schools have shown great interest in waste related issues. At three schools, many of the ideas that pupils came up with for a more sustainable neighborhood related to this topics. For example, the pupils from the Kaleidoskoop and De Rozemarn proposed talking garbage bins and the pupils of De Hogeraven wanted to organize a cleanup and use the collected waste to make an artwork. This shared interest can be identified as factor that positively influenced the process of co-creation as both the stakeholders and the pupils were enthusiastic about it. One reason for this enthusiasm may be that it is a tangible problems with tangible solutions. Both stakeholders and pupils seemed to believe that they could make a meaningful contribution to this problem.

9.2. Program activities with Stakeholders

In this section, the activities with stakeholders are compared across the four schools. First, the processes of co-creation are assessed in terms of process and output, and then the factors of influence as found in the case studies are compared.

9.2.1. The initiatives

Each of the initiatives that were created in the focus groups were discussed in the case studies. An overview of the initiatives per school is presented in Table 9.1. These processes of co-creation, and the resulting initiatives are compared to each other in this section.

Table 9.1: Overview initiatives that resulted from the co-creation processes per school

De Rozemarn	De Kaleidoskoop	De Hogeraven	De Gagel
organizing a sustainability tour	integration through sustainability	media project on sustainability	Organizing a fieldtrip to Gasvrij thuis
repair cafe to promote re-use and raise awareness about circularity	involving local businesses in sustainable initiatives	reaching parents through school project	Organizing guest lectures at schools in Overvecht on a regular basis
Solving littering problems (designing cool garbage bins)	solving littering problems through environmental stewardship	school project on stuffocation to raise awareness about consumerism and re-cycling	
designing tunnels with pupils	organizing a sustainability tour	organizing activities during sustainability weeks	
gastronomic tour to raise awareness about gas-free living	school project in collaboration with energy box (as part of the IRIS project)	school project on plastic littering	

Comparing the processes of co-creation

In three cases, the stakeholders generated many new ideas in the focus group. Only in the focus group of Overvecht, there was not much converged on long-term goals to more tangible objects (one exception is the field trip to GasvrijThuis, which the pupils visited in workshop 4). In the other focus groups, this was the case, and at the end of the session, the stakeholders decided which three of four ideas they wanted to develop further. The result of the first focus groups was a total of twelve ideas that would be further developed. For each initiative, smaller project groups were created. For three schools, a follow up focus group was organized in which ideas were further developed -in the case of Overvecht only two stakeholder were present. In Kanaleneiland, the activities paused for some weeks after the first focus group. No report of the focus group was send to the stakeholders, and no new meetings were planned by ART. There was no follow-up focus group, but some of the project groups did come together again after some weeks to further develop ideas.

In the period between the first focus group and the moment of evaluation (end of the second program cycle, July 2019), some of the initial ideas have been developed further, new ideas were generated, and some of the initial plans were omitted. At this moment in the program, it is still difficult to say what initiatives are going to be realized as most ideas are still under development. In the case of eight initiatives, the plans for realization were concretized, and stakeholders showed interest to stay engaged. In the case of six other ideas that were generated in the focus group, the stakeholders did take further initiative.

Education related initiatives In the focus groups, Stichting Technotrend did not participate as stakeholder but as facilitator of the SEE Program. Consequently, no ideas were generated in which Stichting Technotrend as provider of education would play a role. In later stages, Stichting Technotrend also became actively involved as stakeholder in some of the projects groups, which resulted in new synergies and ideas. The result is that at each of the schools new plans were generated for Sustainability Education programs for next school year.

Themes of the initiatives

One of the starting points for the activities with stakeholders in this the SEE Program is that the themes are worked are relevant for the stakeholders and also specific to the neighborhood. Comparing the different themes that were brought up in the interviews and focus groups revealed several insights that are discussed below. These insights concern both specific topics, but also the objectives of the new initiatives.

Littering Issues related to littering have been a point of interest at each school, both with stakeholders and with pupils. One school decided on doing a large plastic litter project at the school next school year in collaboration with Stichting Technotrend. At the other two schools, stakeholders are working on initiatives related to littering. At one school, there is a concrete idea of decorating garbage bin with pupils in cooperation with an art collective (same as the initiative at De Achtsprong from round 1), the other initiative relates to environmental stewardship from an Islamic perspective. At this moment, the stakeholders do not seem to be particularly interested to take on this initiative.

Energy transition Taking a closer look at the initiatives that have come forth, it is interesting to note that only one of these initiatives -that is, the gastronomic tour in the H-Buurt to raise awareness about cooking on induction, is directly related to the energy transition.

Raising Awareness Most initiatives have as main objective to inform people and raise awareness about a certain topic. The target group is inhabitants of that neighborhood, and the pupils are often the ones that need to play a connecting role in these initiatives: the pupils are expected to go on the sustainable or gastronomic tours together with their parents; they are going to bring their parents to the repair cafe at school; the videos and vlogs they will make are going to be shared with a greater audience via social media, and so on.

Role of pupils in initiatives Interestingly, only at De Hogeraven, the initiatives that emerged in the course of the program, envisaged a central and also an executive role for the pupils in the realization of initiatives. For example, in the Media Project (item 7.2.2, initiative 2), the idea is that pupils are going to create digital content and manage and share this content as well. In most initiatives at the other schools, the pupils are involved indirectly. For example, in the gastronomic tour, pupils are expected to participate with their parents, but they will not necessarily be playing a role in the realization of this initiative. In other cases (e.g. the idea to stimulate integration at De Kaleidoskoop through a focus on sustainability), it's not directly clear what role pupils should and can play in the development or realization of the initiatives.

What we can conclude from these results, is that the role that pupils play in the co-creation process can vary. The key contribution of pupils in this round of the SEE Program has been the input of ideas for the co-creation process. It is clear that an executive role in the realization of initiatives was in most cases not feasible. The SEE Program team needs to reflect on this finding and discuss what role they want pupils to play. If they want to involve pupils more in the realization of initiatives, the activities with pupils and stakeholders need to be re-designed.

9.2.2. Stakeholders

Stakeholder involvement in numbers

It is interesting to take a closer look at the number of stakeholders that have participated in each of the program activities to get a feeling for the engagement of stakeholders over the course of the program. Table 9.2 gives an overview of these numbers per program activity. Stakeholders that were still active in the co-creation process of one or more initiatives are those involved in 'follow-up' activities.

Table 9.2: Number of stakeholders involved per program activity

	Rozemarn (N=14)	Kaleidoskoop (N=10)	Hogeraven (N=9)	Gagel (N=14)	Total (N=47)
Interviews	8	9	8	11	36
Focus group 1	7	7	7	8	29
Focus group 2	5	n/a	5	2	12
Follow-up	6	4	4	1	15

Out of the 47 stakeholders that participated in the program, 15 of them were still actively involved after the focus groups, which corresponds to a third of the stakeholders approximately. In Overvecht, only one out of fourteen stakeholders stayed involved. In this case, six of the interviewed stakeholders did not come to the first focus group. Only two stakeholders participated in the second focus group. At the other schools, almost half of the stakeholders was still involved in one or more initiatives after the focus groups.

Interesting to highlight is that a significant part of the stakeholder participated in the interview, but did not take part in any subsequent phases of the program. This is not immediately clear from this table as there was an inflow of new stakeholders after the interview round. Four out of fifteen stakeholders involved in follow-up activities got involved at a later stage.

Professional Background of stakeholders

Analyzing the professional background of stakeholders yielded interesting insights into their ambitions regarding the program and the contribution they made to it. An important conclusion that can be drawn from this analysis is that the involvement of stakeholders is influenced by their professional interest in the program; those with professional interest in the program are more likely to participate in the realization of initiatives than stakeholders driven by personal interest. At each of the schools, a similar pattern was observed.

This observation was most visible in case of De Rozemarn (subsection 5.2.2. Compared to the other stakeholder groups, many stakeholders of De Rozemarn showed professional interest in the program. Six of the stakeholders worked for the municipality of Amsterdam, either specifically for the H-Buurt or on area development and transformation projects in the H-Buurt. Some other stakeholders that were involved in area development projects in the H-Buurt wanted to participate in the program on their own initiative. Stakeholders indicated that they had been working on the idea of involving schools and pupils in their projects or that they could see that it had great potential. Also, as there were many obvious work related

links between stakeholders, the network aspect of the program was valuable to them as well. What can be concluded is that for the stakeholder of De Rozemarn, the program objectives coincided with some of their professional ambitions. This seemed to have a positive effect on the attitude of stakeholder during the focus groups, which on its turn positively influenced the process of co-creation.

In the other cases (all schools in Utrecht), the professional background of the stakeholder population was more diverse. For example, in Hogeraven there was one only stakeholder involved that worked for the municipality of Utrecht. Interestingly, in the course of the program, this stakeholder withdrew from further activities as it was imposed from above by the municipality that she could only participate outside working hours. Another stakeholder of this school noted that even though his initial motivation to participate in the focus group was a personal one, he only wanted to invest time in the development and realization of the initiatives if there would be something in it for him professionally as well.

With respect to the stakeholder population, De Gagel is also an interesting case. Stakeholders had diverse backgrounds: one stakeholder worked for the municipality of Utrecht, five inhabitants of the neighborhood - four of which did not represent any other organization-, two stakeholders connected to the school, and 6 stakeholders that represented different organizations active in this neighborhood. In this case, the backgrounds of stakeholder might have had a negative effect on the focus group, as for many of them it might not have been very clear how they could benefit from participation. In the first focus group, no concrete ideas for initiatives were formulated. One of the reasons that can be indicated why stakeholder dropped out after this focus group is that they could not see what further participation could bring them.

When looking at the professional interest of stakeholders in the program or certain initiatives, it's also interesting to note that in some cases, this interest was obtained or grew in the course of the program. For example, in the case of De Kaleidoskoop, some of the stakeholders had a reserved -and some an almost sceptical- attitude towards the program, but they became more engaged when they realized that certain initiatives and collaboration with other stakeholders could be interesting for them as well. These cases can be identified as textbook examples of participatory action research.

Involvement of school staff

Having assessed the contribution of school staff in the SEE Program, it can be concluded that their involvement determines to a great extent what activities can take place on the school and with the pupils. Especially for the creation of initiatives in which the school and pupils play a role, it's important to involve stakeholder with a connection to the school and its pupils in the focus groups.

De Rozemarn In case of the Rozemarn, it was uncertain whether or not someone from the school's management team would be involved up until the first focus groups. After participation in the first focus group, this stakeholder became actively involved. Eventually, this stakeholder has played an important role in shaping the initiatives of the H-Buurt as she was the one that could give input on what contribution her school and pupils could make to the initiatives.

De Hogeraven In case of De Hogeraven, it was discussed before that the teacher that had been involved in the workshops and the focusgroups formed an important bridge between the two project streams. However, a difference with respect to Rozemarn is that as a teacher, this stakeholder was not in a position to make any promises on her own or pupils' involvement in initiatives. For this school, there was also someone from the management team involved as stakeholder. During the first focus group she declared that the school would organize a 'sustainability week' after the summer break. This was a big stimulating factor in the focus group and the workshop. However, these plans were revised and this influenced the initiatives of De Hoograven, as most of them were connected to these sustainability weeks. In this case, the realization of the initiatives depends to a large extent on the schools' determination to realize them.

De Gagel At Gagel, one teacher was directly involved in the program. He was very interested in the program but he indicated that he was not in position to say anything about the involvement of other pupils in initiatives. One other stakeholder with close links to De Gagel was involved in the focus groups. This person is a member of the management team of the community of schools in Overvecht De Gagel is part of. This person has shown an intrinsic motivation for sustainability, and he is the only stakeholder that was still involved in any activities after the second focus group. This stakeholder has been responsible for participation of this school in the SEE Program.

De Kaleidoskoop At the Kaleidoskoop, it can be noticed that most of the topics that were discussed in the focus group, could not immediately be connected to the school and pupils. After the focus group, the school's representative indicated that some of the ideas she had been interested in and that did directly involve schools and pupils, were not taken up by the other stakeholders.

Inhabitants of the neighborhood In three of the four cases, stakeholders observed that the people participating in the program did not reflect the multi-ethnicity which their neighborhoods characterize. The majority of participants was 'native Dutch' and 'highly educated'. One of the causes may be that when relevant stakeholders are identified, inhabitants that are not involved in any sustainability or community related initiative already, are easily overlooked. In one of the focus group it was discussed that it is really difficult to engage people that have no intrinsic motivation for sustainability.

9.2.3. Ownership over initiatives

When comparing the four schools, it can be seen that making stakeholders responsible for the process and initiatives is not always easy. Overvecht can serve as an example of a case in which the majority of the stakeholders have not taken ownership over the process and initiatives. Even though the stakeholders had ambitions plans for their neighborhood and the school as well, it became clear during the process that most of them wanted to participate in the program in an advising role only. They did not want to be involved in subsequent phases. In Overvecht, there is only one stakeholder that has taken ownership over some of the plans discussed. In the other cases, the same thing has happened, though on a smaller scale. In some cases, this is being counteracted by the fact that new people are being involved as well.

Expectation management Expectation management is one factor that could have influenced the involvement of stakeholders, and to what extent they took ownership over the initiatives. Some stakeholders indicated that they had not realized that they were expected to keep involved in project groups for a longer period of time. Some thought they would only be involved in an interview, or in a focus group in an advising role. Having assessed the engagement stakeholders throughout the process, it can be concluded that a significant part did not have the ambition to become part of a network of stakeholders committed to the realization of new initiatives.

Professional interest of stakeholder Another factor, that has already been discussed is the background of stakeholder and their professional interests. When stakeholders see professional value in the initiatives, which has been the case for stakeholders of De Rozemarn and also De Kaleidoskoop, they are more likely to invest time in an initiative, or even take ownership over the initiatives.

Stakeholder identification One important process factor that relates to both identified factors above, is the identification of stakeholder. It can be observed that this first phase of the program in which relevant stakeholders are identified and approached for participation, is crucial. In this phase it's not only determined 'who' is being involved, but also under what 'conditions'. It can be seen that many stakeholders do not continue in the program after the

first interview, which means that from an initiative development perspective, they have been a 'waste' of resources.

Role of Stichting Technotrend as stakeholder An interesting observation I made in later phases of the program, is that Stichting Technotrend became actively involved as stakeholder in some of the initiatives. In other words, Stichting Technotrend took ownership of initiatives (together with other stakeholders). In each of the cases, this involvement gave new momentum to these co-creation processes. Interestingly, the initiatives they engaged with were often different from the ones created in the focus groups. In all cases, they were created at a later stage. Therefore, these plans were not included in this evaluation in a structured manner. Still, it is an interesting finding that when Stichting Technotrend takes the role from participant in stead of facilitator, this has a positive effect on program outcomes.

9.2.4. Overview of factors of influence per school

It is clear that the co-creation of initiatives is the central focus of the SEE Program. The comparative analysis presented in this chapter revealed what factors have influenced these co-creation processes at each of the schools. The results are summarized in table Table 9.3

Table 9.3: Overview of driving and impeding factors of co-creation processes per school

De Rozemarn	De Kaleidoskoop	De Hogeraven	De Gagel
Collaboration between stakeholders and pupils (+)	Ideas of pupils and stakeholders did no match (-)	Input from stakeholders resonated with the ideas of pupils (+)	Stakeholders interested in long-term, high impact initiatives (-)
School's principal actively involved in focus group and initiatives (+)	School's vice principal highly motivated about sustainability (+)	Teacher formed link between pupils and stakeholders (+)	management staff not involved in the program (-)
Stakeholders from the municipality involved (+)	Involvement of STT as stakeholder (+)	Involvement of STT as stakeholder (+)	Involvement of STT as stakeholder (+)
Stakeholders with professional interest in the program (+)	Multi-ethnicity of neighborhood not reflected in focus group (-)	multi-ethnicity of neighborhood not reflected in focus group (-)	multi-ethnicity of neighborhood not reflected in focus group (-)
Stakeholders involved from previous program cycle (+)	No second focus group (-)	Pressure put on school by parents to pay attention to sustainability (+)	Expectations of stakeholders: advising role (-)
Activities around city transformation project in Amsterdam-Zuidoost (+)	Activities and funding for sustainability in Kanaleneiland for IRIS Project (+)	Ambition of school to pay attention to sustainability (+)	

9.3. Schools and Education

One of the more fundamental questions that is at the basis of the SEE Program, is what role sustainability should play in primary education today and in the future, and what the challenges and opportunities are for schools to take this issue forward. Though this analysis does not attempt to provide conclusive answer to this question, a comparative analysis of the school's vision on education and education for sustainability in particular does provide valuable insights. For this section, the interviews with teachers and school management in combination with observations on the school's involvement in the focus groups and initiatives form the basis of the cross-analysis performed. The different topics that have been discussed in the interviews and that followed from the analysis are discussed below.

9.3.1. Schools' ambition on Education for Sustainability

Schools with a sustainable ambition At two of the four schools, the school's management team voiced the ambition to include sustainability in the curriculum. At De Kaleidoskoop, this ambition stems from an intersection of the school's vision on education and the opportunities that arose from participation in the IRIS project. The school indicated that it wanted to focus on science and technology education because of the good job prospects for pupils in

this sector. Also, the school hopes that with a focus on sustainability it will become more attractive for native ‘white’ Dutch parents that highly value sustainability.

At De Hogeraven, the second school that voiced a sustainable ambition, the reversed situation occurred. This school has a population of predominantly ‘white’ pupils, and the school indicated that under pressure from parents, it wanted to pay more attention to sustainability.

Schools without a sustainable ambition At the other two schools, there does not seem to be a clear ambition or willingness to pay more attention to sustainability. These school indicated that they had other priorities. Pupils from De Gagel do participate in sustainable project sometimes, but the interviewee noted that these projects are always initiated and facilitated by external organizations. In case of participation in the SEE Program, the interviewee noted that this resulted from a personal interest in sustainability of the teacher that participated in the program with his class. De Rozemarn did not have a particular interest in sustainability either. In the case of the Rozemarn, it was the element of participatory citizenship which appealed most to the school’s principal.

