Education for sustainable development (ESD) has been launched worldwide to empower young people by providing them with action competence for a sustainable future. ESD certifications are commonly used by schools as support in their ESD implementation efforts. To date, scholarly attention to and critical reflection on the effects of such certification on students' perceptions of sustainability have been limited.

This doctoral thesis focuses on this gap in ESD research through five large-scale studies of which four were conducted in Sweden (N=2413) and one in Taiwan (N=1741). Questionnaire instruments measuring students' sustainability consciousness (SC) and experiences of ESD were developed for the project. The findings reveal that the effect of ESD certifications on students' SC is limited. The results also show positive effects of ESD on students' SC in the form of the teaching approaches based on holism and pluralism, regardless whether schools were ESD certified or not. Moreover, results also reveal that in the certified schools the general adolescent dip and gender gap in students' SC were reinforced. Given the findings, this thesis can give more generalizable empirical guidance for schools and certifying organizations to further reorient education towards ESD.

Daniel has 15 years of experience as a science teacher at the lower secondary school level in Sweden. Since 2012, he has combined research on education for sustainable development (ESD) at Karlstad university with work in the municipality of Karlstad, where he supports schools to implement ESD in practice.

This doctoral thesis is based on the following papers.


Student Sustainability Consciousness

Investigating Effects of Education for Sustainable Development in Sweden and Beyond

Daniel Olsson
Student Sustainability Consciousness

Investigating Effects of Education for Sustainable Development in Sweden and Beyond

Daniel Olsson
Environmental and sustainability education has been an important part of education worldwide for many years, aiming to foster pro-environmental behavior among young people. Education for sustainable development (ESD) and its teaching components holism (the approach to the content) and pluralism (the approach to teaching) has been launched as the educational approach to support this aim. Environmental and sustainability certifications are commonly used by schools as support in their ESD-implementation efforts. To date, scholarly attention to, and critical reflection on the effects of such certification on students’ perceptions of sustainability have been limited.

This doctoral thesis focuses on this gap in ESD research through five large-scale studies, four of which were conducted in Sweden and one in Taiwan. Questionnaire instruments measuring students’ sustainability consciousness (SC) and their experiences of ESD were developed for the project. In total, 2,413 students in Sweden and 1,741 students in Taiwan (grades six, nine and twelve) participated by filling in the SC questionnaire. The Swedish students also filled in questionnaires about their experiences of ESD at their schools in terms of holistic approach to content and pluralistic approach to teaching.

The results question the impact of schools’ environmental and sustainability certification on students’ SC. The results also show the importance of holism and pluralism in ESD for students’ SC, regardless of whether schools were certified or not. Moreover, the findings reveal an adolescent dip in students’ SC as well as a gender gap, both of which were reinforced among students in the certified schools.

Given the findings, this thesis can give more generalizable guidance for schools and certifying organizations to further reorient ESD towards teaching and learning approaches that have an effect on student SC.
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List of papers

This doctoral thesis is based on the following papers, which are referred to by their Roman numerals.


Authors’ contributions

Authors’ contributions to Paper I
Daniel Olsson, Niklas Gericke and Shu-Nu Chang Rundgren developed the research ideas, the research design and the research questions. Daniel Olsson conducted the data collection and performed the statistical analysis. Daniel Olsson wrote the first draft of the paper and interpreted the outcomes of the statistical analysis with contribution from Niklas Gericke and Shu-Nu Chang Rundgren.

Authors’ contributions to Paper II
Daniel Olsson and Niklas Gericke developed the research ideas, the research design and the research questions. Daniel Olsson conducted the data collection and performed the statistical analysis. Daniel Olsson wrote the first draft of the paper and interpreted the outcomes of the statistical analysis with contribution from Niklas Gericke.

Authors’ contributions to Paper III
Daniel Olsson and Niklas Gericke developed the research ideas, the research design and the research questions. Daniel Olsson conducted the data collection and performed the statistical analysis. Daniel Olsson wrote the first draft of the paper and interpreted the outcomes of the statistical analysis with contribution from Niklas Gericke.

Authors’ contributions to Paper IV
Daniel Olsson, Jelle Boeve-de Pauw, Niklas Gericke and Teresa Berglund developed the research ideas, the research design, the research questions and the questionnaires. Tzuchau Chang collected the data in Taiwan. Daniel Olsson and Jelle Boeve-de Pauw developed the analytical plan and performed the statistical analysis. Daniel Olsson wrote the first draft of the paper and interpreted the outcomes of the statistical analysis with contribution from Niklas Gericke and Jelle Boeve-de Pauw. All authors read and approved the paper before submission.
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Introduction

We are the first generation that can end poverty, and the last that can end climate change (UN, 2015a).

These are the words of the former UN Secretary-General Ban Ki-moon when receiving an honorary degree from the Catholic University of Leuven, Belgium, in 2015. In one sentence he puts the spotlight on two of the major tasks for our present civilization. The nature of the tasks that we are presently facing on earth commonly involves the interaction between environmental, social and economic dimensions. These three dimensions define the concept of sustainable development (SD) together with the past, present and the future as well as the local, regional and the global perspectives (WCED, 1987). The present and future citizens in all societies worldwide therefore need knowledge and competences to deal with such problems, which puts education in the driver’s seat for empowering people with such competences and knowledge for a sustainable future (UNESCO, 2006; 2009; 2014a).

The United Nations proclaimed the years 2005-2014 to be the Decade of Education for Sustainable Development (DESD), as a response to the need of SD in education (UNESCO, 2006). The educational approach of education for sustainable development (ESD) should not only provide young people with knowledge, but also with the competence to take action for a sustainable development (Jensen & Schnack, 1997). Hence, the core message of the DESD was that the increased globalization has made it important to educate through an approach which broadens the scope of environmental education, to include both economic and social dimensions in addition to the environmental.

Internationally, the DESD and the subsequent Global Action Program for Education for Sustainable development (UNESCO, 2014a), has been a benchmark for national curriculum development worldwide. In Sweden, a new curriculum was launched for the primary and lower secondary school levels as well as for the upper secondary school level (Swedish National Agency for Education, 2011a; 2011b). The Swedish curricula are in-
fluenced by the international policy discourse on ESD (to be further discussed). However, teachers encounter barriers in reorienting teaching and learning towards ESD, where interdisciplinarity is an example of such a barrier, (Borg, Gericke, Höglund, & Bergman, 2012).

Certifications and awards have been important tools in the implementation process of ESD to reorient teaching and learning in Sweden and other countries (e.g. FEE, 2018; Swedish National Agency for Education, 2018a; ED-GRS, 2018; MoEP, 2018; GPPT, 2018). Even if we believe that environmental and sustainability certifications are crucial tools for implementing ESD, do we know that such certifications empower young people with lifelong learning action competence for a sustainable development? In the beginning of the DESD there was very little empirical evidence for the effectiveness of such implementation efforts at a student level and to what extent ESD is experienced by students in the classrooms (Atkinson, Dietz, & Neumayer, 2007). The DESD came to an end in 2014 and one of the messages in the final report address: ‘the need for more research, innovation monitoring and evaluation to develop and prove the effectiveness of ESD good practice’ (UNESCO, 2014b, p. 11).

Scholarly attention has been drawn to the effects of the implementation efforts using environmental and sustainability certifications. Studies in the Czech Republic and Slovak Republic (Cincera & Krajhanzl, 2013; Cincera, Kovacikova, Maskova, Medal, & Medalova, 2012), Flanders (Boeve-de Pauw & Van Petegem, 2011; 2013a), Israel (Goldman, Pe’er, & Yavetz, 2017) and the U.S. (Warner & Elser, 2015) have shown that the effects of what comes out at the student level are limited. Furthermore, the research to date has focused on the environmental dimension, which means that we do not know much about the student perceptions and broader consciousness of sustainability, including social and economic dimensions along with the environmental.

Research in the Swedish context has so far highlighted investigations at the teacher level (e.g. Borg, Gericke, Höglund, & Bergman, 2012; 2014; Bursjöö, 2014; Hasslöf, 2015; Stagell, Almers, Askelund, & Apelqvist, 2014; Sund, 2015). Less research has had a focus on environmental and
sustainability perceptions at the student level (e.g. Berglund & Gericke, 2016; 2018; Kramming, 2017; Manni, Sporre, & Ottander, 2013; Ojala, 2015; Torbjörnsson, Molin, & Karlberg, 2011). Moreover, there has been limited scholarly attention in Sweden regarding generalizable effects at the student level of the implementation of ESD in schools using environmental and sustainability certifications (Berglund, Gericke, & Chang Rundgren, 2014). The research in this doctoral thesis therefore follows a quantitative tradition in that the effects of ESD at the student level are studied, rather than the learning process in the classroom.

The overall aim of this thesis is to investigate and contribute novel and generalizable findings on the effects of ESD implementation at a student level. This overall aim is twofold. The first aim is to explore the impact of certifications of education for sustainable development at the student level in Sweden. In relation to this first aim, our research group had the opportunity to collaborate on a research project in Taiwan. Findings from the Taiwanese context are used for comparative purposes with the findings and implications in the Swedish context, but also to contribute to the body of knowledge on ESD implementation initiatives using certifications. The main comparison in the investigations are between students in schools with a certification or award for ESD and students in schools without such certification. Factors that could be expected to have impact on the results (e.g. age and gender) are included in the investigations.

The second aim is to investigate the effects of ESD teaching (in terms of holism and pluralism) at the Swedish student level and to look beyond the impact of certifications on student sustainability consciousness. In the background section I will go into more detail on the ESD approaches (e.g. holism and pluralism) that have been described as important for students to experience at their school.

The aims outlined above justify the need of a more generalizable quantitative large-scale research design rather than a small-scale qualitative design. There are five papers included to address the aims of this thesis. The first four papers focus on the first aim, regarding which the first three pa-
pers concern the Swedish context and the fourth paper the Taiwanese context. The fifth paper focuses on the second part of the aim outlined above. In the following sections I will elaborate on the background, methods, the main findings and discuss conclusions in relation to the overall aim covered by the five papers.
Background

Theoretical foundation
This doctoral thesis is based on the interdisciplinary environmental psychology tradition which considers research in the interplay between individuals and the surrounding environment (see Gifford, 2016). In the current research project, the surrounding is referred to as education and more specifically, environmental and sustainability education. In environmental psychology there is strong cross-cultural and generalizable support for the relation between basic human values and pro-environmental attitudes and behaviors (Schultz et al., 2005). Values are commonly structured into four main categories (Schwartz, 1992; 1994). Values of self-transcendence (universalism and benevolence) have its antagonist in self-enhancement (hedonism, achievement and power). Values of openness to change (stimulation and self-direction) have its antagonist in the domain of conservation (security, conformity and tradition) (Schwartz & Rubel, 2005).

In environmental psychology a strong relation has been confirmed between the values of self-transcendence and pro-environmental attitudes and behaviors (Schultz et al., 2005). Self-transcendence means valuing beyond self and incorporates living and non-living nature and not just the relation to other people (Schultz et al., 2005). Between values of self-enhancement and pro-environmental attitudes and behaviors, the relationship is negative (Schultz et al., 2005). Values of self-enhancement covers a narrow scope of self, in that it reflects less inclusiveness of others or the living world. The basic human values (Schwartz, 1992; 1994; Schwartz & Rubel, 2005) provide the lens through which components of pro-environmental attitudes can be understood. Hence, environmental psychology builds on the notion that psychometric models can be used to guide education (commonly in a generalizable way). Researchers commonly investigate mental constructs of environmental attitudes among individuals that are exposed to specific educational approaches or interventions (Kollmuss & Agyeman, 2002).
The globally recognized DESD policy (UNESCO, 2006) was targeted to influence education in such a way. Through national development of environmental and sustainability education approaches, the aim of the DESD was to empower young people with knowledge, attitudes and competences to act for a sustainable development (UNESCO, 2006). By taking a quantitative environmental psychology approach, that goes beyond the environmental dimension to also include economic and social dimensions, this thesis zooms into effects on students. The thesis therefore contributes novel and valuable information for the further development of environmental and sustainability education in Sweden and internationally.