Integration of sustainability in the curriculum As described above, two schools voiced the ambition to include sustainability in the curriculum. To that end, these schools wanted to look at the possibilities of integrating (elements) of the SEE program in the school’s curriculum. At De Hogeraven, there was looked at linking the workshop to the DaVinci curriculum for world orientation, as this curriculum is used for Science and Technology education as well. However, the school did not immediately find a workable starting point given the curriculum’s focus on history.

The Kaleidoskoop started using a new curriculum for world orientation this school year (2018-2019). As this curriculum covers science and technology education as well, the initial plan was to link the SEE workshops to this curriculum and to ‘kick-start’ science and technology at the Kaleidoskoop. In the end, this link to the curriculum Blink has not been realized. A reasonable explanation is that as the SEE Program is in fact, a one-time thing, it did not really make to include it the school’s learning progression for S&T education and look for an integration with Blink.

At the other two schools, the SEE Program was never intended to become part of the school’s curriculum. De Rozemarn is currently working on the development of ST education, and the teachers interviewed for this school indicated that they would have liked to know more about the SEE program and see what they could learn from it. Next school year, the educational specialist of Technotrend is going to talk with these teachers about how Technotrend could help the school with developing S&T Education.

9.3.2. Science and Technology Education and Inquiry based learning

Though Science and Technology education and inquiry-based learning are two distinct things, they are often mentioned in the same breath. Schools often use Science and Technology education to refer to subjects or content. Inquiry based learning on the other hand is a pedagogy, which appears to be very suitable for teaching science and technology related subjects.

Importance of curriculums Based on the interviews it can be concluded that for STE and IBL, the schools rely heavily on curriculums. In Dutch primary education, STE is part of ‘world orientation’. The Kaleidoskoop started using a new curriculum for world orientation this school year (2018-2019). At De Gagel, they also want to purchase a curriculum for world orientation and they are now in the orientation phase and doing pilot lessons. At De Hoge Raven, they already have a curriculum that covers science and Technology education, the curriculum DaVinci. At De Rozemarn, they are also working on the development of STE and IBL. One of the challenges for this school is that they do not necessarily want to start using a new curriculum for Science and Technology education, but that it is also difficult and time consuming to decide what learning and teaching material to purchase and for what grade level it is appropriate. Also, it’s difficult to guarantee consistency over different grade levels when you can’t rely on pre-described learning progressions that come with a curriculum.

Competencies An important reason for the schools to rely on curriculums is being reflected in the difficulty of developing one's own educational program as encountered by De Rozemarn. These curriculums for world orientation and science education include learning progressions for IBL related competencies. One of the challenges regarding IBL that several interviewees mentioned is that when pupils haven't been practicing with IBL from a young age, teachers need to start at the very beginning or it will be too difficult for pupils. Using learning progressions provides a solution to this problem, though not on the short-term. At De Hoge Raven, they already have a curriculum that covers science and Technology education, the curriculum DaVinci. This curriculum is well suited for inquiry-based learning. However, one of the interviewees from this school noted that IBL is not practiced regularly as the teachers do not have the required competencies. For IBL, teachers need to become the facilitators of the pupils' learning for which they need coaching skills.

What can be noticed is that schools do have the ambition to make use of IBL. The schools want to inspire curiosity and develop inquisitive attitudes and skills to perform research independently. However, in each of the cases, a challenge is that both the pupils and teachers do not have the competencies and experience to realize this. Some of the schools hope that a new curriculum (for world orientation) provides a solution. However, from De Hogeraven we can learn that having a good curriculum is not enough. It's the teachers that determine to a great extent the implementation of inquiry-based learning practices in the classroom. Several interviewees mentioned that teachers need to learn new coaching skills to be able to facilitate pupil's learning.

9.3.3. Value of the SEE Program for schools

Having analyzed the different aspects of the schools vision on education, and discussing this with interviewees in the light of the SEE Program, conclusions can be drawn regarding the value there is for schools in participation in the SEE Program. Also, suggestions can be made on how to increase this value.

Supporting the schools' ambitions Two schools have shown an internal drive to make sustainability part of education. For one of these schools, this is a result of the internalization of the demand of parents to do so. At these schools, the SEE Program supports the school in realizing this ambition. At two schools, the sustainability related activities in which the school participates are externally driven. For one of these schools, the value of the SEE Program lies in its focus on active citizenship.

What became clear from the interviews is that the schools has many different tasks to fulfill, and always trade-offs must be made on what is being prioritized at any given moment. From the interviews it became clear that for the schools it was valuable that this program supported the school in their responsibility to pay attention to sustainability related topics. Though the priority this receives varied, each school indicated that it was valuable that the program brought knowledge and expertise about sustainability. Different interviewees mentioned that they believed it to be very valuable for the pupils to become more aware about different sustainability related topics.

Value for Science and Technology Education and inquiry-based learning As has become clear from this analysis, at each of the schools the development of the Science and Technology curriculum and integration of inquiry based learning methods is a point of discussion. The schools are struggling to give shape to either one or both (i.e. STE and IBL). Subsequently, the schools noted, there is immediate value in the SEE Program; it provides the pupils with a chance to participate in a science and technology project and practice with inquiry based learning and all of this without increasing the work load for teachers and school management.

The side note that must be made here, is that in this regard the SEE Program does not provide for a long-term solution. At two schools, it was assessed whether an integration of the program with the Science and Technology curriculum was possible, but no workable starting point was found. At a third school, the interviewees noted that the SEE Program could have been more valuable if there had been looked for possibilities to integrate parts of the program in the curriculum or run the program each year.

However, when looking at the design and implementation of the SEE Program, it can be concluded that in its current form, the program may not be very suitable for curriculum integration. One of the reasons is that there is specifically chosen for an approach in which the program activities are not predefined. Though this might be beneficial for the program outcomes, it makes it almost impossible to use as starting point for integration -and thus repetition. Also, it can be noted that most initiatives that resulted from the SEE Program are not suitable to be linked to the school's curriculum's. As this has never been an explicit aim of the program, it does not come as a surprise.

Involving teachers A suggestion for the program that followed from this analysis is that it would be interesting to look for a closer cooperation with teachers in the workshops. In this round, only at one school, there was worked with a complete class. The teacher of this class was present during the workshops and actively involved in guiding the pupils with different assignments. Several interviewees noted that it can be valuable to involve teachers and to do the workshops in their classrooms. For the teachers this can be an opportunity to gain experience with this kind of teaching. As most teachers are both unfamiliar and inexperienced with teaching about sustainability, and using IBL approaches, the SEE Program could be a great source of inspiration.

Results of the Statistical Analysis

This chapter is concerned with presenting the quantitative results that can be derived from the surveys that were filled out by a set of pupils in each participating schools. First, the characteristics of the respondents are presented in section 10.1. Subsequently, section 10.2 elaborates on choices that were made concerning the statistical analysis. These choices are important to keep in mind when interpreting the results from the analysis. In section 10.3 the results of the analysis are presented.

10.1. About the response group

Leaving out the Rozemarn A total of 83 children participated in the survey research. For the Rozemarn, only 5 children took part in the survey, and all of them were in the test group. Because of the low number of respondents for the Rozemarn, and because it was impossible to compare the test- and control group for this school, the responses from the Rozemarn were left out of the analysis.

Respondents that were included in the survey-research 78 respondents were included for analyzing the survey-research. The representation of pupils per school withing the response group is shown in Table 10.1. This table also shows the representation of pupils in the test and control group and the grades the pupils are in. The pupils that participated in the SEE Program were assigned to the *test group*.

Table 10.1: Characteristics of the response group

	Frequency (N=78)	Relative (%)
<i>School</i>		
Hogeraven	23	29,5
Kaleidoskoop	26	33,3
De Gagel	29	37,2
<i>Test or control</i>		
Test group	37	27,4
Control group	41	52,6
<i>Grades</i>		
Grade 3	14	17,9
Grade 4	43	55,1
Grade 5	15	19,2
Grade 6	6	7,7

More details on the response group, including information on the distribution of ages and classes in the response group, can be found in appendix C. For this analysis, the effects of age or class on the answers to the survey were not examined.

10.2. Methodological choices

Several choices were made concerning the analysis in SPSS. These are discussed in this section. First, a significance level (α) of 5% was adopted. Secondly, it was chosen to do two-tailed testing as we do not presume a certain relationship between the answers to the questionnaire and the characteristics of the response group. For instance, we do not expect that children from the test group will give a higher rating to a question when compared to the control group (as they may perhaps give a lower rating).

This survey measures the environmental literacy and action competence of pupils on the dimensions behavior, knowledge and attitude. The survey items and constructs as discussed below are the *dependent variables* of this analysis. It is assumed that the answers given on a Likert-scale, were of the so-called interval level. The *independent variables* chosen for this analysis are 1) whether the pupils are part of the test or the control group and 2) the school that the respondents were from.

Survey constructs

Several questions in the questionnaire relate to each other, i.e. they measure similar things. These questions were appointed to several topics: *objective knowledge*, *subjective knowledge*, *attitude* and *behaviour*. This subdivision of survey items is shown in figure 10.1. As can be seen in figure 10.1, there are *constructs* and there are questions related to a topic.

Survey part 1 and 3 For the constructs of *objective knowledge* and *behaviour*, the construct had the value of the sum of the answers in the question. For part 1, the answers of these questions were either correct or incorrect. For part 3, the answers were either 'yes' (relating to sustainable behaviour) or 'no' (relating to unsustainable behaviour).

Survey part 2: Likert-scale questions The items in part 2 were measured on a 4-point Likert-scale. To check whether it was responsible to use a sums core for these questions, reliability analyses were conducted. By developing such sum scores per constructs, the chance is smaller that random or systematic measuring errors give an incorrect overview of the results. A prerequisite for constituting such sum scores is that the questions have high internal validity, meaning that the questions correlate. The results of this analysis are summarized in table 10.2. For the construct *attitude* the questions (Q1, Q2, Q3, Q5, Q6, Q10) proved to be have high internal validity. For the *behaviour related questions* (Q8 and Q11) and *subjective knowledge questions* (Q7 and Q8), these questions did not have high internal validity. Therefore, for those topics the answers to the questions were examined individually.

Table 10.2: Reliability analysis for part 2 survey items

	N of items	Cronbach's Alhpa
Attitude	6	0,862
Subjective knowledge	2	0,456
Behavior	2	0,609

Program specific questions

The last 5 questions of part 2 of the survey (denoted by *Only related to the SEE Program* in figure 10.1) refer to program activities and could therefore only be answered by pupils of the test group. For these questions the response frequencies have been assessed, as well as the mean scores compared across the schools. These questions were included to get insight in experience of pupils with the workshops.



Figure 10.1: How the questions were divided over different constructs and topics

Methodological considerations

Several considerations should be kept in mind while interpreting the results of the quantitative analysis. The independent sample t-test was used frequently throughout this research. One of the assumptions when conducting this test is that one assumes the sample to be drawn independently and to accurately reflect the population. For the SEE Program, the pupils that were selected to participate, were not solely randomly picked. For instance, for De Gagel all pupils were in sixth grade, while this was not the case for the other schools. In case of De Hogeraven there is also a selection bias in the test group compared to the control group. At De Hogeraven, the pupils that participated in the program are the best-performing pupils of their grade.

Low sample size An important note here is that the sample sizes used in this analysis are relatively low. This is especially the case for samples sizes of the independent t-test for test and control groups within schools where we have N varying between 10 and 17. However, it should be noted that the total population from which we draw our samples is small as well (as we are working with schools with no more than one or two classes per grade). Therefore, we assume that the smaller sample size is still acceptable. Undeniably, the confidence in our findings would improve if larger sample sizes could be used, but this was not a possibility given the limited number of pupils that participate in the program per school. Also, the results discussed in the next section provide confidence in the validity of our results as similar response patterns between test and control groups are observed across different schools.

10.3. Results

This section presents the results of the quantitative analysis of the survey filled out by the pupils of participating schools. Different statistical tests were performed to analyze the data. The complete analysis of results can be found in Appendix C. In this section, first, the results of the comparison of test and control groups of each school are presented in subsection 10.3.1. Then the test-groups of schools are compared to each other in subsection 10.3.2. In the last subsection 10.3.3, an analysis of program specific questions -answered by the test-groups only- is presented.

10.3.1. Comparison of test and control groups

The responses given by the control group and the test group were compared by means of an independent samples t-test. Below the results of these t-tests for the different components of the knowledge, attitude and behavior dimensions are shown. Comparison of the control and response group was performed for all respondents and for each of the schools separately.

Knowledge components

A summary of results of the independent t-tests performed for the knowledge components of the survey is shown in table Table 10.3.

Objective Knowledge An important finding we can take from Table 10.3 is that for two schools, the pupils that participated in the SEE Program score significantly higher on objective knowledge than their peers in the control group. This is the case for Hogeraven and De Rozemarn. In the case of De Hogeraven, we observed that the pupils from the control group scored relatively high. Overall, this difference is significant as well with a p-value of 0,000. This is an important result as it confirms our hypothesis that participation in the SEE Program improves the knowledge of pupils on sustainability.

Also, an analysis of individual items from which the 'objective knowledge component' is built up was performed, the results of which are shown in Table C.27, Table C.28 and Table C.29 in Appendix C. When looking at the mean scores per question it can be noted that the test-group scored highest on Q1 (mean score of 3.84 out of 4) and lowest on Q3 (2.35 out of 4). The same pattern was observed for the control group, though in this case the scores were closer to each other.

Table 10.3: Results T-test on knowledge components

	Hogeraven		Kaleidoskoop		Gagel		Total	
	N	Mean	N	Mean	N	Mean	N	Mean
Objective knowledge								
Control group	11	8,0	13	7,85	17	6,59	41	7,37
Test group	12	9,42	13	9,46	12	9,42	36	9,43
	t	p	t	p	t	p	t	p
t-test	-1,613	0,122	-2,300	0,034	-3,432	0,002	-4,465	0,000
Knowledge Q4								
Control group	11	3,09	13	2,62	17	2,29	41	2,61
Test group	11	3,45	13	2,62	12	2,67	36	2,89
	t	p	t	p	t	p	t	p
t-test	-0,964	0,346	0,00	1,00	-,7772	0,447	1,031	0,306
Knowledge Q9								
Control group	11	2,91	13	3,38	17	2,29	41	2,80
Test group	12	3,17	13	3,00	12	3,36	36	3,17
	t	p	t	p	t	p	t	p
t-test	-0,637	0,534	0,959	0,357	-2,226	0,035	1,437	0,155

Subjective Knowledge When assessing results of the independent t-test for subjective knowledge items, we can see that on Q4 and Q9 no significant difference is observed for the responses from the total test and control group. Only for De Gagel, the difference between test and control group for Q9 is significant with a p-value of 0,035.

Attitude

A summary of results of the independent t-tests performed for the attitude construct is shown in table Table 10.4. Notable is that in none of the cases a significant difference was found between the test and the control group in their attitude towards sustainability as measured by this questionnaire. It should be highlighted that the pupils that participated in the SEE Program at De Kaleidoskoop, scored on average lower on this construct than the pupils from the control group. With a p-value of 0,098 this difference not significant but still relatively close to it.

This finding can be interpreted with the help of observations being made in the last workshop (when pupils filled out the questionnaire). Most pupils present were not enthusiastic about being present in the workshop. They indicated to rather be in their own classes. A reason can be that this workshop took place in one of the last weeks before the summer break. Another suggestion I make is that these pupils had lost their interest in the workshops given that they took part in a total of six workshops. These workshops did not form a coherent whole, meaning that pupils did not work on a certain project in consecutive weeks. In this last workshop, they had to participate in two small brainstorm assignment that did not have a concrete outcome. Either way, the pupils were bored in this last workshop, which might be reflected in this survey.

Overall, we observed that 80% of the pupils have a positive attitude towards sustainability

- ¹. The respective frequencies from very positive to very negative are 58%, 23%, 11% and 9%.

Table 10.4: Results T-test on attitude components

	Hogeraven		Kaleidoskoop		Gagel		Total	
	N	Mean	N	Mean	N	Mean	N	Mean
Attitude construct								
Control group	10	19,90	13	20,77	16	18,94	39	19,79
Test group	12	22,00	111	17,09	12	19,25	35	19,51
	t	p	t	p	t	p	t	p
t-test	1,373816	0,185	1,729	0,098	-0,191	0,850	0,265	0,792

Behavior components

The results of the independent t-tests of the behavior components of the questionnaire are summarized in table Table 10.5.

Table 10.5: Results T-test on behavior components

	Hogeraven		Kaleidoskoop		Gagel		Total	
	N	Mean	N	Mean	N	Mean	N	Mean
Behavior construct								
Control group	11	3,64	13	3,00	17	1,82	41	2,68
Test group	12	4,83	13	2,92	12	3,08	37	3,59
	t	p	t	p	t	p	t	p
t-test	-2,964	0,012	-2,300	0,034	0,143	0,887	-2,826	0,006
Behavior Q7								
Control group	11	3,90	13	3,0	17	2,53	41	2,83
Test group	12	3,50	13	2,69	12	2,33	36	2,84
	t	p	t	p	t	p	t	p
t-test	-1,427	0,168	0,652	0,521	0,413	0,6837	-0,033	0,974
Behavior Q8								
Control group	11	2,09	13	2,85	17	1,35	41	2,02
Test group	12	2,92	13	2,00	12	1,92	36	2,27
	t	p	t	p	t	p	t	p
t-test	-2,147	0,044	2,008	0,056	-1,400	0,173	-0,944	0,348

¹when pupils slight or very much agree with positive statements related to their attitudes towards sustainability, this is counted as 'positive'; pupils that slightly or not at all agreed with positive statements on attitude questions were counted as 'negative'

Behavior items measured on a likert-scale The results of the t-test for question 7 show that there is no significant difference between the responses of test and control group on the question if they do things that are sustainable at home (Q7).