In the following sections of the background I delve more into details on the context of the research, give an overview of the emergence of environmental and sustainability education along with some built in tensions in the field. Finally, I will present research in the field that includes psychometric models and instruments, which have been important in the research process of this thesis. I will round off the background section by a brief introduction to the concept of sustainability consciousness and the instrument sustainability consciousness questionnaire and finally provide the order of the papers included in this thesis.

The Swedish context

The Swedish school system is rather decentralized to the local level. Even though there are governmental national curricula and directives for the formal educational system, the decision on how to form education locally is taken on the municipality level.

Compulsory schooling in Sweden starts in grade one (ages 6–7) and ends with grade nine (ages 15–16). Almost all children in Sweden also take a preparatory school year before the compulsory school starts (preschool class). Nearly 100% of the students continue from grade nine to an upper secondary school program of interest, i.e., grade ten (ages 16–17) to grade twelve (ages 18–19). In the final three years of the compulsory school system (lower secondary school) and the three years of the upper secondary school teaching is traditionally provided by subject teachers, who usually teaches the students in one to four subjects. At the primary school level
(grade 1–3), it is more common for one teacher to teach most subjects in a class. A new curriculum for the compulsory school system (Swedish National Agency for Education, 2011a) and a new curriculum for upper secondary school (Swedish National Agency for Education, 2011b) were launched in Sweden in 2011. At the same time, a new grading system was introduced, in which student knowledge and competences in all school subjects are assessed.

National curricula in Sweden have partly been adopted and adjusted to align with the international objectives for ESD outlined during the UN DESD (UNESCO, 2006; 2009). These international objectives regarding ESD have support as educational aims in the Swedish compulsory curricula (Almers, 2013). In the compulsory school system there are subject specific aims that students should achieve in grade three, six and nine. For the upper secondary school system there are aims related to each of the courses connected to the different subjects. The inclusion of the SD concept in the curricula is not totally straightforward and unproblematic. According to Svalfors (2017), the economic and social dimensions do not balance and challenge the natural scientific environmental dimension of SD in the upper secondary curriculum, which more or less leaves it up to the individual teacher to make learning holistic (including all three SD dimensions) for the students.

**ESD and certification systems in Sweden**

The Swedish National Agency for Education initiated a new assessment portal to support teachers’ understanding of the 2011 curricula and syllabi. It took a great deal of the teachers’ and the school leaders’ time for professional development to build knowledge and competences around the new assessment system during a period before and after the launch of the curricula and syllabi (Swedish National Agency for Education, 2018b). Hence, there was less time for professional development in ESD. Except for the curricula, there have been few other political initiatives to support schools with ESD implementation during the DESD. Sinnes and Eriksen (2016) found the lack of ESD political initiatives to be an international trend. Educational reforms have centered on student performance on
national and international educational assessments rather than on reforms towards ESD (Sinnes & Eriksen, 2016). For the national level in Sweden, this means that schools have turned to organizations and authorities for support in implementing ESD. There are several well-known organizations supporting schools, teachers and school leadership in ESD, on the basis of the Swedish curricula and the benchmarks of international policy agreements (Keep Sweden Tidy Foundation, 2018; WWF, 2018; The Swedish Council for Higher Education, 2018). The Keep Sweden Tidy Foundation administers the international eco-school certification (FEE, 2018) in Sweden. Schools get support with themes to work with and are supposed to send in action plans and reports to keep their certification. The Swedish National Agency for Education founded an award in 2005, to which schools can apply to become ESD schools (Swedish National Agency for Education, 2018a*). One big difference between the eco-school certification and the award school for sustainable development is that eco-schools give support to schools in terms of instructional material and feedback on the action plans, which schools cannot get via the award administrated by the Swedish National Agency for Education. Schools can apply for the award and if they fulfill all the criteria, they can keep the award for three years (Swedish National Agency for Education, 2018a). A few non-governmental organizations in Sweden have worked specifically with a few model schools for ESD, but also with more general support of environmental and sustainability activities to schools (e.g. SSNC, 2018; WWF, 2018). The prominent role of ESD certifications in the Swedish school system has made the certified schools proxy-schools for ESD. It therefore makes them interesting to include in investigations on the effects of ESD implementation at the student level. However, so far there has not been any scholarly attention drawn to generalizable perspectives in Swedish research on ESD in general and certifications specifically.

* In 2005, the Swedish national agency for school development (Myndigheten för skolutveckling) was responsible for the ESD implementation in the Swedish school system. The Agency was discontinued in 2008.
In the mid-DESD Review of context and structures for education for sustainable development and in the DESD final report, it was concluded that the implementation of ESD should be an evidence-based process rather than a learning-based process (UNESCO, 2009; 2014b). Moreover, the process must be adapted to the cultural context of the specific country (UNESCO, 2006; 2014a). Results from cross-cultural research in environmental education conclude that cultural differences do exist and should be considered in research to improve discussions on findings and implications in the field (e.g. Boeve-de Pauw & Van Petegem 2013b). With this in mind, it was important to include more than one cultural context in the research to be able contribute to comparisons for more generalizable findings and implications to the research field. Regarding this thesis, it was possible to include data from the cultural context of Taiwan in the research project.

The Taiwanese comparison

The trend of using certifications and awards when implementing ESD is not only a Swedish phenomenon, but an international trend. The Taiwanese central government has worked actively on implementing the concept of a sustainable Taiwan in the past decades. Education plays a central role in their implementation strategy for sustainable development (Tsai, 2012). The Ministry of Education decided, in 1999, to promote and fund the ESD certification green school partnership project in Taiwan (GPPT), as an important step in the strategy (GPPT, 2018). The GPPT certification was initiated by the Graduate institute of environmental education, which was also responsible for its implementation. The GPPT is “characterized by school autonomy, connections among green school partners, and having a reward and evaluation system” (Lee, Wang, & Yang, 2013, p. 185). Schools in Taiwan join the project voluntarily. When connected to the project, the schools get support for their action plans, instructional material, and access to resources through the Taiwan green school partnership network (GPPT, 2018).

Despite the differences in implementation strategies between the two countries (Sweden and Taiwan), there are two important similarities.
First, sustainability certifications play a significant role regarding ESD in the educational systems of both countries. Second, scholarly attention and critical reflection on the effects of such sustainability education initiatives are missing in both countries. Findings from nationwide generalizable effect-studies at the student level, including the most widely implemented ESD certification programs in Sweden and with support from Taiwan, would contribute new knowledge to the field of environmental and sustainability education research.

**The effectiveness of environmental and sustainability certifications**

In the international research field, scholarly attention has been given to the effectiveness of environmental and sustainability education implementation initiatives, of which some include an environmental or sustainability certification. In the introduction, a few key example studies, which have been important for the direction of this thesis are mentioned.

In the Czech Republic and the Slovak Republic, the eco-school certification has been shown to have limited effects on student action competence for pro-environmental behavior (Cincera & Krajhanzl, 2013; Cincera et al., 2012). The students’ environmental action competence was not affected by how long time they had participated in the eco-school program. Cincera and Krajhanzl (2013) concluded that students who participate in decision-making at their school develop a higher level of environmental action competence. Hence, for the Czech and Slovak contexts it does not seem likely that it is the schools’ participation in environmental certification programs that had an impact at the student level, but the students’ opportunities to participate and make decisions in the environment at their school (Cincera et al., 2012; Cincera & Krajhanzl, 2013; Cincera & Maskova, 2011). The importance of such emancipatory approaches in environmental and sustainability education was highlighted and argued for in a recent evaluation study of the eco-school program in the Czech Republic, where the students’ participation predicted their satisfaction with the program (Cincera, Boeve-de Pauw, Goldman, & Simanova, 2018).
The eco-school certification in Flanders has been shown to have limited effects on students' environmental perceptions (Boeve-de Pauw & van Petegem, 2011; 2013a; 2017). The results show that students in eco-schools know more about the environment in general in comparison to students in non-eco-schools (Boeve-de Pauw & Van Petegem, 2011; 2017). Boeve-de Pauw and Van Petegem (2011) found that students' utilization values (utilizing nature) correlated negatively with their environmental knowledge. Preservation values (preserve nature) on the other hand, has been found to correlate positively with environmental behavior (Boeve-de Pauw & Van Petegem, 2011; Milfont & Schultz, 2016). However, the eco-school system in Flanders has no effect on the environmental behavior of their students (Boeve-de Pauw & Van Petegem, 2011; 2013a). The conclusion from the Flemish context was that eco-schools seem to mainly focus on cognitive outcome and miss components in the pedagogy that will have effect on student environmental behavior (Boeve-de Pauw & Van Petegem, 2017). Moreover, there were gender differences in Flanders worth considering when investigating the effectiveness of environmental and sustainability education. Boys showed a higher tendency to utilize nature, while girls showed a higher tendency towards values of preservation of nature (Boeve-de Pauw, Jacobs, & Van Petegem, 2014). These gender differences were in line with other research findings in the field (e.g. Liefländer & Bogner, 2014). The Flemish investigations of the effectiveness of the eco-schools led to a process of reconstructing the eco-school certification system in Flanders (Vanhoof, Boeve-de Pauw, & Van Petegem, 2016).

Results from Israel suggest that students' behaviors and attitudes become less environmentally friendly as they enter adolescence (Negev, Sagy, Garb, Salzberg, & Tal, 2008). These findings are in line with other research where student environmental attitudes decrease as they enter adolescence (Liefländer & Bogner, 2014). More recent Israeli research reveals the conflict in young people's minds between pro-environmental behavior intentions and their consumption patterns (Goldman, Pe'er, & Yavetz, 2017). Moreover, social aspects linked to environmental topics were less familiar to the young Israeli people (Goldman, Pe'er, & Yavetz, 2017). Similarly, the Americans Warner and Elser (2015) found that the majority
of the investigated green ribbon schools in the U.S. implemented many projects that existed in isolation from each other. This meant that students in these schools did not get support in addressing social and economic issues along with the environmental perspective. This highlights the importance of including more perspectives than the environmental when dealing with environmental and sustainability topics in education. Nevertheless, there are currently optimistic insights into using a green school certification to build pro-environmental behavior and action competence for SD among students in Israel (Goldman, Baum, Ayalon, & Weiss, 2018; Shay-Margalit & Rubin, 2017). Shay-Margalit and Rubin (2017) conclude that it is possible to change student behaviors and attitudes in a pro-environmental way using green school certifications. However, the effects were mainly visible in the green schools that introduced environmental instructions in education in a persistent and more intense way. Goldman and colleagues (2018) deepened the investigations on the effectiveness of the Israeli green school strategies to promote sustainability. They confirmed the student inability to connect their consumption patterns to its impact on sustainability. Including more of sustainability learning competency goals was suggested as a means towards a more effective green school certification in Israel (Goldman et al., 2018).

In Sweden there is very limited research including such generalizable investigations zooming in on the student level. Moreover, the international research outlined above indicates the importance of including the factors of gender (Boeve-de Pauw, Jacobs, & Van Petegem, 2014) and age (Negev et al., 2008) in the investigations.

**Swedish ESD research**

In the Swedish ESD research context the Graduate school in education and sustainable development (GRESD, 2018) has been an important actor. The graduate school started in 2009 (i.e. in the middle of the DESD) with the intention to strengthen Swedish ESD research nationally and internationally. The main part of the research in the graduate school has had a qualitative approach zooming in on ESD teaching and learning contexts and theories (GRESD, 2018).
The presence of GRESD in Sweden has led to a strong research tradition of contributing knowledge to the international field of environmental and sustainability education research at many levels. Before GRESD, the works of Sandell, Öhman and Östman (2005) and Öhman (2008) on selective environmental teaching traditions have been of great importance for understanding the role and character of environmental and sustainability education in the Swedish school system. The researchers have described three environmental teaching traditions, namely the fact-based (i.e. teaching factual knowledge contributing to finding the right answer to a problem), normative (i.e. the teachers implement actions to foster certain behaviors) and pluralistic, which is synonymous with the democratic teaching approach in environmental and sustainability education (Rudberg & Öhman, 2010).

Mogren, Gericke and Scherp (2018) recently investigated differences at the upper secondary school organizational level in Sweden between schools that are explicitly implementing ESD and schools that are not active in implementing ESD. Their results show that the ESD active schools have greater potential to support practical teaching and pedagogical activities than do the non-ESD active schools. The school improvement processes in the ESD active schools are also more coherent and have higher quality (Mogren, Gericke, & Scherp, 2018).

A large proportion of the Swedish research on ESD focuses on the teacher level of the school organization. For example, Borg and colleagues (2012; 2014) found subject bound differences in upper secondary teachers’ perceptions of SD and barriers encountered by teachers implementing ESD. Bursjöö (2014) found barriers that make it difficult for teachers to practice ESD, of which one important factor was the lack of professional development. Sund (2015) highlighted the importance of using the complexity of SD in educational settings (i.e. not simplifying for the students) when teachers in an ESD certified upper secondary school empowered students to become informed and democratic citizens. Hasslöf (2015) zoomed in on the political and democratic dimensions of ESD among teachers and contributed new insights on ESD as an overarching perspective to the overall educational aim. There are strong indications that teachers in Sweden
generally teach environmental and sustainability issues in a normative manner (Borg et al., 2012), including teachers in ESD certified schools (Stagell et al., 2014), i.e. the teaching is not oriented towards pluralism as suggested in research and the curriculum. A normative teaching that limits the sustainability action alternatives may make the students to become “moral captives in the prevailing societal system”, but also render them without the knowledge of potential actions for complex sustainability issues (Stagell et al., 2014, p. 110).

ESD certified schools have also been shown to have limited impact on upper secondary students’ broader consciousness of sustainable development (Berglund, Gericke, & Chang Rundgren, 2014). Only small differences were found between students in ESD certified school and non-certified schools. The same upper secondary students’ meaning making of the environmental, social and economic dimension of SD varies with the context presented. The inclusion of more than one dimension at a time seems to be important for students’ broader consciousness of sustainability (Berglund & Gericke, 2016). Recently, Berglund and Gericke (2018) investigated young peoples’ views of the relationships between economic growth, economic development and SD. They identified four clusters of views in which students expressed an un-differentiating positive, nuanced ambivalent, two-way convinced, or a critically position in their view of the necessity of economic growth and economic development to reach SD (Berglund & Gericke, 2018). Research has also shown that there is a strong correlation between environmental and social commitment among upper secondary students in Sweden, (Torbjörnsson, Molin, & Karlberg, 2011). On the other hand, Manni, Sporre and Ottander (2013; 2017) found students (primary school students) to have difficulties to see the interconnection between SD dimensions.

Even though Sweden has contributed a large amount of environmental and sustainability education research over the past decade, this thesis contributes to the field by zooming in on the student level through more generalizable nationwide studies on the effectiveness of ESD. So, the question arises, what are the generalizable effects to evaluate among students?
To answer that question, I have to dig a little bit deeper into the tradition of environmental and sustainability education research.

**The tradition of environmental and sustainability education**

Environmental and sustainability education research is a field that has been under strong growth and development in recent decades (Van Poeck & Lysgaard, 2016; Scott, 2009). The emergence of the environmental and sustainability education field is well documented by many researchers (e.g. Kopnina, 2014; Sinakou, Boeve-de Pauw & Van Petegem, 2017; Stevenson, 2006). Therefore, there is no great value in re-producing an extensive walkthrough of the development of the field. However, I still want to highlight some important milestones in the environmental and sustainability education history that have been important for the direction and development of this thesis. The field of environmental and sustainability education includes the two major traditions environmental education (EE), based on more ecocentric perspectives, and education for sustainable development (ESD), based on more anthropocentric perspectives. From an EE ecocentric perspective, it is the environmental dimension that draws boundaries on human socioeconomic activities, while an ESD anthropocentric perspective tends to prioritize human socioeconomic needs to the same extent as the environmental dimension (Kopnina, 2012). After a brief look into the emergence of EE and ESD, I elaborate further on the similarities and tensions between the two traditions. However, at this stage it is worth mentioning that this thesis builds on the perspectives inherent in ESD (UNESCO, 2006) and the Swedish ESD research tradition described previously.

**Environmental and sustainability education in policy**

The awareness and importance of EE began to spread throughout the world in the late 1960s. Through the so-called Belgrade charter (UNESCO-UNEP, 1976), the first joint international agreement was signed, in which the goal of EE is defined, 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

The citation above shows that EE is centered on the environmental dimension and the solution to environmental problems. Moreover, the Belgrade charter clarified that environmental problems may be associated with societal issues such as economic and human development. EE objectives in the Belgrade charter clarify the kind of environmental awareness, knowledge, attitude skills and commitment that education should foster among individuals and social groups in the world population. Even though there was a strong environmental focus in the guiding principles for EE, there were also guidelines suggesting that EE should consider environmental education from a broader perspective, i.e. EE should include other perspectives than the environmental (UNESCO-UNEP, 1976).

During the 1980s, sustainable development (SD) emerged as a concept, whose definition has become widely known through the report, Our common future, from the World commission on environment and development (WCED, 1987). The SD concept brought the economic and social perspective together with the environmental perspective in the environmental and sustainability education discourse. A few years later in Rio de Janeiro, Agenda 21 (UN, 1992) was introduced. In Agenda 21, the ‘environment and its associated problems’ from previous international agreements were brought together in the concept of ESD, by more explicitly including the economic and social dimensions (UN, 1992). In Agenda 21, the first major steps were taken to reshape the curricula worldwide by introducing the concept of ESD.

In 2005, the UN launched the DESD (Decade of Education for Sustainable Development) to further implement ESD into educational systems throughout the world (UNESCO, 2006). The intention was to put education in the driver’s seat and thereby empower (young) people with action competence (Jensen & Schnack, 1997) to deal with the highly complex problems that characterize present society. The studies in this thesis were performed at the end of the DESD. This was the time of the evaluation of the national ESD implementation efforts and the time to bring implica-
tions of ESD research into the transition to the next phase of ESD implement-
ment – the Global Action Programme (GAP) (UNESCO, 2014a). The cur-
current GAP aims to scale up actions at all levels of the school organization
when implementing ESD in educational practices. The underlying idea is
that ESD should empower young people by equipping them with action
competence for SD, and thus in the long run, to contribute to transforming
the society into being environmentally, socially and economically sustain-
able (Lotz-Sitiska, Wals, Kronlid, & McGarry, 2015). What characterizes
the educational approaches that are considered effective in transforming
society towards SD? Before elaborating on this topic, some of the tension
and similarities built into the value systems of EE and ESD need attention.

EE and ESD research – tensions and similarities
In the previous section a brief overview was given of the environmental
and sustainability education policy development of ESD from EE. So,
what is the difference between EE and ESD? The different routes in the
field of environmental and sustainability education and research have not
developed without friction and tension (Van Poeck & Lysgaard, 2016). Ba-
sically, the tensions between EE and ESD and the debate in the field, con-
cern different ways of looking at the world. In environmental psychology
and philosophy, the ecocentric perspective and the anthropocentric per-
spective are described as opposites (e.g. Dunlap, Van Liere, Mertig, &
Jones, 2000). However, both ecocentric and anthropocentric values in-
cludes expressions of environmental concern, but the tensions lie in the
reasons for the concern. Ecocentric value involves Earth’s living and non-
living systems and attributes intrinsic value to all organisms (Thompson
& Barton, 1994) (compare with biocentrism, which does not include non-
living systems). In anthropocentrism, the environment deserves protec-
tion because of its relation to human needs and welfare. Humans are
therefore given a special position in relation to other organisms and non-
living systems (Thompson & Barton, 1994). Critique of ESD derives from
the more anthropocentric perspectives embedded in the concept, whilst
EE more often represents an ecocentric perspective (Kopnina, 2012). An
ecocentric perspective does not put human needs before other organisms.
Instead, the intrinsic value of nature is highlighted (Kopnina, 2012; 2014; Piccolo, 2017).

In ESD, social and economic perspectives are often presented as being equally important as the environmental perspective. Poverty reduction, cultural diversity, gender equality and re-orienting market economy are examples of social and economic sub-themes that together with the environmental perspective and sub-themes, such as climate change and biodiversity, were defined in connection with the DESD policy agreement (UNESCO, 2006). There are 15 such topics of anthropocentric character that frame the content of ESD (UNESCO, 2006, pp. 18-21). The environmental dimension consists of five such sub-themes, the economic dimension of three sub-themes and the social dimension of seven sub-themes. A wide definition makes it easy for people, organizations, companies and governments to adapt the concept of SD to their own agendas, resulting in priority being given to the social and economic dimensions (Giddings, Hopwood, & O’Brien, 2002). Further critique against ESD is that the environmental dimension in these sub-themes has been downgraded (from an ecocentric perspective) in relation to the social and economic dimensions (Kopnina, 2012). Kopnina argues that this may lead to practitioners changing their focus, away from environmental issues in education towards mostly social issues. According to Kopnina (2012; 2014), we thereby miss the goal to build environmental action competence in education.

However, other researchers argue that ecocentric oriented values coexist with anthropocentric oriented values (Piccolo, 2017; Wiseman & Bogner, 2003). The fact that environmental problems are related to our way of living, and hence structurally anchored in society highlights the importance of not separating environmental, social and economic dimensions in education (Jensen & Schnack, 1997; Rudsberg & Öhman, 2010; Vare & Scott, 2007). The context and the nature of the topic must be considered upon deciding which of the embedded dimensions is of most importance. Some researchers raise a warning that the current capitalist and neoliberal agenda (which basically means the agenda of economic and social transformation within a free market) tends to prioritize national local economic
interests over others, and therefore contradicts the ideals of environmental and sustainability education (Kopnina, 2015; Lotz-Sisitka, 2016; Man-teaw, 2008). National decisions have effect outside the country boarders, at an international level and vice versa. As a consequence, Lotz-Sisitka (2016) argues for a more radical framework for environmental and sustainability education research and policy that moves beyond the country boarders reinforced by the neoliberal agenda.

These critical voices above are important components in challenging the discourse on ESD. As mentioned, ESD implementation nationally has been influenced by international policy agreements (e.g. UNESCO, 2006; 2009; 2014a) which means that decisions regarding ESD implementation often are based on policy compromises and practitioners’ gut feeling. To contribute empirical evidence of what comes out of ESD at a student level is therefore an important contribution of this thesis. However, to evaluate the effects of ESD it is important to clarify what an ESD approach involves.

**EE and ESD educational approaches**

The way in which we tackle environmental and sustainability issues in teaching and learning has received increasingly scholar attention (Aikens, McKenzie, & Vaughter, 2016; Jensen & Schnack, 1997; Lijmbach, van Arcken, van Koppen, & Wals, 2002; Rudsberg & Ohman, 2010; Wals; 2011; Vare & Scott, 2007). The overall message is the importance of the role of education in providing young people with competences and thus in the long run, contribute to transforming the world into a more sustainable place (Lotz-Sitiska et al., 2015; Vare & Scott, 2007). The concept of action competence has been described as an educational ideal in the Danish health and environmental education research (Breiting & Mogensen, 1999; Jensen & Schnack, 1997; Mogensen & Schnack, 2010). Environmental and sustainability action competence has been described as covaritions between knowledge of action possibilities, confidence in one’s own influence and the willingness to act (e.g Breiting & Mogensen, 1999).

Similarly, other researchers have described the same kind of teaching and learning approach (towards capacity building) as transformative learning (Wals, 2011), or as ESD 1 and ESD 2 (Vare & Scott, 2007). ESD has also
been defined as consisting of the two parts holism and pluralism (Lijmbach et al., 2002; Rudsberg & Öhman, 2010; Sandell et al., 2005; UNESCO 2009; Öhman, 2008). As a pedagogy, pluralism is a democratic approach characterized by an effort to acknowledge and engage different views, values and perspectives in education (Rudsberg & Öhman, 2010; Öhman, 2008). Moreover, pluralism means no teaching towards predefined solutions (Rudsberg & Öhman, 2010), i.e. the teachers do not know the answer to a problem in advance. In a pluralistic approach, students are trained to view a problem from many perspectives before they take a decision towards a solution. The pluralism part of ESD therefore deals with how to approach issues and problems related to SD in education. The holism part of ESD involves the approach to content by tapping into the relation between environmental, social and economic perspectives, the past-present-future, and local-regional-global relations embedded within these issues, i.e. the students have to consider different contexts along with the relations and conflicts inherent between the SD dimensions as they work on a solution to the problem (Sandell et al., 2005, UNESCO, 2009; Öhman, 2008). The holism part of ESD therefore deals with how to approach the SD content in education. Hence, when holism and pluralism go together in ESD, students develop the knowledge and the competences (i.e. action competence) required to the transformation towards SD.