For Q8, which asked pupils if they talk about sustainability with their parents, we found that at De Hogeraven the pupils that participated in the SEE Program respond significantly more positive on this statement than the pupils from the control group. At the other two schools, the same pattern is observed. In the case of De Kaleidoskoop the p-value of the t-test is close to the significance level. At de Gagel, the difference between test and control group is not significant.

It is interesting to highlight that pupils score relatively low on these questions, and Q8 in particular, compared to the other likert-type questions for knowledge and attitude. Still, in two cases, the test group scores significantly higher than the control group. What these results suggest is that overall, pupils do not talk about sustainability with their parents much, but that the SEE Program has the potential to get the conversation between parents and children on sustainability going.

Behavior items measured on a true-false scale For the last part of the survey, pupils were asked about their sustainable behavior at home. The results of the t-test for these questions are found under the header 'behavior construct'. The results of the t-test show that at De Hogeraven and De Gagel, the pupils from the test-group score significantly higher than the pupils in the control group on this part.

10.3.2. Comparison of results across the schools

In this section I present the results of the one-way analysis of variance (ANOVA), which was used to investigate the differences in responses of pupils among the three schools. It should be recalled that the conditions under which the program was implemented at each school varied greatly. Also, the workshop activities were different at each school. Comparing the responses of the pupils across schools, can give insight in what contextual and intervention factors influenced the level and development of environmental literacy and action competence of pupils. The analysis discussed in this section concerns a comparison of pupils that participated in the SEE Program (test-groups). In the Appendix C, the ANOVA analysis including responses of all pupils, are presented as well. As before, the results are discussed for the three dimensions separately.

Knowledge Comparing the mean scores of the test groups on the absolute knowledge component as shown in Table 10.3, we see that these mean scores are very close to each other. This is interesting as the programs per school have been implemented in a different way. Based on the results of previously discussed t-test, we found that participation in the SEE Program improves pupils knowledge on sustainable energy sources and action possibilities. The results from the ANOVA suggest that the development of this knowledge in pupils is not dependent of specific program activities, pupil and school factors. Also, on the subjective knowledge items Q4 and Q9 from part 2, no significant differences between test-groups across the schools were found.

Attitude The results from the ANOVA for the attitude construct of pupils from the test-groups show that the pupils from De Kaleidoskoop scored significantly lower on attitude items than the pupils from the other two schools ($p = 0.045$). Interestingly, this test group was the only group that scored lower on this construct than their peers in the control group as well (see discussion of the independent t-test on attitude). The same explanation as provided before (regarding the lower score of the test-group pupils of the Kaleidoskoop compared to the control group) can be used for the interpretation of this finding. That is to say, the pupils did not seem motivated and enthusiastic about the workshop when they filled out the survey, which may be reflected in their attitude scores.

Behavior components Table 10.6 shows summarizes the results of the ANOVA analysis for the test-groups of the three schools. From the results it clear that the sustainable behavior as measured by the survey varies across the test-groups of the three schools. For first two components (behavior construct and Q7), the p-values smaller than 0,05 show that these are significant differences. For the third component (Q8) this difference was close to significant.

Table 10.6: Comparison of pupils' sustainable behaviour across schools (ANOVA)

	Post Hoc Bonferri					
	Behavior construct		Behavior Q7		Behavior Q8	
	Kaleidoskoop	De Gagel	Kaleidoskoop	De Gagel	Kaleidoskoop	De Gagel
Hogeraven	0,002	0,004	0,179	0,028	0,140	0,102
Kaleidoskoop		1,000		1,000		0,232
F = 8,396 ; p = 0,001		F = 4,008 ; p = 0,027		F = 3,033 ; p = 0,061		

It is interesting to notice that on each component, the pupils from the Hogeraven score higher than pupils of the other two schools. No significant differences were found between the behavior of pupils from De Kaleidoskoop and De Gagel that participated in the SEE Program. In interesting question that follows from these findings, is what causes this difference. More specifically, we would like to know if this difference is a results of intervention factors or the contextual factors. This question is treated in this discussion section of this thesis.

10.3.3. Project specific questions

The questionnaire included 5 questions that could only be answered by pupils that had participated in the SEE workshops. The pupils had to give scores on statements that related directly to the program. In Table 10.7, statistics of the program specific questions Q11 to Q15 of the second part of the questionnaire.

Table 10.7: Statistics of program specific questions

		Mean	Mode	% negative responses	% positive responses
Q11	knowledge of action possibilities	3,0	4	26%	74%
Q12	Attitude (self-efficacy)	2,72	4	41,7%	58,3%
Q13	Attitude (self-efficacy)	2,92	3/4	27,8%	72,2%
Q14	Behavior (communication)	2,49	1	48,6%	51,4%
Q15	Behavior (action)	2,43	3	45,9%	54,1%

Statistics What we can take away from these statistics is that pupils score lowest on the behavior related questions. These results suggest that the effect of the workshops on pupils perceived knowledge of action possibilities and self-efficacy larger than the effect on pupils self-reported sustainable behaviors and communication about sustainability. For Q14 and Q15, we found that approximately half of the pupils responded positively and half the pupils negatively. The mode of Q14 is 1, which means that most pupils that participated in the SEE Program did not talk about this with their parents.

ANOVA Having compared the scores of the schools against each other with an ANOVA analysis it is notable that for each question except for Q12, the pupils of De Hogeraven show on average higher scores than the pupils of De Kaleidoskoop and De Gagel. For Q12, De Kaleidoskoop and De Hogeraven have the same mean score of 3,08 and De Gagel a much lower score of 2,0. The differences between the schools were found to be significant for Q12 and Q13 and are a result of the significantly lower scores of De Gagel compared to the scores of De Hogeraven and De Kaleidoskoop.

Discussion of Results

Having assessed the SEE Program at each of the four schools individually, and in comparison to each other, the results of these analyses are discussed in this chapter. The discussion is structured as follows: in the first part of the discussion (section 11.1), for each program objective it is discussed what effects (program outcomes) this evaluation has identified. Also, there is elaborated on the factors that have affected the program outcomes. In the second part of this chapter (section 11.2) it is discussed what lessons can be learned from this evaluation in terms of design and implementation of the program interventions. In the last section, the results of this thesis are put context of the existing literature as discussed in chapter 3.

11.1. Effects and factors of influence

The analysis of effects focused on the process of co-creation of new initiatives, the value for schools, and the environmental literacy of pupils. Also, it was investigated what factors have affected the measured effects. These factors include intervention factors as well as contextual factors.

11.1.1. Co-creation of initiatives

One of the objectives of the SEE Program is to facilitate processes of co-creation between stakeholders, the school and pupils which would result in initiatives that would accelerate the local energy transition. To that end, activities with stakeholders in the schools' neighborhoods were organized, and workshops were facilitated at the schools. Many new ideas for a more sustainable neighborhood were being created in the course of the SEE Program. About twelve rough ideas for sustainable initiatives resulted from the first round of focus group. At the moment of evaluation (end of the second program cycle, July 2019), around eight initiatives were still under development.

The implication of this finding is that it was not yet possible to present conclusive evidence for the effects of the program on the creation of new initiatives. Arguably, the results discussed below can be seen as monitoring effort rather than as program evaluation. On the other hand, the program initially aimed at the creation and realization of (some of the) initiatives before this evaluation moment. This subsection discusses the results of the qualitative analysis of these processes of co-creation at the four schools, which (among other things) cast a light on this issue.

Overview of initiatives

Even though the program initially aimed at the creation of new initiatives that would accelerate the energy transition, it was observed that most participants (i.e. stakeholder, pupils and school staff) did not show a specific interest for the energy transition: participants were interested in sustainability in general and also in the element of citizen participation that were present in this program. This is being reflected in the initiatives that resulted from the program. Only one initiative was directly related to the energy transition (i.e. the gastronomic

tour to raise awareness about induction cooking). The stakeholders and pupils had many ideas that related to waste separation and littering.

Another finding regarding the themes of interest, was that most initiatives aim to increase public awareness. Stakeholders noticed that children can play a key role in initiatives as they can stimulate their parents to take part in initiatives (this argument was brought to the table for several initiatives such as the repair cafe, the gastronomic tour and the sustainable tour).

Realization of Initiatives

As mentioned above, only one initiative was realized at the moment of evaluation. This was field trip to Gasvrij Thuis that was organized for the pupils of De Gagel in cooperation with one of the stakeholders. For eight initiatives, stakeholders were still involved, though showing different levels of engagement. It cannot be said with certainty whether or not the stakeholders have taken ownership over the initiatives. If this is not the case, the action research team must intervene to ensure further development and realization of the plans -either by increasing the level of engagement of stakeholders, or by taking ownership over the initiatives themselves. Based on insights gained from the first cycle of the SEE Program, it can be expected that when such an intervention does not take place, the realization of initiatives is unlikely.

The engagement of stakeholder proves to be a determining factor for the success of the SEE Program as it is prerequisite for the processes of co-creation that the SEE Program aims to facilitate. The case studies and cross-analysis revealed insights in contextual and intervention related factors that influenced stakeholder engagement in case of the SEE Program. These are discussed below.

Value proposition The results show that stakeholders can be reluctant to become or stay engaged when they can not see what value there is in participation. From the results it is clear, that almost half of the stakeholders are still active in one or more project groups. It is interesting to highlight that some stakeholders argued that a research programs such as the SEE Program should incentivize people to take part; in one way or another, stakeholders want to see their time investments returned. This is especially important when you want to involve people that have no professional interest in the program, such as inhabitants of the neighborhoods.

Expectation management To be able to engage people in the process and make them participate actively, it's important to be clear about what the program has to offer to people, and what is expected from them in terms of the contribution to the program. In general it can be noted that a significant part of the stakeholders never had any ambition to become part of a network of stakeholders committed to the realization of new initiatives. In other cases, stakeholders did not realize they were expected to keep involved in project groups for a longer period of time.

This is important as the take approach now comes with the risk of spending time and resources on people that quickly withdraw from the program. Almost half of the stakeholders only participated in the interview round of the program. From a research perspective, this may not necessarily be a problem, but with respect to the co-creation processes, the time of arranging, conducting and processing interviews may not be so well spent. For the co-creation process, it is participation in the focus group rather than in the interview that is key to stakeholder engagement.

Stakeholder Population From the results of the analysis it is clear that the stakeholder population had great impact on the involvement and attitude of the stakeholders. One of our research findings is that stakeholders with a professional interest in the program -stakeholders

for which program objectives coincide with professional objectives- are more likely to make a positive contribution to the creation and realization of initiatives than stakeholders driven by personal interest. One of the reasons we identified is that for these people participation is part of their jobs.

Incentivizing stakeholder to participate In the light of the discussion on incentivization of program participation, this seems to be a reasonable finding. As the SEE Program does not provide any reimbursement for stakeholders to participate in the program, it's mostly stakeholders that can participate in the program as part of their daily jobs that keep motivated and engaged throughout the program.

Prior Research on co-creation for sustainability The engagement of stakeholders and a lack of clear ownership of solutions are often heard roadblocks to effective processes of co-creation. The results discussed above are in line with the findings of the Social Innovation Community Europe (SIC Europe), that experimented with co-creation methods and design thinking for social innovation purposes. They found that creating ownership over problems and solutions during co-creation processes can be very challenging and that crucial to stakeholder engagement is accurate management of the expectations and time SIC Europe (2019). With the latter, they mean that it's important to respect that it takes time to engage stakeholders and take them on the co-creation journey.

Role of pupils

A strong variation was observed between the four cases in the role that pupils played, and consequently the impact they made on the co-creation of initiatives. The input of pupils was received with varying degrees of interest by stakeholders. The following factors were identified that influenced to what extent the input of pupils was used.

Focus groups The focus group is where the ideas of pupils are presented to the stakeholders. When the interests and ideas of the stakeholders and the pupils matched, this was observed to have a positive effect on the creative process in the focus group, and it was more likely that stakeholders would use the ideas of pupils as starting point. Another observation suggests that when a stakeholder can enthusiastically explain what ideas the pupils had (based on first hand observations), the ideas are received more positively than when they are presented as second-hand accounts.

Input from Pupils It is in the workshops that pupils are challenged to come up with their own ideas for a more sustainable neighborhood. From the analysis of the workshops observations, it can be concluded that creating ideas for a more sustainable neighborhood may not be as straightforward as it sounds. The following factors were identified that can impede or stimulate the creative process of pupils:

- **Complex assignments:** Some of the assignments (e.g. village mapping) consisted of many different elements. This caused confusion among pupils on what they had to do and how they should approach that. This would sometimes even be a source of frustration.
- **Working together:** Some of the assignments assumed a certain level of cooperation skills. For some pupils, working together was difficult. In such cases, working together had a negative influence on the creative process.
- **Inspiration** Just as adults, children need some inspiration to stimulate their creativity. In the SEE Workshops, the photo voicing assignment was very valuable in this respect. At one of the schools, the pupils arranged an interview with the manager of the local super market, which served as a source of inspiration throughout the project.

Workshop Design The analysis of the workshops also showed that in the SEE Workshops, the pupils did not go through the full design or inquiry cycles that form the basis of design and inquiry based learning as described by van Graft and Kemmers (2007). Rather, the workshops use elements of these cycles as basis for the 4D cycle of appreciative inquiry. Even though on a conceptual level, the cycle of design and inquiry based learning, and the 4D cycle of AI show great similarity, the first provides more specific tools to guide pupils through a design or inquiry process. The 4D cycle on the other hand is a tool that is often used in action research, and not necessarily transferable to the context of education. This might explain why the workshops did not form a coherent whole. Based on the results of the workshops, I argue that pupils need more guidance in both the design and inquiry processes (which should be discerned from each other).

Interesting research is being conducted at the moment at the TU Delft on 'co-design with kids' (Wetenschapsknooppunt TU Delft, 2019). The question that is central to this research is how children can be involved in a design project with the goal to align the design with their preferences and concerns, but also to improve design related skills of pupils such as creative thinking and empathy. This research group developed a toolkit for facilitators of co-creation workshop with pupils. The design cycle as referred to above is a central element to this toolkit, but additionally, they provide many suggestions on how realize the potential of co-creation with children.

Realization of initiatives One of the objectives of the SEE Program is that pupils make a contribution to the realization of initiatives. In this cycle of the SEE Program this objective was not reached. The simple reason is that when the last workshops took place at the schools, none of the initiatives that were being developed were yet in the implementation phase. It can be concluded that the current time planning as adopted in this cycle of the SEE Program does not allow pupils to take part in activities related to the realization of initiatives.

Importance of school staff The analysis also revealed that when initiatives were being developed, stakeholders often did not have clear view on what role pupils and schools could play in the realization of their ambitions. Involvement of teachers and other stakeholders with a close connection to the school proved to be a stimulant for the creation of initiatives in which the pupils play a central role. In this regard, the involvement of members of the school management staff is prerequisite. An assessment of the specific contributions of the school's management staff in the focus groups showed that their involvement determines to a great extent what activities can take place at the school and with the pupils. They determine what is possible and what not, and therefore, their contribution in focus groups is crucial.

Evans (2015) concluded that the intrinsic motivation of schools is an important -but often lacking- factor for ESD programs to lead to transformative changes in the schools. Having assessed the engagement of management for this thesis, we come to a similar conclusion. At the two schools, the management staff shared a set of values with the SEE Program resulting in an intrinsic motivation and strong commitment to actively participate in the program. At one school, we observed that the motivation of the management staff was extrinsically driven (pressure from parents). At the fourth school, the management staff showed no commitment to the SEE Program at all. At the schools that showed a strong commitment, the co-creation processes were more successful (and can be expected to have more impact).

This finding is interesting in the light of one of the research gaps identified in the literature review. Tauritz and Wals (2009) pointed out that an important question in the field of sustainability education is how schools and education can be re-oriented towards their communities. As this research has investigated the role of schools in processes of co-creation together with their community, the findings discussed above give insight in factors that can drive this re-orientation of schools and education. An important driver in the SEE Program was found to be the active involvement of members of the school staff as discussed above. Especially the management staff is important as these people have a great influence on the

activities that can take place. When these people show strong commitment to the program, the impact of the program on both the school and the community can be expected to be higher.

11.1.2. Effects on the school

The SEE Program aimed to support schools with Science and Sustainability Education. The pedagogy of Inquiry based learning was also important in this respect as the pedagogy is often used in Science and Technology Education and schools have difficulty implementing it in their curriculum. From the interviews with teachers and school staff, conclusions can be drawn regarding the effects of the SEE Program on Education. Also, insights were gained in the value of the SEE Program for schools. Below the key findings and the implications of these findings that followed from this part of the analysis are discussed.

Focus of the schools

The schools showed different motivations for participation in the program. At two schools, a clear ambition was shown by the school's representative to pay more attention to sustainability. At other schools, the focus was more on citizen participation and in one case, it was personal interest in sustainability of a teacher. Consequently, the focal point of education was different in each case. The results of this research reveal that at each school there was interest in the following elements of the SEE Program (though each school put a different emphasis):

- Pupils learn about sustainability
- The program can be identified as 'Science and Technology' Education
- The use of the Inquiry and Design Based learning pedagogy
- The program contains elements of citizen participation

Value of the SEE Program

The results of the analysis highlighted that schools have many different roles to fulfill and that at each moment, they need to make trade-offs on what should be given priority. These can be trade-offs regarding education -for example what subjects to prioritize-, but can also be about the role the school wants to play in the neighborhood. For three schools, it was found that they do not have the time and resources to prioritize sustainability. Two schools did not have a particular interest in sustainability. At each school, IDBL is something the school staff indicated to be important but also difficult to implement. Science and Technology Education was important for two schools.

Interestingly, it was in the light of prioritization that participation in the SEE Program was found to be valuable to schools. This is illustrated perfectly by something one of the interviewees noted, namely that it is valuable that the program supports the school with their responsibility to pay attention to sustainability. Also, the results of the interviews reveal that The SEE Program is valuable in bringing knowledge and expertise on sustainability and sustainability related topics. Also, it brings people that are committed and enthusiastic about it and are able to make pupils enthusiastic as well. In general, schools believe that the SEE Program raises awareness about the importance of sustainability among pupils, teachers and parents.