Vare and Scott (2007) consider ESD 1 to be synonymous with learning for sustainable development (p. 193). In ESD 1, learning should promote attitudes and behavior among individuals in a certain direction. This is a common and traditional approach in EE research, in which, for instance, pro-environmental attitudes and behavior are frequently measured in order to determine the impact of education. ESD 1 is comparable to what Wals (2011) calls the transmissive approach. Vare and Scott (2007) argue that acting on the basis of predetermined goals can help people do the obvious in order to contribute to a sustainable future by changing attitudes and behaviors. Short-term goals can promote the benefits of SD to society and individuals. Vare and Scott’s (2007) second path, ESD 2, rests on a slightly different assumption than ESD 1. They consider ESD 2 to be an approach synonymous with learning as sustainable development.
(Vare & Scott, 2007, p. 194) and that it is characterized by two features. Firstly, ESD 2 is characterized by conflicting perspectives and by the exploration of the various contradictions inherent in current environmental and sustainability problems. Such contradictions and conflicts are characterized by the involvement of environmental, social and economic perspectives and the fact that a problem could have different solutions depending on the degree of consideration taken to a certain perspective. Vare and Scott (2007) stress that the second main feature of ESD 2 involves the development of critical thinking and the building of competences to tackle issues and dilemmas concerning sustainability. ESD 2 can therefore be seen as closely related to the transformational pedagogy for a sustainable society (Wals, 2011) and to the two approaches holism and pluralism (Rudsberg & Öhman, 2010; Sandell et al., 2005).

However, holism and pluralism, or ESD 1 and ESD 2, do not constitute an either-or-debate. Attention should be paid to both the approaches holism and pluralism (or if we prefer to use ESD 1 and ESD 2 to describe ESD) (Rudsberg & Öhman, 2010; Vare & Scott, 2007). Although scholars describe environmental and sustainability education with slightly different words, there is still consensus on the importance to include the components outlined above. In the international arena, these components have been heeded in the DESD (the decade of education for sustainable development).

Countries worldwide have agreed on the key areas that should be included in the reorientation of education towards ESD. One part concerns the previously mentioned sub-themes in the implementation scheme for the DESD (UNESCO, 2006). Another part of the reorientation process concerns the key principles relevant for to all cultures covering the scope, purpose and practice of ESD. These key principles were specified in the mid-decade report as follows:

- a transformative and reflective process that seeks to integrate values and perceptions of sustainability into not only education systems but one’s everyday personal and professional life;
a means of empowering people with new knowledge and skills to help resolve common issues that challenge global society’s collective life now and in the future;

a holistic approach to achieve economic and social justice and respect for all life;

a means to improve the quality of basic education, to reorient existing educational programmes and to raise awareness (UNESCO 2009, p. 26).

As shown in the citation above, an ideal goal of ESD has been proposed to empower students by equipping them with action competence for sustainable development (UNESCO, 2014a). According to the discussion in this section, it is therefore important to investigate effects that depend on how ESD is implemented in the schools. In other words, such investigations should not determine what is right or wrong ESD according to the current policy and education in schools, but rather need to determine effects of the current education in terms of ESD 1 and ESD 2 (or in other words, effects of a transmissive and transformative approach). Furthermore, Aikens and colleagues (2016) call for an increased empirical engagement in environmental and sustainability education research and Scott (2013) argues that empirical evidence is a missing piece in the discourse on sustainability education. Therefore, this thesis yields more generalizable findings and contribute implications for the environmental and sustainability education discourse.

Models in environmental and sustainability education research

As outlined in the previous section, aspects of knowing, attitude and behavior were brought together in the concept of action competence for the environment (Jensen & Schnack, 1997). Building action competence among young people has been described as the ideal goal of ESD (e.g. UNESCO, 2014a). To measure generalizable effects of education at the student level using psychometric models that include the aspects of knowledge, attitude and behavior has been part of the environmental psychology tradition for a long time (Kollmuss & Agyeman, 2002). But why are these aspects important to include in such investigations and what about models including these psychometric aspects, with the same generalizable research intentions, in the field of ESD?
Traditionally, EE builds on the notion of fostering environmentally concerned and literate young people (Kollmuss & Agyeman, 2002). Developing young peoples’ environmental attitudes related to environmental issues is a way to enhance their world view and their view of themselves and others (Reid 2003; 2015). Eagly and Chaiken (1993) defined that an attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor (pp. 1-2).

Reid (2015) stresses that there is currently consensus on attitudes involving the three components of ‘what we know; how we feel and how we behave’ (p. 7). The first component (what we know), is usually described as the cognitive component concerning knowledge about an issue. This component is sometimes described as the component of beliefs, which is defined as the views one holds on what is true and not true about an issue, topic or about the world (Murray, 2012; Reid, 2015). The second component described by Reid (2015) is the affective component, which commonly is expressed as the agree/disagree, or like/dislike component. This component is commonly referred to as attitudes when used in scales. Finally, the behavioral component concerns one’s tendency towards action, although not simply any action, but actions towards something or someone (Reid, 2015). Nevertheless, this thesis builds on the notion that the term environmental attitude should be seen as the affective component, that together with the cognitive and behavioral components, constitute the broader concept of environmental consciousness outlined below.

Building pro-environmental behavior through cognitive and affective components like knowledge and attitudes has been presented in many models (e.g. Ajzen, 1991; Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1987; Kollmuss & Agyeman, 2002; Roth, 1992; Zelezny & Schultz, 2000). Hines and colleagues (1987) presented the model of responsible environmental behavior. In this model the possession of the right environmental attitudes and environmental knowledge will lead to raised intention to act pro-environmentally. Similarly, in his theory of planned behavior, Ajzen (1991) argued that possession of attitudes and beliefs towards a certain action will lead to a higher likelihood of performing the actual pro-environmental behavior. Kollmuss and Agyeman
(2002) maintain that the link between the right attitude and knowledge is not so clear-cut. Kollmuss and Agyeman further argue that it is not possible or useful to develop a model that covers all factors leading to pro-environmental behavior. In the model of pro-environmental behavior, affective and cognitive components go together with personal and societal factors in a complex called pro-environmental consciousness, which leads to increased pro-environmental behavior (Kollmuss & Agyeman, 2002). Furthermore, Jiménez Sanchez and Lafuente (2010) have also presented a multidimensional model of environmental consciousness. In their model, environmental consciousness is a mixture of knowledge, beliefs and personal attitudes, which influence pro-environmental behavior.

All the models outlined above are the result of a long and strong tradition in EE research on investigations of what factors that lead to environmentally concerned and literate citizens. There is no tradition in describing sustainability conscious young people or citizens using the same kind of models or terminology as in the field of ESD. Hence, for sustainability education research there is a need for a multi-dimensional psychometric model that could span all the SD dimensions, i.e. economic, social and environmental.

The concept of sustainability consciousness

In 2012, our research group at Karlstad university began development of a theoretically founded concept including all the dimensions of sustainable development (which has been a missing piece in ESD, according to the previous paragraphs). In the development process, our research group considered that the concept developed needed to offer opportunities to generalize. Moreover, the concept also needed the potential to capture effects of ESD in education in terms psychometric components of action competence regarding SD. Finally, we had to expand and develop a new instrument that also covered the environmental, social and economic dimensions of SD. We defined and operationalized the concept of sustainability consciousness (SC) in a recent publication:

Sustainability consciousness (SC) refers to the experience or awareness of sustainability phenomena. These include experiences and perceptions that we
commonly associate with ourselves such as thoughts, feelings and actions (Gericke, Boeve-de Pauw, Berglund, & Olsson, 2018, p. 3).

Hence, the SC concept takes a multidimensional starting-point in relation to the concept of environmental consciousness outlined in the previous section. Like Kollmuss and Agyeman (2002), we do not claim a direct relationship between what we call knowingness and pro-sustainability behavior, which also aligns with the view in this thesis. As we express it in the citation above, the different factors go together in the complex we call SC (see Figure 1). The concept of SC has been presented in my previous licentiate thesis (Olsson, 2014) and is also theoretically outlined in another article (Gericke et al., 2018).

Moreover, the development process and validation of an instrument covering the scope of SC is described in the same article (Gericke et al., 2018) and the licentiate thesis (Olsson, 2014). Even though the instrument is thoroughly described in these publications, I will here give a short background starting with previous studies including instruments in the field of environmental and sustainability education research.

![Figure 1. A representation of the concept of sustainability consciousness. K=knowingness; A=attitude; B=behavior; ECO=economic; SOC=social; ENV=environmental; SC=sustainability consciousness](image-url)
EE research is part of the environmental psychology tradition, where focus is on the interplay between individuals and the surrounding environment. For EE specifically, the surrounding environment is education and different kinds of educational approaches and interventions. In EE research there is a tradition of investigating generalizable effects at the student level. Several instruments are developed to cover the outcome components described above. Dunlap and colleagues (2000) have developed the new environmental paradigm (NEP) scale tapping into ecological values and attitudes. Ecocentric perspectives are used as pro-environmental attitudes in the scale and anthropocentric perspectives are used for the counter direction. The NEP scale has been frequently used to investigate effects of environmental educational programs or environmental interventions (e.g. Manoli, Johnson & Dunlap, 2007; Ogunbode, 2013). Wiseman and Bogner (2003) argue that an individual can express preservation (ecocentric) and utilization (anthropocentric) attitudes towards the environment, i.e. attitudes towards the environment can be two-dimensional. They developed the scale of two major environmental values (2-MEV) (Bogner & Wiseman, 2006). The 2-MEV scale has been used in many studies and in different countries and contexts, for instance to evaluate effects of environmental interventions (Liefländer & Bogner, 2014; Schneller, Johnson, & Bogner, 2015) or in evaluations of effects of environmental certification programs (Boeve-de Pauw & Van Petegem, 2013a; Johnson & Manoli, 2008). There are also other well-proven scales in the EE field, such as the children’s environmental attitude and knowledge scales (CHEAKS) (Leeming, Dwyer & Bracken, 1995) and the environmental attitudes inventory (Milfont & Duckitt, 2010). All these scales represent instruments with a rather narrow scope, covering and focusing on environmental attitudes. The field of EE research has also produced several other scales adapted to measure different outcomes in a specific context, like environmental knowledge, beliefs or environmental literacy (e.g. Cincera & Krajhanzl, 2013; Dunlap et al., 2000; Goldman, Pe’er & Yavetz, 2017; Goldman et al., 2018; Négev et al., 2008).
The concept of environmental consciousness has been explored as a concept that can be used to measure awareness of environmental issues (e.g. Jiménez Sanchez & Lafuente, 2010; Sharma & Bansal, 2013). Environmental consciousness involves psychological factors related to the individual’s intentions to engage and act pro-environmentally (Zelezny & Schultz, 2000). Jiménez Sanchez and Lafuente (2010) describe environmental consciousness as a multidimensional and behavior-oriented understanding. The concept involves an affective/dispositional dimension (such as general beliefs and personal attitudes), a cognitive dimension (including information and knowledge) and an active dimension (including pro-environmental behavior). Their construct was operationalized and validated in a Spanish study, in which they found the different measures to materialize the concept of environmental consciousness (Jiménez Sanchez & Lafuente, 2010).

Nevertheless, the instruments and scales in the realm of environmental studies have a strong environmental orientation. The need for instruments covering more than the environmental perspective emerged through the UN DESD (2005-2014). National curricula, including the Swedish (Swedish National Agency for Education, 2011a; 2011b), have been influenced by the anthropocentrically oriented educational objectives for ESD (see UNESCO, 2006; 2009). It could therefore be disadvantageous that instruments covering the environmental dimension are not adapted to investigate effects in relation to ESD educational aims and initiatives. The ESD research field zooms into the social and economic dimension along with the environmental dimension of sustainability. In contrast to the realm of EE, there is not a tradition of research instruments tapping into all three of these dimensions. Consequently, critical reflection on effects of ESD implementation, focusing on the entire spectrum of SD was missing in the research field at the end of the DESD.