Science and Technology Education and Inquiry and Design Based learning With respect to science and technology education and IBL, the schools indicated that it is valuable that this program provides the pupils with chance to participate in a science and technology project and practice with inquiry and design based learning and all of this without increasing the work load for teachers and school management. However, the schools indicate that they need to look for a long-term solution as well. Therefore, the schools emphasize the importance of curriculum integration as discussed below.

Curriculum Integration One of the things that does become very clear from the results is that curriculum integration is valued highly by school staff. Another thing that this evaluation

revealed is that in its current form, the SEE workshops are not suitable for curriculum integration. Schools have indicated that curriculum integration is something they are interested in, as it allows for replication and the development of learning progressions, which can increase effectiveness and quality of education. At two schools, there was looked at integration of the workshops in the curriculum. However, no starting points for such an integration were found. Several reasons can be identified why the workshops are not suitable for curriculum integration. Most importantly, it is due to the fact that both the process of co-creation and the initiatives that result from this process are one-time activities. Schools and stakeholders lack the ambition and resources to organize a new action research project in coming years. From this perspective, it is not clear what integration of these workshops in the curriculum entails.

Existing school structures

In the literature review (chapter 3) it was discussed that the influence of existing school structures on sustainability education is something that has not received much attention by researchers yet. Tauritz and Wals (2009) noted that more work is necessary to develop a deeper understanding of the role of fixed formal education structures in processes of change that schools need to go through if they want to engage with their communities. The results of this thesis shed new light on this topic, as the existing school structures have been a topic of discussion in the interviews, and were being investigated via observations of program activities.

Our results demonstrate that indeed, formal education structures are an important factor of influence. For example, the existing curriculum determines if and where there is room to incorporate sustainability in the classroom. Also, the level and skills of pupils which are results of the schools' curriculum determine what pupils are capable of in workshops. An interesting finding is that teachers seem to be more sensitive to existing structures than members of the management staff. The first seems to be more reluctant about things that not fall within existing structures whereas the latter tends to see more room to deviate from the beaten track.

Even though these findings provides some initial insights on this topic, additional studies are needed to develop further our understanding about the dynamics of these processes of change in education. A limitation of this study is that the existing school structures have not been assessed in a systematic way. A new approach is therefore needed to investigate this in more detail.

11.1.3. Effects on pupils

A summary of the quantitative analysis of survey results was presented in chapter 10. The complete analysis was included in Appendix C. A survey was used to gain insight in the development elements of environmental literacy and action competence as results of participation in the SEE Program. To that end, a survey was designed containing knowledge, attitude and behavior elements. This discussion is structured along these same categories. The survey responses of pupils that participated in the program (the test-group) were compared with responses of pupil that did not participate in the program (the control group). Also, there was looked at differences among schools. This subsection discusses the most important results and insight gained from the analyses performed.

Knowledge

Two types of knowledge questions were asked: 1) objective knowledge items, 3 questions with 4 items each, for which the total number of correct answers were measured, and 2) subjective knowledge items, for which pupils indicated on a Likert scale to what extend they (dis-)agreed with a statement.

Objective knowledge From the results, it is clear that the test group scored significantly higher on the objective knowledge component than the control group. The pupils of the test-group had on average, more correct answers. They new better what energy sources can be identified as sustainable and what things you can do that are sustainable.

Subjective Knowledge On the subjective knowledge questions, no significant differences were found between complete test and control group. Only in the specific case of De Gagel, we found that there was a significant difference between test and control group on question nine, which means that on average, pupils of the control group agree more with the statement that they were able to point out in their neighborhood what was sustainable (Q9 part 2).

Comparison across schools From the comparison across schools, it followed that the pupils of De Hogeraven scored significantly higher on Q4 than the pupils of De Gagel. This is interpreted as that the pupils of Hogeraven feel that they have many ideas on making the neighborhood more sustainable, and the pupils of De Gagel less.

This findings confirm something that was observed in the workshops as well, which is that the pupils of Hogeraven had less difficulty with coming up with sustainable ideas than the pupils of De Gagel. In the light of the co-creation processes this might provide for an explanation on why the contribution made by pupils of De Hogeraven was observed to be more and better than in the case of De Gagel. As the result of the survey don't provide evidence that participation in the workshops improves the knowledge on action possibilities which is an element of action research, it should be considered whether this element should be identified as learning outcome, or rather as a prerequisite for successful implementation of the workshops.

Attitudes

With respect to attitude of pupils we found that there is no significant difference in attitude towards sustainability (including attitude towards sustainability education, concern for the environment and attitude towards action). Both the test and control groups scored relatively high on the attitude items. On average 80% of pupils showed positive attitudes toward sustainability.

One of the things than is interesting to highlight is that pupils in the control groups demonstrated such positive attitudes towards sustainability. This was also observed when the surveys were administered to the pupils of the test groups. Pupils showed great interest resulting from what they had heard about the workshop from their peers. Some pupils asked whether they could participate in the program next year. The results from the survey confirm that both the test and the control group have a positive attitude towards sustainability education.

Two critical notes must be made with respect to the results of the attitude component of this questionnaire. Firstly, the high scores for both test and control can also be an indication that the highest attitude score failed to capture the most positive evaluation possible which would be a so called 'ceiling effect'. Secondly, there is the possibility that pupils provide the answers that they believe adults want to hear from them, i.e. the socially desirable answers. This is known as social desirability bias and it is something that children are particularly prone to (Hall et al., 2016).

comparison across schools One other notion that can be made based on the survey results, is that the test group of De Kaleidoskoop scored on average lower than the control group on attitude related questions (though the difference is not significant). The workshop observations demonstrated that in the last workshop (in which they filled out the survey), the pupils were not happy to be in the workshop at all. They noted that they would rather be somewhere else. Several explanations are possible for this behavior, one of which is that they had been participating in five workshops already and that they did not like it anymore. Also, it did not help that it was Friday afternoon and that their peers were playing outside (in one of the first workshops this had also been the case). This might also provide explanation why they scored on average lowest on attitude compared to all other test and control groups.

Program specific questions Two program specific questions were asked to the pupils of the control group relating to self-efficacy (which is also an attitude component). The pupils of De Gagel scored significantly lower on these items than the pupils of De Gagel and De Hogeraven.

Again, the low scores of the Gagel could be attributed to the the different approach taken in these workshops. These pupils did not work on their own plans and initiates (in consecutive workshops) as the pupils of the other schools did. The low average score on Q12 and Q13, which state "I have contributed to making my neighborhood more sustainable" and "Some of the plans we made are going to be realized", are in line with the findings from the qualitative analysis.

Behavior

Sustainable behavior was measured by this questionnaire on two scales: 1) measured on a likert scale, and 2) measured on a true-false scale. A similar pattern across schools was observed on most behavior questions: De Hogeraven has the highest mean, followed by De Kaleidsokoop and the lowest average mean for De Gagel.

Behavior items measured on a likert scale These items were divided in action related questions and communication related questions. No significant difference was observed for the answers provided by the pupils in the test and the control group on these questions. A significant difference between test and control group on Q8 was found only in the case of De Hogeraven. This results shows that pupils of the control group on average agree more with the statement that they talk about sustainability with their parents.

The communication component of behavior is interesting to highlight. We found no significant difference between the test and control group. Also, the pupils scored relatively low on this component compared to survey attitude and knowledge items. The mean score on the item: 'I talked to my parents about sustainability' was only 2,05. Pupils of De Gagel rated this question lower than those from the other two schools (mean score of 1,58 compared to a mean score of 2,52 and 2,42 at the other two schools). A similar results was obtained for Q14 which asked if the pupils had talked about the workshop at home. A mean score of 2,49 was observed. 59% of the pupils disagreed, 42% agreed with the statements. The mode of this question was the response option 'strongly disagree'.

What is interesting in the light of these results is that program assumes that children can act as 'agents of change' that can influence their parents to become more conscious about sustainability. In her work on the carbon literacy of children, Satchwell (2013) argues that though the notion of 'children as agents of change' is considered to be effective in health-care and marketing, it is not necessarily transferable in other contexts such as sustainability. From the results obtained it can be argued that the notion of 'pupils of agents of change' in the context of the SEE Program is indeed questionable. Based on the results, it can not be assumed that parents are being influenced in their behavior or attitude as result of this project.

Behavior items measured on a true/false scale The third part of the questionnaire measured sustainable behavior in pupils using the sum score of five true-false questions. The test group scored significantly higher on average (3,59/5) than the control group (2,68/5). The difference between test and control group was significant in case of De Hogeraven and De Gagel. Also, we found that the pupils of De Hogeraven scored significantly higher on this question than the pupils of both the Kaleidoskoop and De Gagel.

The results on this question suggest that the pupils that participated in the SEE Program said to behave more sustainable than the children that did not participate. This finding can be important for the SEE Program as it indicates that the program contributes to more sustainable behaviour among children. There was looked at the response frequencies of Q15 in this case as well. On average 55% of the pupils agreed with the statement that due this project, they did more things that are sustainable at home.

With respect the true-false behavior questions it is important to note that the present evidence for the higher scores on sustainable behavior for the true-false questions for the

test group, rely on a comparison of responses that is actually not valid. The phrasing for this question was slightly different for the test and control group. The test group was asked if it was true of they did something *more, as a result of the workshops*. They could choose between the response options 'true', 'false' and 'we already do this'. The control group was asked 'do you do these things at home?'. They had two response options, true and false. As both the questions and the response options are not the same, comparing scores of the two groups with t-tests is not valid. The approach chosen did provide initial insights in the behaviors of pupils.

11.2. Lessons Learned

Now that we have discussed the different effects of the SEE Program, as well as the factors that have determined these effects, this section will elaborate on the lessons that can be learned from this evaluation in terms of design and implementation of the SEE Program and the different interventions of which this program is build up from.

11.2.1. Program Goals and Objectives

One of the things that is clear from this evaluation is that the SEE Program aims to make an impact on many different levels. This thesis gave insight in the different elements the program consists of and the different objectives it tries to reach. The insights gained and lessons that can be learned regarding the program goals and objectives are discussed below.

Energy Embassy or Sustainability Embassy

As the name of the program makes clear, this program intended to empower schools as 'energy embassies' in their neighborhood, to make a positive contribution to the energy transition in that neighborhood. From this study, it can be concluded that in practice, the program had a broader focus than energy. Both in the activities with pupils and stakeholders, there was not converged to ideas and initiatives that related to the energy transition specifically. This broader focus reflected the interest of the pupils and stakeholders. This can therefore explain the 're-focus' of the program: one of the main principles of action research is to follow the energy of participants.

If the program wants to focus on more specific topics in the future with a similar program, the activities with stakeholders and pupils should be approached differently to facilitate this convergence. This conclusion is in line with the reflections on co-creation experiments of SIC Europe (2019), who found that one of the challenges of these co-creation processes for facilitators is to keep the processes flexible but However, based on the results of this thesis it can be questioned how feasible it is that primary school pupils can come up with ideas to accelerate the energy transition in their neighborhood. It is clear that pupils more easily relate to other topics related to sustainability such as waste, recycling and flora and fauna.

Program objectives for workshops

In broad terms, the SEE workshop aimed to learn pupils about sustainability in their neighborhood by letting them discover the neighborhood and come up with their own ideas on making the neighborhood more sustainable. From the assessment of the workshops, it is notable that for the SEE Workshops no specific learning goals were identified and no corresponding learning-teaching plans was written. Elements of the cycles of design and inquiry based learning were used, but in most cases, the pupils did not go through a full cycle.

Reflecting on learning goals In this cycle a of the program, the workshops did not have a clear focus in terms of learning goals and objectives. Sometimes, the focus was on involving pupils as researchers, at other times emphasis was put on the notion of pupils as designers. But also, the workshops aimed to develop knowledge, a positive attitude towards sustainability, pro-environmental behavior, competencies related to design and inquiry based learning or 21st-century skills. I argue, that due to a lack of focus, the activities with pupils sometimes lacked coherency. To increase the effect on pupils and the output and quality of the workshops -that must serve as input for the co-creation process, I recommend that the objectives, learning goals and teaching-learning approaches are formulated in more detail.

Focus of workshops Re-defining the workshops objectives can be approached from different angles. For example, there could be looked at the different elements of environmental literacy and action competence. The question in this case would be: what change do we want to bring about in pupils: is that a change in behavior, attitude, knowledge or competencies. It has become clear that in series of five workshops (which corresponds to 7,5 hours of workshops approximately), it is not feasible to achieve results on each of these dimension. An important reason to be more specific about the workshop objectives that it will help to better manage the expectations of schools. Schools indicated that it is useful to know what pupils are going to do and learn in the workshops. They indicated that this in the recruitment of schools for participation in the SEE Program this would help.

Another approach that can be taken is an output driven approach that takes as starting point what contribution we want the pupils to make to the SEE Program. The decision that should be made first is whether the SEE Programs wants to focus on 'design' or 'inquiry' Though there is overlap between the two approaches to learning, the fundamental principles of the two processes are different Kraaij (2012): a demand for knowledge to be satisfied by inquiry (in the case in inquiry based learning) or finding a solution for all kinds of issues by means of design (in the case of design based learning). Secondly, it has become clear that there pupils can make a contribution different forms. Their ideas can be used as input for the co-creation process, but they could also be involved in later phases in which initiatives are realized.

Implications in the light of prior research The importance of formulating clear program goals and objectives has been discussed extensively in literature on the evaluation of sustainability education and also been highlighted in 3.1.4. To facilitate effective learning in pupils appropriate teaching-learning plans are needed that specify what and how pupils are expected to learn. TEAL (2019). Planning ahead also includes deciding on what specific methods you can use to reach certain objectives. Also, when the conditions above are satisfied, more appropriate assessment methods can be chosen that align better with the workshops.

These findings are in accordance with the results of Carleton-Hug and Hug (2010), that showed that clear program objectives are essential because they guide the identification of outcomes of interest of the evaluation. Also, Smith-Sebasto and Semrau (2004) argued that it is important to align program objectives, design and evaluation. What can be concluded from this evaluation is that in the SEE Program, it's the alignment of objectives and activities that needs to be focused on in the first place. The second step would be to further adjust evaluation efforts on the program objectives and design.

Parental involvement

An implicit assumption of the program is that parents can be 'reached' through pupils, and that they might be able to influence their parents. As discussed before, the notion of children as agents of change is not yet proven in the context of sustainability, but from the results it also has become clear that stakeholders see potential in this notion. Consequently, some of the initiatives involve both pupils and parents. However, on the basis of this evaluation it can be concluded that the SEE Program has not actively reached out to parent as part of this cycle's intervention design. Few parents were involved as stakeholders, and the analysis of survey results suggests that many pupils did not talk about sustainability more, or did more sustainability things at home as results of this program. From the review above, the key finding emerges that if the program aims to influence parents as well as pupils, specific interventions will need to be design to realize this objectives.

11.2.2. Co-creation

Stakeholder identification

It was found that the stakeholder population has great influence on the processes of co-creation the stakeholders take part in. Important here is to think about how and what stakeholders we want to approach. The community event at which the program was pitched, in the H-Buurt in Amsterdam-Zuidoost has been very useful as it attracted stakeholders that

wanted to become involved on their own initiatives. The program can be ‘marketed’ better and a suggestion that can be made here is to start earlier: informing people that the program is going to take place, what possibilities there are for participation, and why it would be interested to become engaged.

Program Planning

One of the things we can learn from this cycle of the SEE Program, is that the planning of the activities should be reconsidered. In this cycle, the SEE Program aimed at the creation of initiatives in five different neighborhoods, engaging many stakeholders, involving pupils, and realizing at least some of the initiatives before the last workshops so that pupils would be able to make a physical contribution to the initiatives as well. It can be concluded that this planning is too tight and the following suggestions can be made:

Time planning We have seen that co-creation processes are organic and hard to plan. The relationship between stakeholders can grow over time, and it is important to take into consideration that it may take some time for ideas to evolve. With the time planning that was used now, it was clearly unfeasible to involve pupils in the realization of initiatives after only 3 months from the start of the program. Another time planning should be adopted, or the program objectives should be adjusted accordingly; for example, by reduce the involvement of pupils to the design phase of initiatives.

Distribution of resources The number of schools that can participate in one cycle of the program should be reconsidered in the light of man-hours available for the project. From this cycle, it is clear that facilitating the program at five schools may have been an overload. When less school participate at a time, more time can be spend at the engagement of stakeholders which has proven to be critical factor for succesful co-creation processes.

Also, there can be looked at how the resources available per school should be distributed over different program activities. Comparison to the time spend on the focus groups round and the interview round, and the relative importance of these components on the co-creation process, it is advisable to reconsider the amount of time spent on the interviews.

Stakeholder Management An important finding from this research is that expectation and time management are key in the facilitation of a co-creation journey with stakeholders. Only when the communication between the ART and the stakeholders is clear, and everyone knows what to expect, there is room for meaningful collaboration. In the case of expectation management we found that it particularly important to ensure that the ART and the stakeholders are on the same page when it comes down to the responsibilities they have. Expectations about the role and involvement of stakeholders should therefore be clearly communicated at the start of the process. Also, in between activities, the stakeholders should be asked what there expectations are. In this way, the chance on surprises regarding responsibilities can be minimized. Based on this research. I argue that it can be helpful to reserve (enough) time at the end of each stakeholder activity -and in the focus groups specifically-, to discuss and specify what next steps need to be taken and who is responsible for this. This is an important step in making the stakeholders the owner of the co-creation process. Therefore this can have

Co-creation with children

Facilitating creative thinking in pupils is an important objective for the SEE Program. In the 4D approach used now, the dream phase may not be facilitated enough. To stimulate the creative process of the pupils, to really let them think outside the box, there can be looked at new methods. There are methods and tools dedicated to the facilitation of creative session with pupils (see Wetenschapsknooppunt TU Delft (2019)). There can be looked at how these tools can be used to improve the input of pupils on the co-creation of initiatives for a more sustainable neighborhood. An import aspect would be to look at the involvement

of stakeholder in this process as well. Interaction between stakeholders and pupils showed to be very promising.

Working forms with pupils The results of the evaluation showed that the contribution that pupils can make to the process of co-creation of initiatives is influenced by the working formats that are used, and the level of the pupils. The level of the pupils is affecting the output of the pupils that serves as input for the co-creation process in two ways: 1) the workshop content is adjusted to the level of the pupils, which affects the form of the output, and 2) the quality of the output is better (the output is better usable). The 'level of the pupils' in this case is to a great extent determined by the development of certain skills and competencies in pupils. When certain competencies are not developed, it can not be expected that the results of their assignment will be of good quality. Therefore, it's important to take the levels into account when making lesson plans.

11.2.3. Supporting schools

One of the program objectives was to support schools in providing education: Sustainability Education, Science and Technology Education and Inquiry and Design based learning and elements of active citizenship. These elements make the program valuable to schools. Based on this research, we found that there is also room to extend the program's impact on education beyond the duration of the program.

Curriculum Schools are looking for ways to integrate projects as the SEE Program into their curriculum to increase the impact of the program. In its current form, the program is not yet suitable for curriculum integration. I suggest that program should look for new approaches that will allow for this integration. Ways to achieve this is by involving more teachers and formulating and sharing lessons plans. If this is not feasible, the program should be transparent about its limitations to prevent the school from having false expectations about the program.

Involving teachers An easy way to increase impact is to involve more teachers in the program, and in this case especially in the workshop with the pupils. By doing so, teachers can learn from the educational specialist about how to approach such workshops and what it means to become a facilitator of pupils in learning. Also, the workshops can serve as source of inspiration for teachers.

Sharing lesson plans A third way in which the effects on education can be increased, is by sharing lesson plans of these workshops with school staff. In the first place with teachers school management of the participating schools, but why not with everyone that it is interested? Teachers indicated that they would be interested to see such lesson plans, as they could use it for their own portfolios. As the resources of the SEE Program are limited, how other teachers can be inspired to start working on similar projects is something to be considered more closely.

11.3. Research findings in context of scientific literature

In this section, some of the results have already been discussed in the light of prior research. Two broader points of discussion that are not specific to individual research findings are discussed below.

Evaluation of educational programs in a community context

When looking at the research gaps identified in chapter 3, it can be observed that one of the objectives of this research was to examine the program impact and factors of influence in a community context. To that end, this thesis did not only focus on the effects of the program on pupils, but also investigated what the effects of the program were in terms of the co-creation of initiatives and on the value for schools in terms of science and sustainability

education. The analysis performed resulted in a rich picture of program impacts on both the school and the community so far lacking in the scientific literature.

Identification of mechanisms by which programs come to have impact

Recent work from Stern et al. (2014) and Rickinson et al. (2016) emphasized that for the evaluation of educational programs it is not only important to assess what the effects are, but also how and why certain outcomes were produced. For this thesis, much effort was put into the investigation of the factors that have influenced the program. When looking at the results, it can be seen that especially in the case of the effect on education and the co-creation of initiatives, factors were identified that have influenced the effects of the SEE Program. Notably, the insights in these mechanisms provide fertile ground for further research as well as for improving the intervention.

With respect to the effects on pupils, it was difficult to identify the mechanisms by which the program had an impact on the pupils. One of the reasons is that a relatively small number of schools and pupils took part in the survey. Still, the comparison and analysis of qualitative and quantitative data across schools suggest that the specific activities the pupils participated in affected their environmental literacy and action competence. However, more work is needed to gain a deeper understanding of the mechanisms by which certain elements of the SEE workshops. For example, individual elements can be assessed more systematically and in isolation.

Conclusion and Recommendations

In this chapter, the conclusions of this research are presented by answering the research questions that formed the basis of this thesis research. In the second part, the recommendations for future research that followed from this thesis are discussed.

12.1. Conclusions

As part of an overarching action research program that assesses the role of schools in the energy transition, empirical research was performed on the effects and working mechanisms of the SEE Program. With a series of interventions at schools and in the neighborhood, the program aims to empower schools as energy embassies in their neighborhood that will accelerate the local energy transition. This research evaluated the implementation of the program at four primary schools in different neighborhoods in Utrecht and Amsterdam to answer the following research question:

“What are the effects of the action research program ‘Schools as Energy Embassies’ on the school, its pupils and the surrounding ecosystem, and what factors influence the program outcomes?”

An important part of this evaluation was to take into account the wider context in which the program is set. This means that there was not only looked at the effects of the program on the school and its pupils, but also on the school’s ecosystem in the form of processes co-creation of sustainable initiatives. A simple conceptualization of the co-creation process consisting of the three participant groups is shown in figure Figure 12.1.

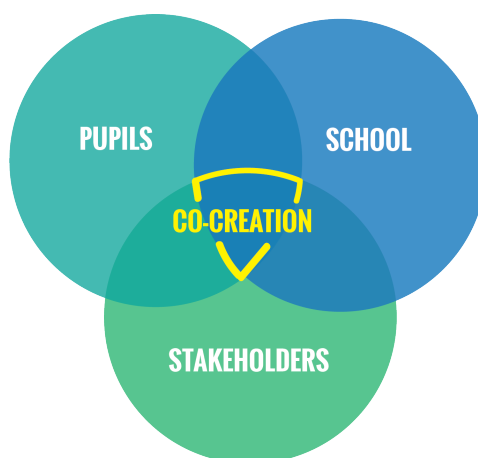


Figure 12.1: Co-creation of sustainable initiatives in the SEE Program

An important objective of this research was to cast new light on the conditions under which positive outcomes can be expected. To answer the main research question a set of sub-questions was formulated that formed the basis of this research. In conclusion of this research, the sub-questions are answered in this chapter. Not all sub-questions are answered individually as there is much overlap. Still, the sub-questions follow the same structure used throughout this thesis: first the design and implementation of the program is discussed, followed by the most important effects of the SEE Program. Then, the factors of influence are presented. Lastly, the lessons learned and next steps are discussed.

How is the SEE Program implemented?

Description of workshop design and implementation is crucial in understanding better why and how the program led to certain outcomes. The importance of this sub-question explains why a large part of this research is descriptive in nature. By answering this first question, important insights were gained about intervention factors that influenced the outcomes of the SEE program, which provides input for sub-question 4 (on factors of influence) and sub-question 7 (lessons learned). Regarding the implementation of activities with stakeholders and pupils, the following conclusions can be drawn:

Energy vs Sustainability Though the initial focus of the program was on the energy transition specifically, in practice, the program had a broader focus than energy. Both in the activities with pupils and stakeholders, there was not converged to ideas and initiatives that related to the energy transition specifically.

Focal point of program activities The focal point of the program was the facilitation of processes of co-creation with schools, the pupils, and 'relevant stakeholders'. To that end, between April and July 2019, at each of the four schools a series of activities for a pupils (aging 8 to 12) and for stakeholders (people with a close connection to the school or the neighborhood) was implemented that aimed to stimulate the co-design of solutions for local issues related to the energy transitions.

Program activities at schools In each of the cases, the starting point for the workshops was the 4-D cycle of appreciative inquiry as discussed in section 2.3. The last phase of the 4D cycle of AI was not reached in any of the cases. This corresponds to the deliver phase in which pupils should work on the realization of co-created initiatives for a more sustainable neighborhood together. The most important factor determining the workshop implementation was found to be the inquiry based learning competencies of pupils. The SEE Program assumes that that pupils can work together in groups effectively and autonomously on assignments in which they needed to think critically and creatively (brainstorming). As this was not always the case, workshop needed to be adjusted to pupils capabilities.

Program activities in the neighborhood The program activities with stakeholders followed a similar structure in each of the cases. Again, the 4D-cycle of AI was the starting point for intervention design. The following phases can be discerned: stakeholder identification, interviews, focus groups, follow-up. The approach should lead to stakeholders taking ownership over the ideas. At the moment of evaluation, none of the initiatives had reached the deliver phase yet in which initiatives should be realized. Also, the transition of ownership from the SEE Project team to stakeholders has not happened (yet).

Alignment of program activities Concerning the alignment of program activities at schools and in the neighborhood, it can be concluded that even though activities with stakeholders and pupils are interrelated, in practice the activities in these two streams often occurred independent of each other. A reason for this is that in broad terms, an alignment of program goals and objectives of both streams was defined, but an operationalization of this theoretical variable into specific procedures and actions was not articulated in detail. Consequently, the members of the SEE Program team did not have a clear idea of what this alignment of activities

should entail, and how to realize it. Another observed impeding factor was the time planning. Therefore, alignment of activities was not always feasible. Also, the tight time schedule left little room for experimentation.

What are the effects of the SEE Program?

The effects of the SEE Program were investigated in three domains: 1) effects in terms of social innovation for sustainability, 2) effects on pupils and 3) effects on education. The most important effects of the SEE Program in each of these domains are presented below.

Effects on social innovation for sustainability in the neighborhood In the first place there was looked at the effects of the program on social innovation for sustainability in the neighborhood, by looking at the outcomes of the co-creation processes that the SEE Program facilitated. Obviously, an important measure for success of processes of co-creation is the realization of initiatives. In this respect, this evaluation took place too early: the co-created initiatives did not reach maturity yet and were still under development at the moment of evaluation (July 2019). Therefore, the effects of the program in this domain are expressed in terms of the progress of initiatives and stakeholders' engagement in it.

From this research, it can be concluded that an important outcome of the SEE Program is that it is successful in strengthening the schools ecosystem. In each of the cases, new links formed between program participants. These networks of people with a shared interest in education, sustainability or the community, are essential to successful processes of co-creation. The program not only brings people together, also it supports participants in finding and creating a shared interest between them.

We observed that the relationships between active stakeholder grew in the course of the program. On the other hand, it is clear from our research that stakeholders were reluctant to become involved and almost half of the stakeholders disengaged in the course of the program. This is being reflected in the progress made for the different sustainable initiatives as well. At the moment of evaluation, some initiatives were still being worked on actively by the stakeholders and members of the SEE project team. Still, many of the ideas that resulted from the first focus group have not been taken ownership over by stakeholders.

Effects on pupils' knowledge, behavior and attitudes related to sustainability To gain insight in the effects of the SEE Program on the pupils -in other words, the learning outcomes of the workshops- a survey was administered to pupils of the participating schools. From the results of this survey, it can be concluded that the participation in the SEE Program improves the knowledge of pupils on sustainability. On average, pupils that participated in the workshops know more about what energy sources are sustainable, what daily practices are sustainable and what things in their neighborhood are sustainable than their peers that did not participate in the SEE workshops. It would be interesting investigate the possible spillover effects of this knowledge gain. Spillover effects can include a transfer of knowledge to peers or 'peer learning' (Hoxby, 2002) or family members (Hiramatsu et al., 2014). No immediate evidence was found that the SEE program changes pupils attitudes towards sustainability and sustainable behaviors.

Effects on Science and Sustainability Education at the participating schools To get insight in the effects of the SEE Program on the school's education, interviews with teaching and management staff were conducted. From theses interviews, we can conclude that in it's current form, the SEE Program support schools with more than sustainability education only. The SEE Program is a sustainability project, it is a science project, it uses design and inquiry based learning, and it promotes active citizenship. We found that as the SEE-program is a one-time educational program, no structural impact on the schools' curriculum's was made. There is further elaborated on this effect in the sub-question on the school's experience and valuation of the SEE Program.

How do different participant groups experience and value the program?

The participant groups that can be discerned are: the schools, represented by management and teaching staff, the pupils, the stakeholders from the schools' neighborhood and lastly, the members of the SEE Project team. For this thesis, only the experiences of the first two participant groups have been investigated in a structured manner.

Schools' perspective The school staff involved in the program activities experienced and valued the SEE Program positively. For them, the value of the SEE Program is that it brings knowledge and expertise about sustainability but also emphasizes citizen participation. In each of the cases, inquiry based learning is something that the schools want to pay more attention to, but they indicated to lack expertise to realize this.

From the interviews, it was clear that schools have many different commitments: to pupils, to parents, to the government, to society. Meeting all these commitment in a satisfactory manner is an arduous task with the limited resources available to schools. External educational support was therefore very much welcomed. An important observation we made here is that the integration of (elements of) the SEE Program in the school's curriculum is something schools value highly as it increases long-term impacts. However, in its current form, the SEE workshops are not suitable for curriculum integration.

Pupils' perspective How the program was valued and experienced by pupils was deducted from workshop observations and the pupils responses to the attitude items of the survey. On average, pupils showed positive attitudes towards sustainability education. Most pupils indicated to find sustainability education both important and interesting.

The same conclusion can be drawn from the workshops, which the pupils in general were enthusiastic about. An assignment that was experienced very positively at each school was the photo voicing assignment in which pupils were allowed to go outside. Many assignment in the workshops had a 'brainstorm' component. The enthusiasm for these assignments varied. In some cases, a combination of team work and creative thinking was difficult for pupils and not experienced positively. Also, the topic about which they brainstormed influenced their interest. Lastly, we found that pupils that were working towards something, had greater motivation than pupils that were doing an assignment just for the sake of the assignment.

What factors influence the program outcomes?

In the course of this thesis, we have come across many factors that influenced the SEE Program, both in its implementation and outcomes. We have seen that the focal point of the program activities was the co-creation of initiatives. The SEE Program brings together the different participant groups (stakeholders, schools and pupils) and facilitates the co-creation process. Following from this conceptualization, we found that there are factors influencing the process of co-creation related to stakeholders, school's and the pupils. Also, we can distinguish external factors (factors the program can not influence), and internal or intervention factors (i.e. the factors that the SEE Program controls). Table item 12.1 gives an overview of the most important factors of influence for the SEE Program.

Pupil factors The input of pupils on a more sustainable neighborhood is crucial for successful co-creation processes. In this respect, it can be concluded that the competencies of pupils related to inquiry based learning are an important external factors of influence. Working together, and thinking creatively (out-of-the-box) is prerequisite for good results, but these are things pupils also encountered difficulty with. An indirect influence is that workshops are adjusted to the level of pupils. The background knowledge of pupils on sustainability has a similar but weaker influence.

We found two intervention factor that influences what contribution pupils can make. Firstly, the design of the workshops and specific assignment is important. Assignment need to be adjusted to the level of pupils to get the best results (i.e. creative ideas that can serve as input for the co-creation process). Future research is needed to investigate how co-creation with children for local sustainable initiatives can be facilitated effectively. Secondly, the time

Table 12.1: Factors of influence per participant group

	Pupil factors	School factors	Stakeholder factors
<i>Key contribution</i>	<i>Input from pupils</i>	<i>Engagement of management staff</i>	<i>Ownership of initiatives</i>
External factors	1. IBL Competencies - Working in groups - Creative thinking 2. Background knowledge 3. Assertive behavior	1. School's ambitions - personal interest - external pressure - pupil population - local issues	1. Professional interest in program 2. Involvement in other (local) initiatives
Intervention factors	1. Time planning - time for realization of initiatives - time for alignment of stakeholder and pupil activities 2. Assignments adjusted to level of pupils 3. Teaching-learning plans 4. Operationalization of 'alignment' of program activities 5. sources of inspiration	1. Selection of schools 2. Involvement of teachers 3. Expectation management	1. Stakeholder engagement - expectation management - time planning - stakeholder identification 2. Stakeholders reflect local population 3. Involvement of STT as stakeholder

planning of the SEE Program must allow pupils to make a contribution to the different phases of the co-creation process.

School factors The school staff, and especially the management staff, proved to be a crucial factor for successful co-creation processes. The members of the school management team are in the position to make decisions on the involvement of the school and pupils in initiatives. Without their involvement, it is difficult to create and realize initiatives in which the schools and pupils play a central role.

The engagement of school staff is closely related to the ambitions of the school. We found that this ambition does not necessarily have to be a sustainable one. In none of the cases, the schools showed the ambition to become 'energy embassies' in the sense of becoming sustainable examples in the neighborhood, that promote the community to become more sustainable as well. Their interest in the SEE Program was either on sustainability in general, or on other aspects of the program such as citizen participation, Science and Technology Education, and Inquiry and Design Based Learning. External factors that influence the ambitions of the school are pressure put on the school by (expectations of) parents and law and regulations from the central government, but also on the school's population and issues in the school's neighborhood.

The selection of schools that participate in the SEE Program is a factor than can be controlled by the project team. It's important to engage schools that have ambitions that coincide with the goals and objectives of the SEE Program to insure active participation of the school's management staff.

Stakeholder factors For the successful co-creation of initiatives, the key factor related to stakeholders is that in the course of the process, they take ownership over initiatives. When this is not the case, initiatives abort before being realized. This factor is closely related to the engagement of stakeholders. We found that there professional interest of stakeholders determines to a great extent their engagement in the program. The intervention factors related to

stakeholder engagement are expectation management, stakeholder identification, and time management.

Lessons Learned

The lessons learned related to the each of the program objectives have been discussed extensively in the previous chapter. The key lessons are repeated here. They follow directly from the intervention factors that were found to be most influential.

What we must take-away from the evaluation is that co-creation is an organic process that needs time to grow. Therefore, the duration of the SEE Program is too short now. Especially for the realization of initiatives more time is needed. If the facilitation of the design process stops when the initiatives have not been fully developed, and the stakeholders have not taken full ownership over the initiative, there is a risk that the plans fall into oblivion.

Also, it was experienced that involving pupils in the co-creation process is not always easy. Pupils had difficulty with being creative and coming with up ideas and the input of pupils was not always found to be very useful as input for the co-creation process. It will be important that future research investigate how co-creation with children for local sustainable initiatives can be facilitated more effectively. Also, there is room for improvement with respect to the alignment of activities with pupils and stakeholders. It will help to operationalize in detail what this alignment must entail and what action must be taken to realize this. Formulating who is responsible for what, and why will prove to be very helpful.

Next Steps

From this evaluation it is clear that the program has made a positive impact in many different ways already. But there is room for improvement too. With the SEE Program coming to an end, now is the time to reflect on what can be learned from previous experiences so that in a next phase, the impact of the program can be further increased.