There are some common aspects in research between the scales tapping into the broader consciousness of the environment (e.g. Cincera & Krajhanzl, 2013; Goldman, Pe’er & Yavetz, 2017; Jiménez Sanchez & Lafuente, 2010; Sharma and Bansal, 2013), which guided our research group in the development of an instrument covering the concept of SC. Firstly,
the psychological components of knowledge, attitude and behavior are always present in the scales (see Gericke et al., 2018). Secondly, the psychological constructs, covered by knowledge, attitude and behavior (representing the cognitive, affective and behavioral components), are always related to a specific topic. Hence, the SC instrument should cover topics including social, economic along with environmental topics. Thirdly, the scales covering an individual’s broader consciousness of the environment are found to be continuous rather than dichotomous (see Gericke et al., 2018). To the knowledge of our research team at Karlstad university, there were no instruments fulfilling the requirement for the SC concept. We found the sustainable development scales available to be too narrow and specific for our purposes, or only covering attitudinal aspects of sustainable development (Biasutti & Surian, 2012; Biasutti & Frate, 2012). However, in the work of Michalos and colleagues (2012), our team found a starting point for the scope of developing a new instrument covering SC. Their scale tapped into the psychometric components knowledge, attitude and behavior and covered issues of sustainable development.

**Sustainability consciousness questionnaire**

Our research group set out to construct the SC as a holistic concept and operationalized it into a 5-point Likert scale questionnaire based on the theoretical foundation of environmental psychology (environmental consciousness and sustainability consciousness, briefly outlined previously in this background section). We simply called the questionnaire the *sustainability consciousness questionnaire (SCQ)* (Gericke et al., 2018). The items building up the SCQ encompasses the 15 sub-themes of SD as outlined in the definition made by UNESCO (2006). Thereby, the items are related to the three dimensions of SD, environmental, social and economic dimensions. Moreover, the SCQ items are categorized into the psychometric components knowledge (the cognitive part), attitude (the affective part) and self-reported behavior (the behavioral part). Actually, we renamed knowledge knowingness, because the items in this category encompass what people acknowledge as necessary and important for SD. There is seldom only one solution to a SD problem and compromises are often part of the solution. To create dichotomous items of factual
knowledge that are associated with an objective truth would therefore not contribute to investigations on effects of ESD. Solution of sustainability issues is rather seen as complex and context-dependent, and therefore negotiable (Stables & Scott, 2002; Sund, 2015). What is factually correct in one context might not be correct in another context. Von Glasersfeld (1991) therefore argues for a theory of knowing instead of a theory of knowledge, where knowingness has both a cognitive, knowledge-based component and an affective-based component. Hence, knowingness is related to the cognitive part of attitudes. In view of this, sustainability knowingness in this thesis is defined as the knowingness about the fundamentals on which SD is based.

The multifaceted nature and the design of the SC construct of the questionnaire is represented in Figure 1. The figure illustrates that it is possible to measure SC itself or the constructs knowingness, attitudes and behaviors related to SC. Furthermore, it is possible to put focus on each of the three SD dimensions (environmental, social and economic dimensions).

The aim and foci of the papers

The overall aim of this thesis is to investigate and contribute novel and generalizable findings on the effects of ESD implementation at a student level. The overall aim is two-fold. The first aim is to explore the impact of ESD certifications at the student level in Sweden, where further findings from the Taiwanese context are used for comparative purposes. The second aim is to investigate the effects of ESD teaching (in terms of holism and pluralism) at the Swedish student level and to look beyond the impact of certification systems on students’ sustainability consciousness.

The order of the papers reflects the order in which the ideas of the different studies evolved throughout the research. The analysis and findings in the first study (first published online in February 2015) opened doors for further research and investigations in the forthcoming articles, although the fifth article was published before article two three and four chronologically speaking. Below, the papers are presented in the logical order that reflects the progression of the thesis.
In the first paper, I delved deeper into the effect of ESD certifications in Sweden. Using ESD certifications had so far been a prominent and important way in which schools implemented ESD. The purpose was therefore to investigate whether the current ESD certifications in Sweden had had any effect on students’ broader consciousness of sustainable development, i.e. their SC and its sub-constituents. I did this by involving two different groups of students in the investigation. One group included students from ESD certified schools and the other group consisted of students from comparable schools without this kind of ESD certification. Students in grade six (final year of primary school) and grade nine (final year of the lower secondary school system) participated. The research questions covered if there was a difference in student SC between the two groups and if so, what were these differences.

The second paper concerns the age comparison between grade six, grade nine and grade twelve (the final year of the upper secondary school system) and the effect of age on student SC and its sub-constituents. The twelfth-graders were included in this study together with the population of sixth-graders and ninth-graders from the first study to investigate age differences in students’ SC. The impact of an ESD certification on the differences between the age groups was part of the investigations.

In the third article the aim and focus relate to the effect of gender on student SC and the notion of ESD having the capacity to diminish the gender gap between boys and girls. Such gender gap has previously been detected in the field of environmental education and the issue if a gender gap can be identified in sustainability education is therefore addressed. Students in grade six, nine and twelve participated. The impact of an ESD certification on the gender differences was part of the investigations.

The research experiences from the first three Swedish papers were brought to a nationwide Taiwanese research context and wrapped into a fourth, paper. Findings from another cultural contexts were considered important to improve discussions on the findings regarding effects of ESD on student SC. Furthermore, scholarly attention and critical reflection on
the effects of the governmental environmental and sustainability education initiative green school partnership project in Taiwan (GPPT) were lacking. Therefore, this paper focuses on filling that gap. Consequently, effects of the GPPT on student SC and its sub-components are addressed. Comparisons were made between GPPT schools and non-GPPT schools along with cross-sectional comparisons between sixth, ninth and twelfth-grade in Taiwan. Finally, the effects of GPPT on the SC of the two genders (boys and girls) were investigated.

In the final, fifth paper my colleagues and I go beyond the ESD certifications and the findings in the nationwide comparisons in Sweden. We investigated effects of ESD teaching at the student level in relation to the two ESD components holism and pluralism. We used the same sample as in paper II and III, which also gave us the opportunity to investigate if students in ESD certified schools experience a higher degree of ESD (holism and pluralism) than students in non-certified schools, and if students in different grades experience ESD differently.

All in all, the intention throughout the five papers is to contribute novel and more generalizable findings on the effects of ESD implementation at a student level, to fill gaps in the field of environmental and sustainability education research. In the forthcoming section I describe the methods used in the investigations.
Methods

Research design
The overall aim of this doctoral thesis and the research questions underlying Papers I-V reflect the need of a quantitative large-scale research design, rather than a small-scale qualitative design. The main investigations are situated in the context of Sweden, but data from the Taiwanese context support and contribute meaningful comparisons to the Swedish data. The data covering the scope of this thesis were collected through questionnaires to students in nationwide studies. The quantitative approach contributes to the development of methods and research design in the field of Swedish environmental and sustainability education research. Furthermore, the choices made for analyzing the data are crucial for what can be said regarding the results in the end. Therefore, I describe the methods concerning the questionnaires, the sample and the data collection and then elaborate more explicitly on the parts concerning the methods of analyzing the data.

The use of the sustainability consciousness questionnaire
Survey studies are well-established methods of collecting large amount of data to provide more generalizable results (Robson, 2011). Given the qualitative focus in the Swedish ESD research (described previously in the background section), a quantitative design using a survey would be suitable to contribute generalizable findings on the effects of ESD at the student level. In all the studies I-V, I have therefore used the full version of the SCQ1 (see also Appendix 2). The items are categorized into the environmental, social and economic dimensions of SD, within each of the psychometric components knowingness, attitude and behavior. The categorization of items can be found online2 and in Appendix 1. The whole story of the 50 items SCQ development is presented and validated in a recent work of our research team, (Gericke et al., 2018). Even though I delve into the SCQ background and process in the papers in this thesis more extensively and elsewhere (Gericke et al., 2018; Olsson, 2014), a summary of the process is outlined below.
The starting point for the development of the new SCQ was the work of Michalos and colleagues (2012). Their scale tapped into the psychometric components knowledge, attitude and behavior and the items included issues related to SD.

Based on the UNESCO framework (UNESCO, 2006), our research group categorized the items into the environmental, social and economic dimensions of SD. Early in the development process and in advance of the first data collection a group of researchers from the Centre of SMEER at Karlstad university strengthened the face validity of the questionnaire by confirming the categorization of the items. The language was improved, since the items had a great deal of built in policy language. Two pilot studies were performed with a total of 150 participants in the sixth, ninth and twelfth grades. Group interviews were made with students in the different target grades for the studies to ensure that they understood the language and the items. After each pilot study, minor language editing was made to improve the understanding of the questionnaire items. The language editing resulted in two identical questionnaires for grade nine and twelve. For the sixth-grade version the items were the same, but for some of the items the language was further improved to increase the understanding among the students aged 12-13.

An English expert translated the items from Swedish into English. Another English expert translated back into Swedish. Until consensus was reached, a discussion was held on items for which the back translation was not totally in line with the original Swedish version. Gericke and colleagues (2018) validated the SCQ with good model fit (RMSEA=0.033; CFI=0.921; TLI=0.917). The SCQ then underwent the same procedure for the translation into the Taiwanese context. A Mandarin native speaker, who was also an expert in English, translated all the items of the questionnaire from English into Mandarin. To ensure correct translation into Mandarin, another language expert back-translated the questionnaire into English. The Taiwanese model showed good fit to the data (RMSEA=0.03; CFI=0.94; TLI=0.94).
To sum up, our research team provided a validated and reliable instrument, including the environmental, social and economic dimensions of SD, and not just environmental, as customary in the tradition of environmental and sustainability education research. Hence, the SCQ taps into the broader consciousness of sustainability and thereby offers the opportunity to investigate effects of ESD at a student level. Even though the overall aim of this thesis is another, an important side effect of the investigations is the contribution of the SCQ to the research field.

The ESD scales holism and pluralism

Our research team also developed a battery of questions tapping into the student perception of ESD at their school (Paper V). The questionnaire is based on the definition of the selective teaching traditions (Sandell et al., 2005; Öhman, 2008), and the work of Rudsberg and Öhman (2010), which reflects the central features of ESD: holism and pluralism (see the background section). The holism dimension of ESD encompasses the approach to teaching content and illuminates the relation between environmental, social and economic perspectives, the past-present-future, and local-regional-global (Sandell et al., 2005; UNESCO, 2009). Pluralism is characterized by seeking to acknowledge and engage different views, values and perspectives in education, with no teaching towards predefined solutions to which only the teacher knows the right answer in advance (Rudsberg & Öhman, 2010; Öhman, 2008).

The holism dimension of the questionnaire consists of three items (α=0.70):

- In school, we look at the connections between the past, the present and the future as regards various issues
- In school, we look at both local and global problems and the connection between them
- In school, we look at how economics, social issues and environmental problems are connected

and the pluralism dimension of the questionnaire consists of four items (α=0.66):

- In school, we look at the connections between the past, the present and the future as regards various issues
- In school, we look at both local and global problems and the connection between them
- In school, we look at how economics, social issues and environmental problems are connected
When we have class discussions, it is possible for many different views to emerge.
- When we read texts in school, we usually take a critical look at the content.
- In school, we are encouraged to take a stand and have our own opinions on the issues at hand.
- We decide what we study ourselves, with support of the teacher.

The items were introduced in the survey by the following statement: ‘The following claims focus on your experiences in the classroom’. We validated the ESD scales with excellent model fit: RMSEA=0.054; CFI=0.989; TLI=0.982 (see paper V).

**The sample process**

ESD certifications have a prominent role in the Swedish school system as well as in the Taiwanese school system. The fact that schools use these kinds of certifications to implement ESD has made them into proxy-schools for ESD in Sweden and Taiwan. It is therefore important to include schools that are explicitly committed to ESD by using such certifications in education. The sample process in both Sweden and Taiwan therefore included ESD certified schools as well as comparable non-ESD certified schools. Below I highlight the most important steps of the sample process together with some similarities and differences in the process in Sweden and Taiwan. The number of schools, participants, sex-ratios etc. are shown in Table 1.