One of the things the evaluation made very clear, is the SEE Program has a broad scope. This is understandable in the light of the the overarching action research program, Schools as Energy Embassies in their Neighborhood, that is to a great extent exploratory in nature. Now that this phase comes to an end, it is time to start converging and to decide what the focal point of the next phase has to be. The first step of the next phase should therefore be the redefinition of program goals and objectives: narrow down the scope of the program, and making explicit what it is the program aims at. This can be used as starting point for improving the current design of the intervention, both by improving further the elements that were successful already, and by looking for new approaches and methods to social innovation.

12.2. Recommendations for future research

In this section I give a number of recommendations for future research that follow from the results of this research,. Some have been discussed already in the previous section or in the discussion of results.

Short-term vs Long-term effects

What has been mentioned already, is that at the moment of evaluation, it was not yet possible to make any definitive statements regarding the effect of the SEE Program on the realization of initiatives. What we do know is that the SEE Program has brought new people together and strengthened the school's ecosystem, and it can be expected that this network will grow in the future. However, as this evaluation was limited to the assessment of short term effects only, these are no more than speculations now. Future research can further develop and confirm these initial findings by means of monitoring and evaluation of the program outcomes over a longer period of time. This can cast light on the long-term effects of the program as well.

Statistical analysis of survey responses

From this research followed several suggestions for future research regarding the statistical analysis of the survey that measured the learning outcomes of pupils resulting from participation in the SEE Program.

Conducting baseline measurements The time planning of this thesis did not allow me to conduct a baseline measurement of pupils that participated in the program. An independent sample t-test with results of the pre-test and post-test would have provided important insights in the impact of the SEE workshops on pupils. Now, insights on the the impact of the program could only be based on a comparison of the test and control group. For future research, it is highly recommended to conduct a baseline measurement as well.

Correlation between survey items and constructs Because of a lack of time, for the quantitative analysis of survey results it was decided not to investigate the correlations between survey items and constructs, or to examine more closely the frequencies distributions of the data across different schools. Especially the firs would be interesting to look further into. From the results of this thesis it was clear that the most important learning outcome of this program is that it increases the knowledge op pupils on sustainability. It would be interesting to see if the knowledge components correlate to behavior and attitude items of the questionnaire.

Competencies

We have shown that the level of pupils is an important factor determining the success of workshops. For some of the assignment a certain skill set was prerequisite for successful execution. Interestingly, even though we indicated the level of pupils and their skill set to be important, we have little insight in what this exactly means. In this program, the development of competencies was not 'measured' or assessed in a systematic manner. There was looked at what competencies were part of the workshops, but this does by no means provide for conclusive evidence of the development of these competencies. Future research on the effects of the pupil's competencies on specific assignments such as village mapping might extend the explanations of the role that pupils play in co-creation processes. Also, this can provide more insight in the learning outcomes of the workshops.

Sustainability Education in The Netherlands

One of the starting points for this research was to examine the context in which the program was set; on the one hand do develop a broader understanding of the possible effects of the program but also to asses what contextual factors influence the program outcomes. Something that was not considered closely was the current state of education in The Netherlands. It was found that at the moment, a lot is going on with respect to SE in the Netherlands. For example, a new curriculum for primary schools is being developed that proposes the integration of Sustainability in the curriculum. Future research should examine how the SEE Program relates to current developments in sustainability Education in The Netherlands. This can provide insight in the value of the SEE Program, and enables the program to anticipate what schools find important.

Eco-schools

We found that schools that participated in the program in general do not have a clear ambition to become energy embassies in their neighborhood as a result of other priorities mainly. It would be interesting to explore further how the ambitions of a school influence the outcomes of the SEE Program. In this light, it should be interesting to implement the SEE Program at a school that have a vision on education in which sustainability plays a central role, such as the so-called eco-schools. Seemingly, these schools try to play a role as sustainable embassies already. Investigating the approach of eco-schools as compared to the SEE Program might provide a good starting point for discussion and further research.

Actor Networks

It's important to note that the effects of the SEE Program on the school's ecosystem, were operationalized in terms of the initiatives that were created, the stakeholders that participated in the program and the project groups that emerged in the course of the program. Though it can be assumed and seen that many new connections between stakeholders and the schools were created in the process, it is important to realize developments and changes in these actor networks were not assessed systematically. This is an interesting topics for future work.

Center of Gravity of Action Research

Action research has two faces: one is aimed at making an impact in the neighborhood the other focuses on the acquisition of knowledge. This action research program showed that sometimes, the focus on one can compromise the pursuit of the other. Resources have to be divided, but how exactly, is difficult to determine. One of the question that has been brought up several times, is to what extend participatory action research is the right method to explore the role of schools, and empower them as sustainable of energy embassies. A future study should aim to answer this question based on the experiences with action research in the SEE Program.

13

Reflections

In this last chapter, I would like to share with you some final reflections on the work I performed over the past six months. These include some of the broader limitations of my research that have not been discussed previously, the relevance my work from different perspectives, and finally a personal reflection on my thesis.

13.1. Research Limitations

Working on this thesis research, I made numerous decisions that eventually led to the result presented in this report. In many cases, these choices worked out well, in some cases the approach taken proved to have its limitations. In this section I discuss the two main limitations of this research.

Scope of the evaluation One limitation of this research is its broad scope, and consequently, the vast amounts of data that had to be processed and analyzed. In the research approach as it was initially decided upon, the scope of this research was narrowed down to an evaluation of the activities with pupils only. However, it became clear that the activities of pupils could only be analyzed in the light of the activities with stakeholders as well (as the workshops in the first place aimed at letting the pupils make a contribution to the co-creation process of sustainable initiatives). The effects of the workshops could therefore only be assessed and interpreted in the light of the activities with stakeholders.

As a result, the analysis of stakeholder activities got a prominent part in the case studies. This added important context for our analysis and revealed interesting insights in the effects of the program in general and the interaction between the different elements of the intervention. Though, from a research perspective, this approach suffered from the limitation that the broader scope came at the expense of depth of the performed analyses.

Bias The approach utilised suffers from the limitation that it is prone to bias. It's therefore important to be aware of the different sources of bias that have affected the research outcomes. Due to limited time, it's impossible to study every interesting element of the SEE Program in detail. Therefore, there is bias in data collection, which has to do with the chosen focal points of evaluation. The topics that are discussed in the interview, the questions you ask in the survey, the observation you report, in all these activities, often explicit decisions were made that can be difficult to control.

Also in data analysis and interpretation this can be a problem. This is related to the issue raised above in terms of the amounts of data that were processed, analyzed and interpreted for this study. There was so much data available that I had to choose what to use and what not. The approach taken was to use the research questions as starting point, but still it should be noted that what data was analyzed exactly, was also influenced by the fact that you can be drawn to those things that confirm your own beliefs (confirmation bias) or things you have heard before (memory-bias), or simply to the things that you find most interesting.

13.2. Relevance

In this section, I discuss the relevance of this thesis in terms of the scientific relevance, societal relevance, practical relevance and the relevance in light of the master program of which this thesis is part.

Societal and academic relevance

The societal relevance of the program is extensively discussed in the introductory chapter, chapter 1. In the light of climate change, the future seems more uncertain than ever before. We don't know what environmental and ecological crises the generations to come are going to be faced with. We struggle to find solutions that can make a change now, and in the future.

What we see now, is that there is increasingly being looked at what role social innovation and education can play in making the world more sustainable. What these two strategies to sustainability have in common is that they share a strong bottom-up character. The central idea of bottom-up approaches is that when individuals start to change their attitudes and behaviors, and these action are adopted by large numbers of peoples, this can make a real positive impact.

Interestingly, the role of education in local social innovation practices have not been addressed by prior research. In that sense, the SEE Program is a very innovative program. It is located right at the intersection of social innovation and education for sustainability. The multi-disciplinary nature of the program and the research associated with it, is what makes it such an intriguing topic.

So, even though much research has been performed on possible effects of sustainability education, the impact that sustainability education can make on communities is something that has not received much attention yet. Another gap that was indicated in the scientific literature, was what the role of existing educational structures is in the development of sustainability education. In other words, we can state that we want schools to pay more attention to sustainability, but we have little knowledge about the school context in which these development need to take place. Therefore insights are needed in what factors will drive or impede the development and implementation of sustainability education at the school level. In general, literature on sustainability education emphasized the importance of investigating not only what the effects of a program are, but also how and why these outcomes were produced.

As becomes clear, the academic and societal relevance of this research are closely related. In both cases, a key question is what happens at the intersection of social innovation and education for sustainability. In this light, the evaluation of the SEE Program holds valuable information. Due to its exploratory nature, much emphasis was put on mapping the context in which the program activities took place as well as on collecting data on both the design and implementation of the program activities. The result is that I not only gained insights in what the effects of the SEE Program are, but also what factors influenced the program outcomes.

Also, this thesis provides initial insights in the role of educational program in social innovation processes for a more sustainable communities. The findings from this thesis can be used as starting point for future research. For example, it will interesting to further examine the involvement of pupils in processes of co-creation in way that improves both the learning outcomes for pupils and the results of the co-creation process.

Practical Relevance

The practical relevance of this evaluation is that the insights gained can be used to further improve the intervention for future use and potentially, for up-scaling. The evaluation assessed different elements of the intervention, both individually and in connection to each other. The building blocks of this intervention that were discerned, can provide the basis for future interventions that aim to empower schools as sustainable embassies in their neighborhood. Also, the lessons learned as discussed in chapter 11 can provide valuable input for improving the intervention. Especially considering the possibility that a similar action

research programs are going to be implemented in the coming years, the findings of this research cycle can provide fertile ground for a next phase. As discussed in the conclusion, an important point of consideration for this next phase would be to redefine the goals and objectives related to the action research program and narrow down the scope of the intervention.

Relevance to the Master Program Engineering and Policy Analysis

This research is performed to obtain the degree of Master of Science as part the master program Engineering and Policy Analysis (EPA) at Delft University of Technology. This master is concerned with the analysis of complex societal problems, or as we call them, 'the grand challenges'. The analysis of complex socio-technical systems by means of both qualitative and quantitative methods forms the basis of our policy analysis. A multi-actor perspective, the 'wicked' nature of the problems we analyze, and a systematic approach to dealing with these problems are key.

As this thesis research was an evaluation of a policy intervention that aimed to bring about change in a social-technical context, this aligned directly to the objectives of the EPA Program. The approach taken for this evaluation was a system analysis based on both qualitative and quantitative data. Based on this evaluation, recommendations could be given for improvement if this intervention which can be regarded as a form of policy advice.

13.3. Personal Reflection

When I started with this thesis, I thought it was so obvious that schools have an important role to play in working towards a more sustainable society. Just as many others, I would not have had any problems with saying that schools should pay more attention to sustainability. But working on this thesis, I started to realize that it too easy to point to schools to solve this problem. Without having any conception or knowledge of what the implications are for the people to whom we pass the problem, it becomes an empty phrase. It is one thing to say that schools have a role to play in educating children about sustainability, but another to form an opinion about how to realize this.

What made this research so interesting to me, it that its aim was not to prove why sustainability education is important. The aim is providing insight in what it entails to actually implement an educational program on sustainability and social innovation. From what I have seen from the education sector over the past few months, this praxis-oriented knowledge is what we need to keep moving forward and realize that education can play a role in making our society more sustainable.

Another thing which I found interesting is that both the academic fields of social innovation and education for sustainability were completely new to me. During my thesis work, I got the opportunity to broaden and deepen my knowledge in both the practical and theoretical components of these research fields. One day I helped pupils that wanted to make their school yard more sustainable to making a vlog about this, the other day I would look into what measurement criteria I could establish for a questionnaire on pupil's environmental literacy. Working on two topics that are important elements of the social aspects of the energy transition and a more sustainable society is something that I believe to be very valuable.

What is very clear to me after these six months of research, is that there is no point in telling pupils what is right or wrong, or what they should or shouldn't do. The SEE Program is very interesting in this regard as the program is mainly about involving pupils as designers in co-creation processes. With the right tools, every pupil can be of value to these co-creation processes, and learn from them as well. Therefore, I believe there is great potential in the SEE program, but much work is needed to realize this potential. This research showed me that it is by experimentation and reflection that we need to learn about these things. This approach to learning and policy-making (i.e. a reflexive and praxis-oriented approach) necessarily only take small steps at a time. But eventually, if we have the patience to continue our work, and the courage to learn from our mistakes, these incremental changes will undoubtedly make a significant impact on how we involve children through education in making our society more sustainable.

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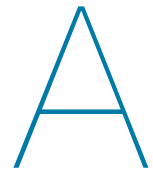
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Interview Script School Staff

The text below shows the script that was used for the semi-structured interviews that were conducted with the schools' staff members.

Thema 1: De School

1. Kan je wat vertellen over hoe het is om hier werken? (wat vind je leuk en minder leuk)
 - a. Waar ben je trots op, op deze school?
 - b. Wat is kenmerkend aan lesgeven hier?**
2. Hoe lang werk je hier al?
- 3. Wat is de visie op onderwijs van deze school?**
 - Hoe geven jullie hier invulling aan wereldoriëntatie en techniek?
 - Hoe merk je dat in de klas?
 - Hoe valt techniekonderwijs daarin?

Thema 2: Interesse in duurzaamheidsonderwijs op jouw school

4. Wordt er op deze school al aandacht besteed aan energie/duurzaamheidsonderwijs?
 - a. Is dit onderdeel van Techniek onderwijs? Of O&O?
 - b. Hoe wordt er invulling gegeven aan Techniek, waar loop je tegenaan?
 - c. Zijn andere docenten/schoolleiding er mee bezig?
 - d. Waar liggen de mogelijkheden voor DE op deze school?
 - Hoe creëer je draagvlak binnen de school voor DE?
 - e. Wat zijn valkuilen voor het opnemen van thema's energie en duurzaamheid in het huidige lesprogramma?
5. De kennis die de kinderen al hebben over duurzaamheid, waar halen ze dat vandaan?

Thema 3: Persoonlijke interesse in duurzaamheidsonderwijs

6. Besteed jij zelf aandacht aan duurzaamheid in de les?
 - a. Waar komt jouw persoonlijke interesse vandaan?
 - b. Waar haal je inspiratie vandaan?
 - c. Zou je dit meer willen doen en waar loop je tegenaan?
 - d. Zijn de kinderen geïnteresseerd in duurzaamheid?

Thema 4: Het programma

7. Welke bijdrage levert dit project voor de school en voor de kinderen?
 - a. Wat vind je belangrijk dat de kinderen meenemen?
8. Wat haal jij zelf uit deze lessen?
9. Wat vind je van de opzet van de lessen, als je kijkt naar jouw klas specifiek?
 - a. Heb jij suggesties voor lesaanpak en lesvorm n.a.v. wat je hebt gezien tijdens de lessen en wat je weet van jouw klas?
 - b. Is deze klas representatief voor de rest van de school?
 - c. Connectie met de buurt?
 - d. Welke rol kan de school spelen voor lokale gemeenschap?
10. Wat vind je van de leskisten?

Thema 5: Ouders

11. Hoe zouden we ouders kunnen betrekken en bereiken bij energie educatie?
 - a. Denk je dat ouders nu bereikt worden?
 - b. Vind je dat belangrijk?



Pupil Surveys

B.1. Survey Control Group

B.2. Survey test group

Hoe oud ben je? _____

In welke groep zit je? _____

In welke buurt staat jouw school? _____

Let op: het is niet erg als je het antwoord op een vraag niet weet. Kruis dit dan aan.

Hieronder staan 4 energiebronnen. Zijn ze duurzaam of niet? Kruis aan:

	duurzaam	niet duurzaam	Ik weet het niet
Olie	☐	☐	☐
Windenergie	☐	☐	☐
Zonne-energie	☐	☐	☐
Gas	☐	☐	☐

Zijn de volgende dingen duurzaam of niet? Kruis aan:

	duurzaam	niet duurzaam	ik weet het niet
Ramen met dun glas	☐	☐	☐
Groene stroom	☐	☐	☐
Afval scheiden	☐	☐	☐
Elektrische auto's	☐	☐	☐

Wat gebeurt er als er meer CO₂ in de lucht komt? Kruis aan:

	waar	niet waar	ik weet het niet
De aarde warmt op	☐	☐	☐
Sommige dieren sterven uit	☐	☐	☐
Meer overstromingen	☐	☐	☐
Meer vulkanen barsten uit	☐	☐	☐

Hieronder staat een aantal zinnen. Lees elke zin goed door en kruis aan wat jij ervan vindt:
Hoe blijer het gezichtje kijkt, hoe meer je het er mee eens bent.

	helemaal niet mee eens 	niet echt mee eens 	een beetje mee eens 	helemaal mee eens 
Ik vind het belangrijk dat we op school leren over duurzaamheid	☐	☐	☐	☐
Ik wil tijdens de les graag helpen de buurt rond de school duurzamer te maken	☐	☐	☐	☐
Ik maak me soms zorgen over het milieu	☐	☐	☐	☐
Ik heb ideeën over dingen die ik en mijn klasgenoten kunnen doen om de buurt duurzamer te maken	☐	☐	☐	☐
Ik vind dat iedereen zijn best moet doen om duurzaam te leven	☐	☐	☐	☐
Ik vind het saai om zelf bezig te zijn met duurzaamheid	☐	☐	☐	☐
Thuis doen wij dingen die duurzaam zijn	☐	☐	☐	☐
Ik praat soms over duurzaamheid met mijn ouders	☐	☐	☐	☐
Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn	☐	☐	☐	☐
Ik vind het leuk om op school te leren over duurzaamheid	☐	☐	☐	☐
Ik weet wat mensen of winkels in de buurt van de school doen aan duurzaamheid	☐	☐	☐	☐

Ben jij **door deze lessen** de volgende dingen **vaker** gaan doen, of deed je dit al thuis? Kruis aan:

	Niet waar	waar	dit deden we thuis al
Kort douchen	☐	☐	☐
Lichten uitzetten als je de kamer uit gaat	☐	☐	☐
Met de fiets naar school gaan	☐	☐	☐
Elektrische apparaten uitzetten als ze niet gebruikt worden	☐	☐	☐
Afval scheiden	☐	☐	☐
Spullen kopen bij de kringloopwinkel	☐	☐	☐

Hoe oud ben je? _____

In welke groep zit je? _____

In welke buurt staat jouw school? _____

Let op: het is niet erg als je het antwoord op een vraag niet weet. Kruis dit dan aan.