As mentioned in the background section, there are several organizations in Sweden supporting schools in their efforts to implement ESD (e.g. Keep Sweden Tidy Foundation, 2018; WWF, 2018; Swedish National Agency for Education, 2018; The Swedish Council for Higher Education, 2018). Two of them include a certification or award (Keep Sweden Tidy Foundation, 2018; Swedish National Agency for Education, 2018). All the ESD-schools in grades six and nine in the Swedish sample were certified with both the eco-school certification (Keep Sweden Tidy Foundation, 2018) and the award of school for sustainable development (Swedish National Agency for Education, 2018). At the upper secondary level most of the
ESD certified schools had the award of school for sustainable development and only a few were certified with the eco-school certification. The Swedish Council for Higher Education (2018) organizes activities and further training for teachers and school leader in ESD. Through their register it was possible to find the most ESD active schools that participate in their programme. The most ESD active schools in Sweden were selected on the basis of certifications, the length of their certification periods and how active the school’s staff had been in ESD further training. These proxy schools for ESD in Sweden constituted the ESD certified group. The sample process is summarized in Figure 2.

Figure 2. A representation of the sample process in Sweden. The non-ESD certified schools were selected so that nothing else would bias the results except for the ESD certification

The non-ESD certified schools were selected in a similar way and on the same basis in both Sweden and Taiwan, i.e. they should be as similar as the ESD certified schools as possible and located in the same geographic area. The SALSA and SIRIS databases were used for the Swedish sample to be able to find non-certified schools comparable to the ESD certified schools in the same geographic region and with the same socio-economic structure. The same kind of database was not at hand in Taiwan, which is why a researcher with good insight into the school system performed the sample.
In Taiwan, the sample of students in ESD certified schools was represented by GPPT certified schools, which have many similarities with the eco-school certification (see Lee, Wang, & Yang, 2013). Schools join to the project voluntarily and can get support for their action plans, instructional material, and access to different resources (GPPT, 2018). The sampling process in Taiwan considered the balance between GPPT and non-GPPT schools, the school location (north, center, and south of Taiwan) and socio-economic factors. The schools were selected to ensure that the socio-economic background of the students should be the same in the GPPT and non-GPPT schools from the same geographic area, so as not to bias the investigations.

**The data collection process**

The survey data was collected in Sweden in the spring 2013 and in Taiwan in the late autumn 2013. The participants marked their answers to the SCQ items on a 5-point Likert scale from totally disagree to totally agree. There were also a 'don’t know’ option. In the ESD scale (holism and pluralism) the 5-point Likert scale covered the options never, seldom, sometimes, often and very often. A 'don’t know’ option was available also in the ESD scale.

An online, web-based, questionnaire software was used to collect the data in Sweden. However, computers were a shortage at some schools, so a paper version was offered when needed. The paper version responses were transferred to the online version by a research assistant. In the online questionnaire, participants were unable to skip questions because they were all mandatory. The high proportion of data collected via the web-based survey can also explain why there was a very small proportion of missing data in Sweden (see Table 1). In Taiwan on the other hand, paper versions of the survey were used to collect the data. Therefore, it was also possible for the participants to skip questions to a higher extent, which is probably reflected in the proportion of missing data in Table 1.

A research colleague or I was always in place in the classroom to give instructions to the students when data were collected in Sweden. This means that all the participants got exactly the same instructions. In this way, the
risk that a specific group of people were more likely to participate was also eliminated. All the present students in the classrooms filled in the survey, resulting in high response rates. The missing data refer to students that were ill or taking an exam and therefore not could be present in the classroom at the time of the data collection. It was a very time-consuming way to collect data, but the reliability in the data collection process was ensured in this way.

In Taiwan the paper versions of the questionnaires were sent to the schools. A teacher in the school gave the instructions to the participants and ensured that the data were sent back to our colleague in Taiwan. The paper version data were transferred to a data file by a research assistant in Taiwan and thereafter sent to Sweden for further analysis.

Tabell 1. The number of participants, sex ratio, and the fraction of missing data associated with each grade.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number of schools</th>
<th>Number of students</th>
<th>Sex ratio (girls/boys)</th>
<th>Missing data (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>16</td>
<td>31</td>
<td>1.0</td>
<td>2.8</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>30</td>
<td>0.9</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* Note: 15 of the schools in Sweden included both the grades 6 and 9. Hence, students in totally 51 different schools participated in Sweden.

Ethical guidelines and regulation associated with this type of research were followed in both the countries (for the Swedish guidelines, see Hermen et al., 2011). A week before the data collection, the schools received an information letter and informed consent forms to distribute to the students. The information was also sent (by staff in the schools) to the sixth-grade parents so they could discuss possible participation or not with their children in advance. Students in the ninth and twelfth grade decided for themselves whether they wanted to participate in the data collection, without the consent of a parent. The sixth-grade students could also be expected to decide on their participation when the questionnaire
concerns matter that are a natural part of school education (e.g. SD). In a similar way, a researcher in Taiwan ensured that the Taiwanese data collection followed the ethical regulations and guidelines of the country.

**The process of analyzing the data**

In the first three papers my analysis focused on SC and its three constituent dimensions of SD, the environment, society and economy. Focusing on the SD dimensions meant inverting the SC concept (compare with Figure 1), and starting with the three SD dimensions, which then were divided into the psychometric component knowingness, attitude and behavior. This was a way to group the items from a content perspective (the SD dimensions). A representation of this way of viewing SC can be seen in Figure 3. The view of SC as represented in Figure 1 is used in my last two articles. According to that representation, the items are grouped into three main groups, thus constituting the psychometric construct of SC. This way of grouping the items puts the psychometric components underpinning the concept in focus of the research.

![Figure 3. A representation of the concept of sustainability consciousness. K=knowingness; A=attitude; B=behavior; within each of the three dimensions of sustainable development.](image)

There is a reason for using one representation of SC in the first three papers (Figure 3) and another in the final two papers (Figure 1), which is
simply that the two perspectives reflect the aims framing the studies and the way the research questions are asked. Furthermore, the two ways of representing SC shows a development process throughout the studies in Paper I to Paper V. The fact that it is possible to focus on the content in the SD dimensions as inverted to the psychometric view is one of the strengths of the SC concept.

It was advantageous to represent SC as in Figure 3 because this enables focusing on the way young people recognize not only the environmental dimension, but also the social and economic dimension of SD, which is beneficial when filling some of the gaps in the field of environmental and sustainability education research outlined in the background. However, a big advantage of defining SC based on the psychometric constructs, as in Figure 1, is that it is more directly anchored in the field of environmental psychology. Furthermore, it might make most sense in the environmental and sustainability education research field to use SC non-inverted (Figure 1). There is a long tradition of models and constructs within the field to relate to (see previous background sections). The two representations of the SC construct (one in Figure 1 and the inverted in Figure 3) provide different conditions for the analysis of data, depending on the aim and the current research questions. In the next sections, I first elaborate on the analysis performed for Papers I, II and III. Then the analysis in Paper IV and V are developed further, to include the method called structural equation modeling.

**Analysis of Papers I, II and III**

Sustainable development and the interconnectedness between the environmental, social and economic dimensions are defined in policy documents (e.g. UNESCO, 2006; 2009; 2014a) and in research literature (e.g. Giddings et al., 2002; Hopwood et al., 2005). There is no tradition in environmental and sustainability education research to statistically base studies on the three dimensions of SD. Whether or not these dimensions are at all in young peoples’ minds is thus unexplored, and as well as if the SD dimensions are recognized among the students who participated in our data collection. Exploratory factor analysis was therefore conducted to get
to know the data and to see if the three SD dimensions were at all included in the students’ minds before further analysis. The software package IBM SPSS statistics version 22 was used for all the analysis in Papers I, II and III.

**Identifying environmental, social and economic dimensions**

Exploratory factor analysis is a statistical method taking many variables into account (in my case, all the SCQ items), which are then statistically reduced into few and hopefully understandable variables (factors) (Yong & Pearce, 2013). Principal axis factoring (commonly called factor analysis) is an exploratory factor analysis technique (Field, 2013 p. 666; Yong & Pearce, 2013). SPSS identifies clusters of variables from which the smallest possible number of factors are estimated, based on the common variance of the maximum common variance among the variables (Field, 2013, pp. 665-719). This means that in exploratory factor analysis no or very limited information about the theory on which the variables are based is fed into SPSS. The researcher simply has to evaluate the clusters of variables, or factors, that SPSS has found in the set of variables (Field, 2013, 665-719). However, it is actually possible to give some input to SPSS about the theory. In my case, SPSS was set to identify three clusters hoping for the three SD dimensions to end up in its respective factor. To use a statistical technique called rotation is another way to add a little bit of theory to the exploratory factor analysis. The environmental, social and economic dimension are on separate scales, but by definition, the SD dimensions should be highly correlated (UNESCO, 2006). When using oblique rotating, SPSS takes into account the relationship between the estimated factors (Field, 2013, pp. 701-704).

The results of the factor analysis are presented in my licentiate thesis (Olsson, 2014). In summary, I identified the factors corresponding to each of the three SD dimensions. In addition to this visual control of the estimated factors, I calculated the correlation between the items of the estimated factors and the items in its defined SD dimension. Reliability measures are a good complement to factor analysis when validating a questionnaire
Exploratory factor analysis is a good way to get to know your data and to explore cluster of data estimated into factors. There are, however, some limitations in using exploratory factor analysis to establish the validity of a questionnaire (Field, 2013; Yong & Pearce, 2013). Firstly, it is difficult to name the estimated factors, since it is difficult to know exactly for what reasons the statistical program put the items into a specific estimated factor, i.e. there could have been other reasons for the program to divide into the environmental, social and economic dimensions than the theoretical notion of SD. Secondly, variables will be difficult to interpret if they load on more than one factor (Yong & Pearce, 2013). There is another statistical technique called confirmatory factor analysis that better validates the researcher’s entire theory in relation to the collected data (Hair et al., 2010), i.e. the researcher gets a measure on how well the data fit the theory behind the research. This topic is further treated below under the heading Analysis of Papers IV and V. With the limitations in mind, the conclusions from the exploratory factor analysis (and reliability measures) were that the SCQ passed the test of a valid and reliable instrument (Field, 2013), and therefore could be used for further investigations in paper I, II and III.

**Multivariate analysis of variance**

In the SCQ the multifaceted design of SC is operationalized. The students marked their choice for each variable on a Likert scale from which it is possible to calculate mean values. The sample makes it possible to compare groups of students with one another. Analysis of variance (ANOVA) and t-test are common techniques to use when groups are compared based on their mean values (Field, 2013). A t-test could be used when one outcome (dependent variable) is compared between two groups. ANOVA could be used when one dependent variable is compared between more than two groups (Field, 2013). However, SC consists of three dimensions, i.e. the environmental, social and economic dimensions. To use repeated t-tests or ANOVAs would risk to making so called type I errors. A type I
error could, for example, occur when repeated measures indicate an effect in a population when in fact there is none (Field, 2013). Setting a stricter significance level or using other statistical techniques are ways to deal with this kind of preconditions.

Multivariate analysis of variance (MANOVA) can be seen as an ANOVA but adapted to situations where several dependent variables (outcomes) are involved (Field, 2013). Testing the dependent variables is accomplished by creating a new dependent variable. In this thesis, this new dependent variable represents SC. There are also a couple of other benefits of using MANOVA: (i) MANOVA takes into account the correlations between the dependent variables (the three SD dimensions), which of course is a strength when analyzing an intertwined concept: (ii) several independent variables (covariates) can be included and controlled for in the MANOVA calculations, e.g. independent variables like gender, ESD certifications and the grade the students are in: (iii) the univariate results for each dependent variable in the multivariate test will be presented in an ANOVA-table from one single calculation which protects against the risk of type I error, and the significance level can be set to the common $p = .05$.