Hieronder staan 4 energiebronnen. Zijn ze duurzaam of niet? Kruis aan:

	duurzaam	niet duurzaam	Ik weet het niet
Olie	☐	☐	☐
Windenergie	☐	☐	☐
Zonne-energie	☐	☐	☐
Gas	☐	☐	☐

Zijn de volgende dingen duurzaam of niet? Kruis aan:

	duurzaam	niet duurzaam	ik weet het niet
Ramen met dun glas	☐	☐	☐
Groene stroom	☐	☐	☐
Afval scheiden	☐	☐	☐
Elektrische auto's	☐	☐	☐

Wat gebeurt er als er meer CO₂ in de lucht komt? Kruis aan:

	waar	niet waar	ik weet het niet
De aarde warmt op	☐	☐	☐
Sommige dieren sterven uit	☐	☐	☐
Meer overstromingen	☐	☐	☐
Meer vulkanen barsten uit	☐	☐	☐

Hieronder staat een aantal zinnen. Lees elke zin goed door en kruis aan wat jij er van vindt.
Hoe blijer het gezichtje kijkt, hoe meer je het er mee eens bent.

	helemaal niet mee eens 	niet echt mee eens 	een beetje mee eens 	helemaal mee eens 
Ik vind het belangrijk dat we op school leren over duurzaamheid	☐	☐	☐	☐
Ik wil tijdens de les graag helpen de buurt rond de school duurzamer te maken	☐	☐	☐	☐
Ik maak me soms zorgen over het milieu	☐	☐	☐	☐
Ik heb ideeën over dingen die ik en mijn klasgenoten kunnen doen om de buurt duurzamer te maken	☐	☐	☐	☐
Ik vind dat iedereen zijn best moet doen om duurzaam te leven	☐	☐	☐	☐
Ik vind het saai om zelf bezig te zijn met duurzaamheid	☐	☐	☐	☐
Thuis doen wij dingen die duurzaam zijn	☐	☐	☐	☐
Ik praat soms over duurzaamheid met mijn ouders	☐	☐	☐	☐
Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn	☐	☐	☐	☐
Ik vond het leuk om op school te leren over duurzaamheid	☐	☐	☐	☐
Ik weet nu meer over wat mensen of winkels in de buurt van de school doen aan duurzaamheid	☐	☐	☐	☐
Mijn klasgenoten en ik hebben geholpen deze buurt duurzamer te maken	☐	☐	☐	☐
Sommige ideeën die wij bedacht hebben gaan echt gebeuren	☐	☐	☐	☐
Ik heb over deze lessen gepraat met mijn ouders	☐	☐	☐	☐
Door dit project doen mijn ouders en ik meer ons best om duurzaam te leven	☐	☐	☐	☐

Ben jij **door deze lessen** de volgende dingen **vaker** gaan doen, of deed je dit al thuis? Kruis aan:

	Niet waar	waar	dit deden we thuis al
Kort douchen	☐	☐	☐
Lichten uitzetten als je de kamer uit gaat	☐	☐	☐
Met de fiets naar school gaan	☐	☐	☐
Elektrische apparaten uitzetten als ze niet gebruikt worden	☐	☐	☐
Afval scheiden	☐	☐	☐
Spullen kopen bij de kringloopwinkel	☐	☐	☐

Results from Survey Research

This appendix presents the outcomes of the statistical tests that were conducted for analyzing the responses from the surveys. The results are first presented separately, after which the results for the total group of respondents are examined and discussed. As already mentioned in chapter 10, the survey responses from the Rozemarn were not included in the analysis of the survey results.

C.1. Characteristics of the response group

This section provides basic information concerning the participants of the survey research.

Respondents' age

Figure C.1 and table C.1 both show the distribution of ages of pupils in the response group. One can see that most pupils were between the age of 9 and 11. The effect of respondents' ages on their attitude towards the program was not investigated.

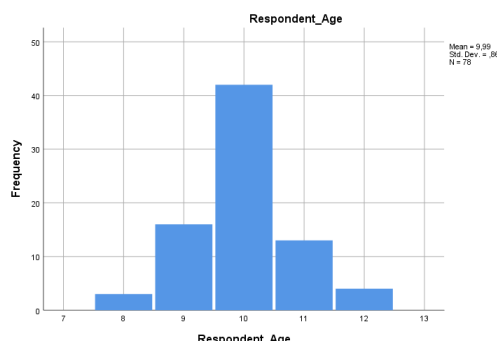


Figure C.1: The distribution of respondents' ages

Table C.1: The distribution of respondents' ages

Age	Frequency	Percent
8	3	3,8
9	16	20,5
10	42	53,8
11	13	16,7
12	4	5,1
total number of respondents (N)	78	

Representation of classes within the response group

Below, figure C.2 and table C.2 show how the classes are represented within the response group. Most pupils that participated in the survey were in group 6. This is due to [waarom dit zo is]. As with ages, the relationship between class and answers on the survey was not examined.

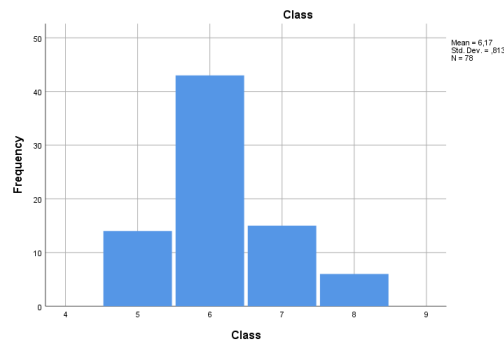


Figure C.2: The distribution of classes within the response group

Table C.2: The distribution of classes within the response group

Class	Frequency	Percent
5	14	17,9
6	43	55,1
7	15	19,2
8	6	7,7
total number of respondents (N)		78

Representation of schools within the response group

As can be seen in figure C.3 and table C.3 the schools are fairly evenly represented in the group of respondents. De Gagel has the most respondents (29), Hogeraven has the least (23).

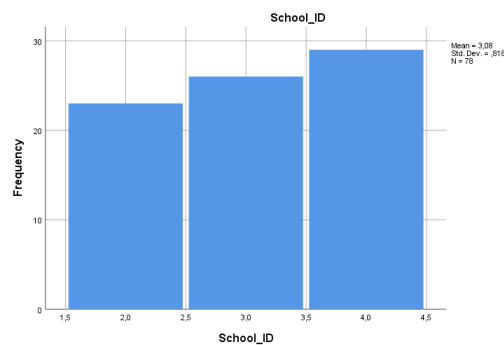


Figure C.3: The representation of schools within the response group

Table C.3: The representation of schools within the response group

School	Frequency	Percent
Hogeraven	23	29,5
Kaleidoskoop	26	33,3
De Gagel	29	37,2
total number of respondents (N)		78

Representation of test group and control group

Table C.4 shows that the number of respondents in the control group is about as large as the number of respondents that was in the test group.

Table C.4: The distribution of respondents over the test group and the control group

School	Frequency	Percent
Control group	41	52,6
Test group	37	47,4
total number of respondents (N)		78

C.2. Survey results Hogeraven

C.2.1. T-tests

On knowledge-related questions

Objective knowledge is firstly measured by a t-test comparing the scores between respondents from the test group and the control group in terms of their correct answers to the first three questions of the survey. When comparing the scores for the pupils of Hogeraven, no significant difference is found between the scores provided by the test group and the control group, as is denoted by the p-value (= 0,122) that is higher than the threshold value of 0,05. Although the test group shows a higher mean score, this difference is not proved to be significant.

Table C.5: T-test: Objective Knowledge questions De Hogeraven

	Mean	Standard deviation	N
Control group	8,0	2,490	11
Test group	9,42	1,676	12
	difference	T	p (two-sided)
t-test	-1,417	-1,613	0,122

Subjective knowledge refers to pupils' perception on their knowledge on sustainability. This is measured by questions 4 and 9 in the survey. The results from a t-test on question 4 are presented in table C.6. The table shows a p-value > 0,05 (namely: 0m346). This tells that no significant difference is found between the responses provided by the pupils from Hogeraven on this question.

Table C.6: T-test: Q4 Hogeraven

	Mean	Standard deviation	N
Control group	3,09	0,944	11
Test group	3,45	0,820	11
	difference	T	p (two-sided)
t-test	-0,364	-0,964	0,346

In addition, subjective knowledge is measured through question 9. Similar to the previous question, a t-test for question 9 shows no significant difference between the test and the control group. It can therefore not be assumed that the groups score differently on their perceived knowledge on sustainability.

Table C.7: T-test: Q9 Hogeraven

	Mean	Standard deviation	N
Control group	2,91	1,221	11
Test group	3,17	0,577	12
	difference	T	p (two-sided)
t-test	-0,258	-0,637	0,534

On attitude-related questions

Attitude is measured by the sumscore for a predefined set of questions. Table C.8 shows the results for the t-test that compares the test and the control group for their scores on these attitude-related questions. The table clarifies that no significant difference is obtained through a t-test ($p = 0,185$ which is $> 0,05$). This indicates that there is no significant difference between the test and the control group. Although it seems that the mean score is higher for the test group, this is not found to be significant.

Table C.8: T-test: Attitude questions Hogeraven

	Mean	Standard deviation	N
Control group	19,90	4,630	10
Test group	22,00	2,374	12
	difference	T	p (two-sided)
t-test	-2,100	-1,373816	0,185

On behaviour-related questions

Firstly, the behaviour for participants in the research was tested with question 7. Table C.9 presents the result from the t-test for Kaleidoskoop in which the test and control group are selected as the independent variable. The t-test reveals no significant difference between the judgment given by the test group and by the control group.

Table C.9: T-test: Q7Behaviour questions Hogeraven

	Mean	Standard deviation	N
Control group	3,9	0,831	11
Test group	3,50	0,522	12
	difference	T	p (two-sided)
t-test	-0,4090	-1,427	0,168

In addition to question 7, question 8 also involves assessing how participants judged their sustainable behaviour. Table C.10 involves the results from the t-test for question 8 for Hogeraven. The table shows a p-value of 0,044 which denotes a significant difference that is obtained from the t-test for the test and the control group for this question. This results indicate that respondents from the test group at Hogeraven agreed more with the statement "Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn" than pupils from the control group.

Table C.10: T-test: Q8Behaviour questions Hogeraven

	Mean	Standard deviation	N
Control group	2,09	0,831	11
Test group	2,92	0,996	12
	difference	T	p (two-sided)
t-test	-0,826	-2,147	0,044

Thirdly, the behaviour is measured along the sumscore for the final questions on behaviour in the survey. Table C.11 shows that a significant differences is found for how pupils in the test group assess their sustainable behaviour in comparison to the pupils in the control group (p-value = 0,012). The results from table C.11 clearly indicate that the children that participated in the Program did in fact judge that they behave more sustainable than those that did not participate.

Table C.11: T-test: Behavioursumscore Hogeraven

	Mean	Standard deviation	N
Control group	3,64	1,286	11
Test group	4,83	0,389	12
	difference	T	p (two-sided)
t-test	-1,197	-2,964	0,012

C.2.2. SEE Program specific questions

C.3. Survey results De Kaleidoskoop

C.3.1. T-tests

On knowledge-related questions

One of the ways to assess the knowledge of the pupils is through the first questions in the survey. A t-test, comparing the scores for the test groep and the control group (where a high score represents a high amount of questions answered correctly), clearly shows different scores for the children in the test group against those in the control group. This difference is significant at a 5% level, as indicated by the p-value in table C.12. This information tells

that the children that participated in the SEE Program scored higher on average for these questions than those in the control group.

Table C.12: T-test: Objective Knowledge questions De Kaleidoskoop

	Mean	Standard deviation	N
Control group	7,85	2,267	13
Test group	9,46	1,127	13
	difference	T	p (two-sided)
t-test	-1,615	-2,300	0,034

A more subjective approach to assessing the knowledge was obtained by the questions 4 ("Ik heb ideeën over dingen die ik en mijn klasgenoten kunnen doen om de buurt duurzamer te maken") and 9 ("Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn"). Table C.13 shows the scores the respondents from the Kaleidoskoop gave to question 4. The average scores for both groups are actually the same, and no significant difference between the two groups is found (p-value = 1,000).

Table C.13: T-test: Q4 Kaleidoskoop

	Mean	Standard deviation	N
Control group	2,62	1,193	13
Test group	2,62	1,261	13
	difference	T	p (two-sided)
t-test	0,00	0,00	1,00

Table C.14 shows the scores for the pupils of Kaleidoskoop for question 9. This question too shows no significance difference was found for the responses in the control group compared to those in the test group.

Table C.14: T-test: Q9 Kaleidoskoop

	Mean	Standard deviation	N
Control group	3,38	0,870	13
Test group	3,00	1,155	13
	difference	T	p (two-sided)
t-test	0,385	0,959	0,357

On attitude-related questions

Attitude was assessed by computing a sumscore over a given set of questions. Table C.15 shows the results that were obtained from comparing the scores between the test group and control group. The p-value (0,098) shows that no significant difference is found at a 5% significance level.

Table C.15: T-test: Attitude questions Keleidoskoop

	Mean	Standard deviation	N
Control group	20,77	4,512	13
Test group	17,09	5,907	11
	difference	T	p (two-sided)
t-test	3.678	1,729	0.098

On behavior-related questions

Tables C.16, C.17 and C.18 all refer to the pupils' expression concerning their own sustainable behaviour.

From table C.16 one can see that a t-test provides a p-value of 0,521 which is well above the threshold value of 0,05. It can be concluded that no significant difference was found between the control and the test group, for this question.

Table C.16: T-test: Q7Behaviour questions Keleidoskoop

	Mean	Standard deviation	N
Control group	3,0	1.291	13
Test group	2,69	1,109	13
	difference	T	p (two-sided)
t-test	0,308	0,652	0,521

In table C.17 one can see that no significant difference is found by a t-test comparing the control group and the test group on question 8 for De Kaleidoskoop. It is interesting to see that the mean score for the control group seems to be considerably higher than that of the test group, however this difference did not prove to be significant.

Table C.17: T-test: Q8Behaviour questions Keleidoskoop

	Mean	Standard deviation	N
Control group	2,85	1,144	13
Test group	2,00	1,00	13
	difference	T	p (two-sided)
t-test	0,846	2,008	0,056

Lastly, also no significant difference was found for the pupils' answers in the test and control group for the behaviour sumscore. This is presented in table C.18. The p-value of 0,887 shows that the difference is not significant.

Table C.18: T-test: Behaviour sumscore Keleidoskoop

	Mean	Standard deviation	N
Control group	3,00	0,913	13
Test group	2,92	1,706	13
	difference	T	p (two-sided)
t-test	0,077	0,143	0,887

C.3.2. SEE Program specific questions

C.4. Survey results De Gagel

C.4.1. T-tests

This section deals with presenting the results that are obtained from various T-test that examine the differences between the test- and the control groups for the pupils in the response group from De Gagel.

On the objective knowledge questions (table C.19), it can be noticed that a T-test shows a significant difference between the test and the control group. More specifically, the pupils that participated in the SEE Program (those were in the test group) gave more good answers than those from the control group (as indicated by a p-value of 0,002 which is below the 0,05 level). This indicates that the Program did sort effect at De Gagel in terms of knowledge gained on sustainability, as it is measured in this survey.

On knowledge-related questions

Table C.19: T-test: Objective Knowledge questions De Gagel

	Mean	Standard deviation	N
Control group	6,59	2,501	17
Test group	9,42	1,621	12
	difference	T	p (two-sided)
t-test	-2,828	-3,432	0,002

Table C.20 shows a p-value of 0,447, which indicates that no significant difference is found in terms of how the pupils from test and the control group at De Gagel perceive their knowledge on sustainability. This was measured (together with Q9) by Q4: "Ik heb ideeën over dingen die ik en mijn klasgenoten kunnen doen om de buurt duurzamer te maken".

Table C.20: T-test: Q4 Gagel

	Mean	Standard deviation	N
Control group	2,29	1,312	17
Test group	2,67	1,231	12
	difference	T	p (two-sided)
t-test	-3,73	-,7772	0,447

Also in terms of subjective knowledge is question 9: "Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn". Table C.21 shows that for this level, a significant difference ($p = 0,035$) is obtained from a t-test comparing the responses from the test and the control group on this question. This indicates that pupils who participated in the program did indeed thought that they knew more about sustainability projects than those that did not participate.

Table C.21: T-test: Q9 Gagel

	Mean	Standard deviation	N
Control group	2,29	1,263	17
Test group	3,36	1,206	11
	difference	T	p (two-sided)
t-test	-1,070	-2,226	0,035

On attitude-related questions

Table C.22 shows a p-value of 0,850. This denotes that there is no significant difference in how pupils from the test and the control group at De Gagel judged their attitude towards sustainability.

Table C.22: T-test: Attitude questions Gagel

	Mean	Standard deviation	N
Control group	18,94	3,958	16
Test group	19,25	4,712	12
	difference	T	p (two-sided)
t-test	-0.313	-0.191	0.850

On behaviour-related questions

As for behaviour, measured by pupils responses to questions 7, 8 and by the sumscore for the final questions in the survey, the following results are obtained.

A t-test on the responses on question 7 reveals a p-value of 0,683 (see table C.23). This indicates that there is no significant difference in the way pupils from the test group judged this question as compared to those in the control group.

Table C.23: T-test: Q7Behaviour questions Gagel

	Mean	Standard deviation	N
Control group	2.53	1.231	17
Test group	2,33	1,303	12
	difference	T	p (two-sided)
t-test	0,196	0,413	0,683

Question 8 deals with a similar question as question 7 and also refers to respondents' behaviour towards sustainability. Table C.24 shows that no significant difference was found for how children from De Gagel judged their behaviour as measured through question 8.