There are some important assumptions and limitations in using MANOVA as a statistical method for analysis: (i) MANOVA requires normal distribution. However, MANOVA is still robust to non-normality caused by skewness: (ii) the technique is very sensitive to outliers, hence a test for outliers must be performed: (iii) there must be homogeneity of variance in the data, which means that there must be equal variance among the indicator variables (items) for the dependent variables: (iv) MANOVA assumes linearity, which means that a linear relationship between all independent and dependent variables are assumed in the analysis. This means that the power is lost in the analysis when an investigated relationship deviates from being linear (Field, 2013). After testing and exploring the data in relation to these assumptions I considered MANOVA to be a suitable statistical method to use when investigating the research questions in the Papers I, II and III.
There is another important limitation to using multivariate analysis (e.g. MANOVA). MANOVA, and other techniques like exploratory factor analysis, actually examine only one single relationship at a time, even though multiple dependent variables and independent variables could be included in the analysis. This means that it is difficult (if not impossible) to test the researcher’s entire theory (Hair et al., 2010). For the analysis of SC, this means that the entire construct of SC could not be tested simultaneously, using MANOVA or exploratory factor analysis. I could not agree more with the words of Little (2013) when he describes his view of statistical methods and techniques: “I discovered that statistics isn’t about math, but a system of principles to guide my research” (Little, 2013, p. vii).

So, letting environmental education psychology theory and statistical principals guide my research, I used a statistical method called structural equation modelling, which makes it is possible to test entire constructs such as SC. In Paper IV and Paper V this step in the statistical analysis was taken.

**Analysis of Papers IV and V**

The SC construct rests on a psychometric basis (Gericke et al., 2018). The common tradition in the field of environmental education research is to explain effects of educational programs and interventions in terms of people’s perceptions of the environment and society based on psychometric measures, as outlined in the background section. Knowledge about other statistical principles to guide the research in this thesis was introduced by a new colleague, from the University of Antwerp, who clarified the principles of structural equation modeling (SEM) and its benefits to us. Using SEM opened the door to new possibilities for investigations including the SC construct.

Paper V was an introduction to the world of SEM for me personally, which evolved into the understanding of the principles of SEM and to knowledge and skills that were used for Paper IV on the Taiwanese data. All the SEM analyses were performed using the statistical software package Mplus (Muthén & Muthén, 2015). IBM SPSS statistics version 22 was used for the descriptive statistics.
**Structural equation modeling (SEM)**

All SEM models have some common characteristics. Firstly, it is possible to simultaneously examine multiple series of dependent and interrelated relationships, i.e. multiple equations can be estimated simultaneously. In the previously described MANOVA, one relationship at a time is estimated. Secondly, all models include the ability to describe unobserved variables. An unobserved variable in SEM is called a latent variable or latent factor. Thirdly, the estimations of the relationships include correction for measurement errors, which should result in more precise estimations in comparison to multivariate techniques such as MANOVA. Finally, SEM gives the preconditions for the researcher to build a model of the entire theory and then test it against the data at hand in the case of conducting further analysis.

The structural model for the SC construct is represented in Figure 4. In this model there are three levels of latent variable, i.e. they are not directly observed. It is therefore called a three-order SEM model. The third-order is the SC factor. SC is a latent variable built up by three other latent variables, representing the psychometric components of sustainability knowliness, attitude and behavior. The three psychometric components represent the second-order of latent constructs in the model. The three psychometric constructs consist of three latent variables representing each of the three SD dimensions. Hence, the first-order in the model is represented by nine latent variables. Between four and seven items are connected to each one of the first-order latent variables. The SCQ consists of 50 items. Since these questionnaire items are the variables that are directly observed, they are sometimes called indicators in SEM. The indicators are omitted from Figure 4 because of limited space, but the categorization and the number of items connected to each latent variable can be seen in Appendix 1. The structural model represented in Figure 4 forms the basis for the SC confirmatory factor analysis.
Figure 4. Theoretical model of sustainability consciousness (SC). The three-order model consists of second-order latent variables referred to as sustainability knowingness (K), sustainability attitude (A), and sustainability behavior (B). The first-order latent variables consist of items categorized into environmental (ENV), social (SOC) or economic (ECO) dimension of sustainable development.

Confirmatory factor analysis, CFA.

The entire theory of a construct is tested through confirmatory factor analysis (CFA) using SEM. It is very important to think through and define all possible relationships, e.g. between different latent constructs or between indicators before using SEM. The relationships can be illustrated in a path diagram. In my case, the full path diagram for the SC investigations in Taiwan is illustrated in the Appendix to Paper IV and the path diagram for the ESD holism and pluralism construct is shown in Figure 2 in Paper V.

By using SEM, it is possible to include the interconnectedness of the latent constructs in the analysis. Furthermore, it is possible to determine how important an item or latent construct is for the model, since SEM includes measurement errors and then incorporate this information into further estimations of the construct (Byrne, 2012; Hair et al., 2010). From the
start, all the obvious relationships in the theory were included in the model. In Mplus, it is possible to turn on modification indices. This function estimates all mathematical meaningful correlations between indicators and/or latent variables that could improve the model if they are included. However, it is very important that only theoretically important correlations, i.e. correlations that are covered by the researcher’s theory, are included in the model (Byrne, 2012). Modification indices were used to improve the Taiwanese model and the relationships included in the model are described in detail in Paper IV.

The results, or fit indices, from the CFA are the common way to show how well the data fit the theoretical model (Byrne, 2012; Duncan et al., 2013; Hair et al., 2010). The results reflect the fit of the whole model and not a single relationship. There are several different fit indices at hand when using Mplus. For the confirmatory analysis in this thesis, the most common ones are used: the comparative fit index (CFI), the Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA), (Duncan et al., 2013; Little, 2013). But what kind of measures are these fit indices and when can the researcher say that the theoretical model fits reality? The CFI used in Papers IV and V is basically a test of the ratio of misfit of the test model and the null model, based on the degrees of freedom*.

To use more than one fit index is a way to ensure that the model really fits reality. Hence, two more fit indices were used in Papers IV and V to describe how well the model fits the data. The TLI is a test that includes the ratio of the chi-square statistic test and the degrees of freedom for both the test model and the null model. In other words, it is a ratio test of the ratios. Finally, the RMSEA is a discrepancy test for the test model. A value of 0 for the RMSEA means that there is no difference between the theoretical model and reality, i.e. the model fits exactly.

* Degrees of freedom are like money; a degree of freedom is used when a parameter is estimated, i.e. the degree of freedom is the difference between the total of unique elements and estimated parameters. A null model is a model where all the sub-constructs in a model are unrelated.
It is not possible to draw an exact line for what is good model fit and for what is not. However, there are some rules of thumb in the literature for the fit indices above (see Duncan et al., 2013; Little, 2013; Tabachnick & Fidell, 2007) that guided the conclusions of the CFA in Papers IV and V.

A value below .06 suggests a good model fit for the RMSEA index. For the TLI and CFI, values around .90 indicate a good fit of the model and values around .95 is referred to as very good or excellent fit. Values around .99 indicate a model of excellent or outstanding fit. Using these rules of thumb, the SCQ in the Taiwanese context (paper IV) was validated with a good model fit, RMSEA=.03, CFI=.94, TLI=.94 and the model of the ESD scales holism and pluralism with excellent model fit: RMSEA=.05, CFI=.99; TLI=.98 (Paper V).

**Investigating the relationships using SEM**

The big difference in using SEM compared with other multivariate techniques (e.g. multiple regression and MANOVA) is that several independent and dependent relationships can be explored simultaneously, even though an independent variable in one relationship could be a dependent variable in another relationship (Hair et al., 2010). Furthermore, SEM corrects for measurement errors and uses variances, covariances, correlations along with the mean values, leading to refined scores and estimations on the underlying construct (Little, 2013). Another advantage of using SEM is that the data does not have to be normally distributed. With this said, SEM is the technique making the fewest assumptions, in comparison to MANOVA, for example (Little, 2013).

It is a common procedure to create dummy variables to test the independent variables of interest. A dummy variable takes the value 0 or 1 to indicate the absence or presence of something, for example in group comparisons. In the fourth paper, gender, grade and ESD certification are example of such independent variables where dummy variables are useful. Significant differences in terms of p-values say nothing about the magnitude of a difference. Therefore, results in SEM are presented as effects ($\beta$). As an example, a result from Paper IV shows an effect between girls and boys,
\( \beta = 0.186, p < 0.001 \). In this case it means that girls score \( \sim 19\% \) of a standard deviation higher than the boys. There are guidelines for how to interpret effect sizes. Cohen (1988) stated that the threshold guidelines of \( \beta > 0.10 \) to indicate a small effect, \( \beta > 0.3 \) medium effect and \( \beta > 0.5 \) large effect. Later on, Rosenthal (1996) had considered the threshold \( \beta > 0.7 \) to indicate a very large effect size. These guidelines are used to interpret results in Paper IV and Paper V.

But what are the disadvantages or limitations using SEM? Well, SEM can sometimes be a little difficult to understand for those not familiar with it, which is why the researcher is responsible for communicating the model, results and interpretations in a good way. A second issue is the common misconception of casual relationships. A model with excellent fit indices does not necessarily represent causal relationships, although a model with excellent model fit could do that (Hair et al., 2010). It is up to the researcher to judge and interpret the results and it must be done in relation to the theory underlying the model (the SC concept in Paper IV and ESD in terms of holism and pluralism in Paper V). It will not be either possible or desirable to claim casual relationships among the findings in Papers IV and V, but the generalizability could benefit the interpretation of the results. A third issue is the sample size. SEM usually requires large sample sizes. There is no exact threshold, but a sample size around 100 would usually be enough for robust estimations (Little, 2013). Hence, the sample size for the studies in this thesis are way above the threshold of 100.
The main findings

In this section a summary of the findings are presented. The studies in this doctoral thesis aimed to contribute novel and generalizable findings on the effects of ESD implementation at a student level. The first four papers contribute findings on different aspects of the effects at the student level of the most widely implemented ESD certifications in Sweden and Taiwan. The fifth paper contributes findings on the effects of ESD teaching in terms of holism and pluralism at the Swedish student level and hence looks beyond the impact of certification systems on students’ SC.

The findings include the SC concept and its sub-constituents, i.e. the environmental, social and economic dimensions of SD, components sustainability, knowingness, attitude and behavior as well as the aspects that are hypothesized to have effect on student SC (i.e. ESD certification, age and gender). The main findings below are presented in the way they came to build on each other during the research.

Paper I

The aim of this paper was to investigate whether the current ESD certifications in Sweden have had any effect on student SC and its sub-constituents. Two groups of students were included in the investigation: one group consisted of students in ESD certified schools and the other group of students in comparable schools without an ESD certification. Students in grade six (final year of primary school) and grade nine (final year of the compulsory school system) participated.

There was a significant difference in student overall SC between the ESD-group and non ESD-group of students in both sixth and ninth grade. Moreover, the findings reveal an important difference between the two investigated grades. Students in grade six were positively affected by an ESD certification at their school, while students in the ninth grade were negatively affected by an ESD certification.
An ESD certification had no effect on student consciousness of the social and economic dimensions in grade six. The positive result of an ESD certification among the sixth graders derives mostly from a significant result in the environmental dimension. However, the effect size was small (0.25) using Cohen’s $d$, which indicates that the magnitude of the difference was small even though it was a significant difference.

For the ninth graders there was no significant effect of an ESD certification on student consciousness of the environmental and economic dimension. The negative impact of an ESD certification on ninth graders’ SC derives mostly from a negative effect in the social dimension. However, the effect size using Cohen’s $d$ was small also here (0.22). In other words, the magnitude of the difference in the social dimension was small even though it was significant.

The conclusion of the first paper is that ESD certifications have limited, or even negative, effects on students’ SC. Furthermore, there is an interaction effect between an ESD certification and gender, which indicates that boys and girls tend to be differently affected by the education taking place in the certified schools. Hence, new areas to explore further were revealed during the analysis of the first paper. What is happening with the SC of the adolescent age group aged 15-16 in grade nine and are there gender differences? The two questions lead to the investigations and findings in Paper II and Paper III.

**Paper II**

The main aim in this paper was to investigate grade and age specific differences in student SC and its constituents. Secondly, the aim was to investigate if an ESD certification influences the age specific differences. Students in grade six (12-13 years old), grade nine (15-16 years old) and grade twelve (18-19 years old) participated in this effort to detect and scrutinize the differences between age groups.