Table C.24: T-test: Q8Behaviour questions Gagel

	Mean	Standard deviation	N
Control group	1,35	0,862	17
Test group	1,92	1,311	12
	difference	T	p (two-sided)
t-test	-0,564	-1,400	0,173

Interestingly, table C.25, presenting the result of a t-test with p-value of 0,010, shows a significant difference for the pupils in the test group compared to those in the test group. This finding indicates that pupils that took part in the SEE Program clearly gave a higher score than those in the control group.

Table C.25: T-test: Behaviour sumscore Gagel

	Mean	Standard deviation	N
Control group	1,82	1,131	17
Test group	3,08	1,311	12
	difference	T	p (two-sided)
t-test	-1,260	-2,766	0,010

C.4.2. SEE Program specific questions

C.5. Survey results across all participants

To get an idea of the effect of the SEE Program at the schools that participated in this round of the research, the results from the surveys are compared. This section presents the results from comparing the test- and control groups over all participants.

C.6. Overall comparison of test and control group

C.6.1. T-tests

On knowledge-related questions

Table C.26 shows the results of the t-test for all respondents, with their score on the knowledge questions as the dependent variable. The p-value of 0,000 shows that there is a significant difference between the scores of the pupils in the test group in comparison to those in the control group. This shows that the pupils in the test group, i.e. those that took part in the SEE Program, scored significantly higher on average than those children that did not participate. Also the standard deviation is lower in the test-group than in the control group.

Below, the tables C.27, C.28 and C.29 show the results for a t-test comparing the results on the questions: Q1 ("Hieronder staan 4 energiebronnen. Zijn ze duurzaam?"), Q2 ("Zijn de volgende dingen duurzaam of niet?") and Q3 ("Wat gebeurt er als er meer CO₂ in de lucht komt?"). All questions had 4 sub-questions, a score of 0 indicates no good answers were given while a 4 represent a correct answer on all questions, etc.

Table C.26: T-test: Objective knowledge questions for the response group

	Mean	Standard deviation	N
Control group	7,37	2,457	41
Test group	9,43	1,444	36
	difference	T	p (two-sided)
t-test	-2,067	-4,465	0,000

Table C.27 below shows that the pupils in the test group scored higher on average than the children in the control group. Interesting to see is that the pupils in the test group score fairly high with a mean score of 3,84 out of 4. The pupils in the control group also score fairly high with an average score of 3,05 out of 4.

Table C.27: T-test: Knowledge question 1

	Mean	Standard deviation	N
Control group	3,05	1,182	41
Test group	3,84	0,374	37
	difference	T	p (two-sided)
t-test	-0,789	-4,055	0,000

The pupils from the test group scored higher than those in the control group, as is indicated by a significant p-value (0,000) in table C.28. The average score for the test group is still relatively high (3,24 out of 4) while the control group scores significantly lower (2,22 out of 4, on average).

Table C.28: T-test: Knowledge question 2

	Mean	Standard deviation	N
Control group	2,22	0,988	41
Test group	3,24	0,723	37
	difference	T	p (two-sided)
t-test	-1,024	-5,175	0,000

When comparing the scores from the test and the control group for the third knowledge-question, no significant difference is observed (as indicated by the p-value of 0,291 as can be seen in table C.29). Interestingly, all pupils tend to score lower on this question than they did on the previous two questions.

Table C.29: T-test: Knowledge question 3

	Mean	Standard deviation	N
Control group	2,10	1,068	41
Test group	2,35	1,033	37
	difference	T	p (two-sided)
t-test	-0,254	-1,064	0,291

Table C.30 shows the scores for the test and the control group on question 4. Question 4 was a measurement for their 'subjective knowledge' score, how the pupils assessed their own knowledge concerning sustainability ("Ik heb ideeën over dingen die ik en mijn klasgenoten kunnen doen om de buurt duurzamer te maken"). No significant difference is observed for the responses from the test group and the control group.

Table C.30: T-test: Q4 for all respondents

	Mean	Standard deviation	N
Control group	2,61	1,202	41
Test group	2,89	1,166	36
	difference	T	p (two-sided)
t-test	-0,279	-1,031	0,306

Similar to question 4, question 9 was also concerned with measuring pupils' perceived knowledge concerning sustainability ("Ik kan dingen aanwijzen in de buurt rond de school die duurzaam zijn"). Again, a t-test shows no significant difference between the two groups (p-value = 0,155). Although the mean score for the respondents from the test group is higher than for those in the control group, this difference cannot be called significant on a 5% significance level.

Table C.31: T-test: Q9 for all respondents

	Mean	Standard deviation	N
Control group	2,80	1,209	41
Test group	3,17	1,000	36
	difference	T	p (two-sided)
t-test	-0,362	-1,437	0,155

On attitude-related questions

Attitude was measured by a sumscore over a given set of questions. Table C.32 shows the results for the independent sample t-test for the attitude comparing the test and the control group. The t-test gives a p-value of 0,792 which means there is clearly no significant difference between the test and the control group concerning their attitude towards sustainability (education) as measured by this survey research. Also, when looking at the mean scores and the standard deviation for both groups, little differences can be observed.

Table C.32: T-test: Attitude questions for all respondents

	Mean	Standard deviation	N
Control group	19,79	4,281	39
Test group	19,51	4,835	35
	difference	T	p (two-sided)
t-test	0,281	0,265	0,792

On behaviour-related questions

Sustainable behaviour by the pupils is measured in three ways: by question 7, question 8 and by a sumscore for the final questions in the questionnaire (as explained in detail in 10 and in appendix C.7).

Table C.33 shows the results for the t-test comparing the scores given by the test group and the control group for question 7: "Thuis doen wij dingen die duurzaam zijn". The p-value of 0,974 shows that no significant difference is observed for the answers provided by the pupils' in the test and the control group. This finding also shows from the fact that both the means score and the standard deviation are similar for both groups.

Table C.33: T-test: Q7Behaviour questions all respondents

	Mean	Standard deviation	N
Control group	2,83	1,160	41
Test group	2,84	1,118	37
	difference	T	p (two-sided)
t-test	-0,009	-0,033	0,974

Another measurement for the sustainable behaviour is by question 8: "Ik praat soms over duurzaamheid met mijn ouders". A t-test for the answers to this question again shows no significant difference ($p = 0,348$) when comparing the answers from the test and the control group. The mean score given by the pupils in the test group is little higher, but the difference is too low to be proven significant.

Table C.34: T-test: Q8Behaviour questions all respondents

	Mean	Standard deviation	N
Control group	2,02	1,129	41
Test group	2,27	1,170	37
	difference	T	p (two-sided)
t-test	-0,246	-0,944	0,348

Finally, table C.35 shows the results from the t-test for the sumscore concerning the behaviour-related questions. A p-value of 0,006 is obtained which clearly shows a significant difference in the answers for the test group and the control group. The test group scores higher on average (3,59) than the control group (2,68). This finding indicates that the pupils that participated in the SEE Program did in fact say to behave more sustainable than the children that did not participate. This finding can be important for the SEE Program as it indicates that the program contributes to more sustainable behaviour among children.

Table C.35: T-test: Behaviour sumscore all respondents

	Mean	Standard deviation	N
Control group	2,68	1,331	41
Test group	3,59	1,518	37
	difference	T	p (two-sided)
t-test	-0,912	-2,826	0,006

C.6.2. SEE program specific questions

C.6.3. ANOVA to compare responses between schools

For this analysis, the schools were selected to be the independent variable. The responses to the questions are still assumed to be the dependent variables.

On knowledge-related questions

Absolute knowledge per school Table C.36 shows that there is no significant difference in pupils' scores when comparing across different schools. Although it seems that pupils at the Gagel, an ANOVA comparing all schools shows that this difference is not significant at a 5% level.

Table C.36: Scores on absolute knowledge comparison between schools (ANOVA)

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	8,74	2,18	23	1,000	0,374
Kaleidoskoop	8,65	1,94	26		0,441
De Gagel	7,76	2,57	29		
F = 1,566 ; p = 0,216					

Both tables C.37 and tabC.38 refer to a subjective measure for the knowledge respondents have concerning sustainability. Subjective knowledge denotes knowledge that pupils perceived that they had. Interesting to see is that there is a significant difference between the way the pupils of the different schools rated this question ($p = 0,037$ which is $< 0,05$). When we look at the Post Hoc Bonferri, it can be noticed that this difference is mainly due to the difference in answers provided by the pupils from Hogeraven when compared to those from De Gagel. Pupils from De Gagel seem to score lower.

Table C.37: Scores on knowledge question 4 between schools (ANOVA)

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	3,27	0,883	22	0,156	0,040
Kaleidoskoop	2,62	1,203	26		1,000
De Gagel	2,45	1,270	29		

$F = 3,452$; $p = 0,037$

The table below shows the comparison between how the pupils on the three rated question 9. An ANOVA shows that no significant differences are found for the responses from the pupils of the different schools.

Table C.38: Scores on knowledge question 9 between schools (ANOVA)

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	3,04	0,928	22	1,000	0,898
Kaleidoskoop	3,19	1,021	26		0,363
De Gagel	2,27	1,329	28		

$F = 1,293$; $p = 0,281$

On attitude-related questions

Table C.39 below shows the results from the ANOVA for the attitude construct over the pupils of all schools. As shown by the p-value of 0,234 ($> 0,05$) no significant differences are found across the schools.

Table C.39: Attitude for the respondents of participating schools (ANOVA)

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	21,05	3,645	22	0,430	0,382
Kaleidoskoop	19,08	5,413	24		1,000
De Gagel	19,07	4,216	28		

$F = 1,485$; $p = 0,234$

On behaviour-related questions

Table C.40 below shows how the pupils from the different schools judge question 7 "Thuis doen wij dingen die duurzaam zijn". The table shows that an ANOVA provides a p-value $< 0,05$ (namely 0,024). When examining this finding more closely, the Post Hoc Bonferri reveals that this difference is mainly due to the fact that the pupils from De Gagel express a lower agreement with the question than pupils from Hogeraven.

Table C.40: On sustainable behaviour (Q7) for the respondents of participating schools (ANOVA)

School	Distribution		N	Post Hoc Bonferri	
	Mean	Std. dev.		Kaleidoskoop	De Gagel
Hogeraven	3,30	0,703	23	0,441	0,019
Kaleidoskoop	2,85	1,190	26		0,544
De Gagel	2,45	1,242	29		

$F = 3,945; p = 0,024$

Closely related to question 7 is question 8: "Ik praat soms over duurzaamheid met mijn ouders". The results from an ANOVA conducted on the responses to this question (dependent variable) compared between the schools (independent variable) shows that the difference between the pupils at the schools show to be significantly different at a 5% level ($p = 0,003$). This difference can mainly be attributed to the fact that the pupils from De Gagel rate this question lower than those from the other two schools.

Table C.41: On sustainable behaviour (Q8) for the respondents of participating schools (ANOVA)

School	Distribution		N	Post Hoc Bonferri	
	Mean	Std. dev.		Kaleidoskoop	De Gagel
Hogeraven	2,52	0,994	23	1,000	0,008
Kaleidoskoop	2,42	1,137	26		0,016
De Gagel	1,59	1,086	29		

$F = 6,168; p = 0,003$

In table C.42, the results from the ANOVA representing pupils' attitude towards sustainability is shown. As clarified in chapter 10 a sumscore was constituted for these questions. In the table, it becomes clear that there is a significant difference in the behaviour that the pupils from different schools expressed in the survey. Pupils from Hogeraven score significantly higher compared to the pupils from De Kaleidoskoop and from De Gagel.

Table C.42: On sustainable behaviour for the respondents of participating schools (ANOVA)

School	Distribution		N	Post Hoc Bonferri	
	Mean	Std. dev.		Kaleidoskoop	De Gagel
Hogeraven	4,26	1,096	23	0,002	0,000
Kaleidoskoop	2,96	1,341	26		0,232
De Gagel	2,34	1,344	29		

$F = 14,765 ; p = 0,000$

C.6.4. SEE Program specific questions

In Table C.43, the statistics of the program specific questions Q11 to Q15 of the second part of the questionnaire are shown including the mean score, the mode and the percentage of positive and negative responses which were determined based on the response frequencies. The pupils that scored 'absolutely disagree' or 'slightly disagree' were counted as negative, those that 'slightly agreed' and 'very much agreed' are counted as positive responses.

The average scores on these questions vary between 2,43 for questions 15 and 3,0 for question 11, which is lower than the pupils scored on average on the attitude related questions. Also, it can be seen that the pupils score lowest on the behavior related questions.

Table C.43: Statistics of program specific questions

		Mean	Mode	% negative responses	% positive responses
Q11	knowledge (action possibilities)	3,0	4	26%	74%
Q12	Attitude (self-efficacy)	2,72	4	41,7%	58,3%
Q13	Attitude (self-efficacy)	2,92	3/4	27,8%	72,2%
Q14	Behavior (communication)	2,49	1	48,6%	51,4%
Q15	Behavior (action)	2,43	3	45,9%	54,1%

Anova for Q11 to Q15

When comparing the scores of the schools against each other with an ANOVA analysis it is notable that on each questions except for Q12, the pupils of De Hogeraven show on average higher scores than the pupils of De Kaleidoskoop and De Gagel. For Q12, De Kaleidoskoop and De Hogeraven have the same mean score of 3,08 and De Gagel a much lower score of 2,0. The differences between the schools were found to be significant for Q12 and Q13 and are a result of the significantly lower scores of De Gagel compared to the scores of De Hogeraven and De Kaleidoskoop. The results of the ANOVA analysis for each of these questions are shown in table Table C.44, Table C.45, Table C.46, Table C.47 and Table C.48.

Table C.44: Anova for question 11 in the test group

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	3,42	0,699	12	1,000	0,293
Kaleidoskoop	3,00	1,225	13		1,000
De Gagel	2,67	1,231	12		

F = 1,456; p = 0,247

Table C.45: Anova for question 12 in the test group

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	3,08	0,793	12	1,000	0,047
Kaleidoskoop	3,08	1,165	12		0,047
De Gagel	2,00	1,128			

F = 4,323 ; p = 0,021

Table C.46: Anova for question 13 in the test group

School	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
Hogeraven	3,67	0,492	12	0,251	0,000
Kaleidoskoop	3,08	0,954	13		0,005
De Gagel	1,91	0,944	11		

F = 13,385; p = 0,000

Table C.47: Anova for question 14 in the test group

	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
School					
Hogeraven	2,75	0,965	12	1,000	0,783
Kaleidoskoop	2,54	1,266	13		1,000
De Gagel	2,17	1,467	12		

F = 0,670; p = 0,518

Table C.48: Anova for question 15 in the test group

	Distribution			Post Hoc Bonferri	
	Mean	Std. dev.	N	Kaleidoskoop	De Gagel
School					
Hogeraven	2,92	0,900	12	0,274	0,437
Kaleidoskoop	2,15	1,144	13		1,000
De Gagel	2,25	1,215	12		

F = 1,757; p = 0,188

C.7. Reliability analysis

The idea was proposed to develop constructs for certain factors that represent how pupils perceive sustainability in school and their environment. In practice, that means that certain questions in the survey relate to the same topic. Several constructs were mentioned:

- Subjective knowledge: subjective knowledge refers to how pupils perceived their knowledge on sustainability. This was measured through questions 4 and 9.
- Behaviour: this is measured through the questions 7 and 8.
- Attitude related questions: this construct denotes the attitude pupils expressed towards sustainability. This was measured in the survey by the answers to questions 1, 2, 3, 5, 6 and 10. It should be noted that for question 6, the answers were inverted. The question originally had the opposite direction compared to the other questions.

A reliability analysis was conducted for checking the internal validity of the questions that should together form a construct, i.e. whether the questions indeed relate to each other (as assumed when coming up with the constructs). A reliability analysis reveals a Cronbach's alpha. A minimum value of 0,7 was used as the base level that allowed for concluding that the questions indeed had high correlation and internal validity. The following results were found:

Subjective knowledge Table C.49 shows that a Cronbach's alpha value of 0,456 is obtained from a reliability analysis in SPSS. This value is not above the 0,7 threshold, therefore it is not permitted to construct sum score for this presumed construct. As a consequence, it was decided to examine the responses to the questions 4 and 9 separately.

Table C.49: Correlations and Reliability analysis for questions 4 and 9

	Attitude_Q4	Attitude_Q9
Attitude_Q4		0,295
Attitude_Q9	0,295	
Cronbach's Alpha	0,456	

Behaviour related questions A reliability analysis for the questions 7 and 8 shows a Cronbach's alpha of 0,609, as is shown in table C.50. This value is below the threshold value of 0,7. Therefore, it is concluded that no sum score can be constituted for this variable.

Table C.50: Correlations and Reliability analysis for questions 7 and 8

	Attitude_Q7	Attitude_Q8
Attitude_Q7		0,438
Attitude_Q8	0,438	
Cronbach's Alhpa	0,609	

Attitude related questions For this proposed construct, a Cronbach's alpha value of 0,862 was obtained, which is clearly above the threshold value. Therefore, it is allowed to develop a new variable, i.e. a sumscore of all the questions represented in table C.51. Subsequently, the responses from the pupils of the different schools are compared against this new construct to check if there is a difference in the pupil's attitudes per school.

Table C.51: Correlations and Reliability analysis for questions 1, 2, 3, 5, 6 and 10

	Attitude_Q1	Attitude_Q2	Attitude_Q3	Attitude_Q5	In_Attitude_Q6	Attitude_Q10
Attitude_Q1		0,664	0,495	0,438	0,619	0,697
Attitude_Q2	0,664		0,581	0,549	0,456	0,641
Attitude_Q3	0,495	0,581		0,483	0,428	0,429
Attitude_Q5	0,438	0,549	0,483		0,310	0,475
Inv_Attitude_Q6	0,619	0,456	0,428	0,310		0,603
Attitude_Q10	0,697	0,641	0,429	0,475	0,603	
Cronbach's Alhpa	0,862					