The main finding of Paper II shows that there was a dip in student SC as they enter adolescence (ages 15-16). The dip is characterized by a decrease in student SC among the ninth graders, followed by a rebound in the
The adolescent dip is also consistent throughout all the SC sub constituents, i.e. it extends beyond previous EE research of environmental issues to include economic and social issues in the knowingness, attitude and behavior components of SC. For the psychometric components the adolescent dip was also present. The biggest decrease (effect size) between the sixth graders and ninth graders was shown among student self-reported sustainability behavior, Cohens $d = 0.50$. This is a somewhat troubling result, since self-perceived intention to act has been shown to be a strong mediator for personal and real environmental and sustainability actions (Bamberg & Möser, 2007).

**Paper III**

This study extends previous environmental education research on gender differences by investigating the gender gap between boys' and girls' sustainability consciousness. The aim was to investigate the effect of gender on student SC in the Swedish school system in a coherent way. Moreover, I was interested in how the hypothesized effect might relate to ESD certification initiatives. A third focus of the paper was to investigate how the effect of gender on student SC differ between different age groups in the school system. Similar to Paper II, the sample used included the grades six, nine and twelve.

The main findings of Paper III reveal a gender gap in student SC as well as for the SD dimensions separately. There were differences between the grades in that older students displayed a larger gender gap, meaning that the effect size of the girl–boy difference tends to increase with each grade in the sample. This interaction between gender and age was especially notable in the environmental and social dimensions of SD. Moreover, students in ESD certified schools showed a larger gender gap than students...
in the non-certified schools which means that students in the certified schools might experience something in the teaching that amplifies rather than reduces gender differences. The interaction between gender and ESD certification indicates that girls and boys react differently to the education taking place in the certified schools. For the sample as a whole this was most prominent for student consciousness of the environmental dimension. However, the findings also show that there were interactions specific to each of the age groups.

The findings in paper III address the urgent question whether the mechanisms of the increased gender differences are to be found in society or school, and especially if the reasons for the increased gender differences are to be related to ESD itself, i.e. the ways in which ESD teaching is currently implemented in the schools.

**Paper IV**

The experiences of the Swedish investigations pointed to three possible foci areas in the Taiwanese context as shown in paper I to III. Therefore, this paper aimed to contribute findings that included comparisons between students in ESD certified GPPT schools and non-GPPT schools, comparisons between different grades and investigations on differences between the two genders boys and girls. By using SEM, a slightly different methodological approach was used in this paper in comparison to paper I to III. Similar to Sweden, a sample of students in grade six (12 years old), grade nine (15 years old) and grade twelve (18 years old) participated.

The main findings can be summarized with regards to the three foci areas in this fourth paper. Firstly, negligible effects on student overall SC were found between the GPPT non-GPPT group of students. The mean values for student self-reported sustainability behavior were slightly lower than the mean values obtained for the sustainability knowingness and attitude. Secondly, there was a significant effect of gender on SC for the entire student sample. However, the biggest effects were found regarding the students' self-reported sustainability behavior, where the girls consistently obtained higher mean values than the boys. The results also reveal that the gender effect on the behavior increased for each of the grades six, nine
and twelve in the school system. Interestingly, the GPPT seemed to reduce the gender gap by affecting the sustainability behavior of twelfth grade boys more than the twelfth-grade girls. Finally, an adolescent dip in student overall SC was identified. The dip was characterized by a decrease in the student SC between sixth and ninth grade, followed by a rebound in the SC associated with the twelfth graders.

The findings in Taiwan are almost completely in line with the Swedish results in paper I to III. However, the twelfth-grade boys’ sustainability behavior were positively affected by the teaching in the GPPT schools in comparison to non-GPPT schools in Taiwan, which was a pattern that not could be found in the Swedish data.

**Paper V**

In the final and fifth paper investigations beyond ESD certifications were conducted. In the fifth paper the aim was to contribute findings on the effects of ESD teaching in terms of holism and pluralism to promote SC among the Swedish students. Moreover, the paper includes investigations of the effectiveness of ESD in the different grades six, nine and twelve, and if students really experience ESD in terms of holism and pluralism in the ESD certified (and non-certified) schools. The sample of students is the same as in Papers II and III.

The overall findings reveal that neither the holistic ESD approach to contents, nor the pluralistic approach to teaching are common in Swedish classrooms, with regards to the operationalization of the concepts in the questionnaire. Scores were only moderately higher than a neutral 3 on the five-point Likert scale. The findings also reveal that students perceived the holistic approach to content as happening more frequently than the pluralistic approach to teaching. Moreover, the students’ experience of pluralism was not necessarily positively influenced by an ESD certification. Actually, students in ninth grade ESD certified schools experienced less pluralism than their peers in non-certified schools. In grade six the ESD certification had no significant impact at all on the experience of pluralism, while the twelfth graders reported a positive effect of pluralism in the ESD certified schools.
If students express that they experience ESD in terms of holism and pluralism, it has effect on their SC, regardless of an ESD certification at their school or not. A strong relationship was found between holism and sustainability knowingness and between pluralism and sustainability behavior. This actually means that if students experience a high level of ESD teaching and learning in terms of holism and pluralism it will strengthen their knowingness of sustainability related issues and their willingness to act in a sustainable way. However, the results are age dependent. A small input of pluralism for sixth graders results in a higher level of self-reported sustainability behavior. There seems to be a possibility that too much pluralism does not suit the younger age group. For the twelfth graders the relationship is linear. The effect of investment in pluralism is apparent in student self-reported behavior. When it comes to the ninth graders it seems that a bigger investment in terms of pluralism is needed to have an effect on their sustainability behavior. This age group has, on the other hand, the capability to “outperform” the other two investigated grades in terms of self-reported sustainability behavior if teachers invest in pluralistic teaching approaches.
Discussion

Result discussion

This doctoral thesis contributes novel and generalizable findings on the effects of ESD implementation at a student level. The findings are two-fold. First, the work contributes findings on the impact of ESD certifications at the student level in Sweden. The findings also include age and gender effects. The second part of the findings contribute new knowledge about the effects of ESD as a teaching approach (in terms of holism and pluralism) at the student level, looking beyond the impact of ESD certifications.

First of all, the nationwide findings from data in Sweden and Taiwan question the effectiveness of the current system of external organizations certifying schools as ESD schools. Only small differences were revealed between ESD certified schools and non-certified schools. In fact, there was a negative impact on students’ SC of the ESD certification in the ninth grade. In the Taiwanese context, the effects of the GPPT (green school partnership project in Taiwan) were very similar and confirms the results in the Swedish context. No differences in SC were found between the students in certified schools and non-certified schools. The results are also in line with findings in other countries where, for example, the eco-school certification has been shown to have no or limited effects on students’ pro-environmental perceptions (Cincera & Krajhanzl, 2013; Boeve-de Pauw & Van Petegem, 2011; 2013a; 2017).

The factors of age and gender

The results in this thesis also reveal an adolescent dip in students’ SC in both countries. The dip is characterized by a decrease in students’ SC (aged 15-16) as they enter adolescence, followed by a rebound among the students aged 18-19. This is an extension of previous findings in which a decrease in student environmental pro-attitudes and concern has been detected (e.g. Liefländer & Bogner, 2014; Negev et al., 2008, Uitto & Saloranta, 2010), i.e. the findings extend beyond environmental issues to in-
clude the economic and social dimensions of SD. The findings in this thesis confirm the results of Kaplan & Kaplan, 2002 that it is an adolescent dip rather than a continuous decline throughout schooling. Moreover, the adolescent dip is amplified if students attend schools with an ESD certification. This means that the difference (or lack of difference) between the students in ESD certified schools and non-certified schools are genuine findings related to the kind of teaching taking place in the certified schools and hence, not only due to a methodological artifact as discussed by Boeve-de Pauw, Jacobs and Van Petegem (2014). They mean that items related to environmental, social and economic attitudes are usually easy to agree with, which, from a statistical perspective, could result in ceiling effects and low variability among the respondents (Boeve-de Pauw & Van Petegem, 2014), and hence the results in this thesis do not fully align with this hypothesis.

Furthermore, the findings reveal a gender gap between girls and boys, in which girls consistently report higher mean values than boys regarding SC and its sub-constituents. This is also an extension of previous findings, in which a similar gender gap in students’ pro-environmental attitude and behavior has been detected (e.g. Boeve-de Pauw, Jacobs, & Van Petegem, 2014; Liefländer & Bogner, 2014; Oerke & Bogner 2010; Zelezny et al., 2000), i.e. the findings extend beyond environmental issues to include the economic and social dimensions of SD. The differences between girls and boys could possibly be traced back to the basic human values. In particular values of self-transcendence and “doing public good” are represented among girls to a higher extent (Schwartz, 1992; Schwartz & Rubel, 2005). Nevertheless, the gender gap increases with each of the investigated grades six, nine and twelve. This is in line with the general trend in education where the socialization process of young people is the most plausible explanation for an increased gender gap between girls and boys (e.g. Quensel & Hurrelmann, 2013). Like the amplified adolescent dip, the findings in this thesis show that the gender gap is amplified if students attend schools with an ESD certification. However, the Taiwanese results show that the twelfth-grade gender gap is remedied (in general) by a teaching component in the GPPT schools. Further investigation of the pedagogy
and ESD teaching approaches with respect to the gender gap in the twelfth grade of GPPT certified schools are therefore warranted, although gender comparisons including girls and boys risk contributing to gender socialization stereotypes. Not all people today feel comfortable in letting their biological sex determine their gender, but rather see their gender identity as falling into various groups (Gough et al., 2003; Russell, 2013). For reason of analysis our study focused only on the two most common genders as a way to illuminate the effects of gender socialization in a generalizable way. The findings shed light on a problem that needs to be considered when planning ESD teaching and learning. Hence, the third or fourth paper does not claim to inductively explore how the gender socialization process occurs. In other words, I am aware that the methodology excluded other possible genders. Further research, taking the socialization of multiple genders into account, is warranted (Russel, 2013).

**The effectiveness of ESD**

Comparing the effects of ESD among students in ESD certified schools and non-certified schools (Papers I-IV) can uncover differences but not fully explain them. The findings in Paper V reveal the importance of looking beyond the ESD certifications and the results that can be explained by using the SC concept. By using the ESD scale, the Swedish students expressed what they have experienced in terms of holism and pluralism as a teaching approach at their school. The most important conclusion from the results in Paper V is that it gives empirical evidence for the effectiveness of ESD. If students experience holism, it affects their knowingness and if they experience pluralism, it has an effect on their self-reported behavior. This is the result regardless if the students were in an ESD certified school or not. With the exception of the twelfth-grade students, the findings reveal that students in ESD certified schools did not experience more holism or pluralism than the students in non-certified schools. Actually, in the ninth grade the students expressed that they experienced less pluralism in the certified schools than in the non-certified schools.

All in all, the key message is that ESD works. In Paper V it is empirically verified that ESD in terms of holism and pluralism has the potential to be
effective, but it is not necessarily dependent on attending certified schools. However, ESD teaching does not seem to be easy to implement. The fact that students in ESD certified schools in Sweden expressed equal levels of pluralism, or even less pluralism than their peers in non-certified schools, reflects the difficulty. If the results of holism and pluralism approaches will be confirmed by the Taiwanese study remains to be seen.

In line with our findings, also other researchers suggest that it is the pedagogy or teaching approach in the schools that will have effects at the student level rather than the certification itself. Findings from the Czech context and the Slovak context, for example, suggest an emancipatory approach in environmental and sustainability education, in which the key factor is opportunities for students to participate in activities and decision-making at their school (Cincera et al., 2012; Cincera & Krajhanzl, 2013; Cincera et al., 2018). Flemish results point in the same direction. The eco-school certification system seems to focus mainly on cognitive outcomes and therefore misses the components of pluralism (including emancipatory approaches) in the pedagogy with effect on student sustainability behavior (Boeve-de Pauw & Van Petegem, 2017).

**Towards reorienting ESD**

According to the results in this thesis, a school’s reorientation towards ESD is not easy. The problems built into the educational systems have been described as follows:

> The most well-educated part of the planet’s population is the one who has biggest impact on the planetary boundaries - something must be wrong in the education system (Charles Hopkins, the UNESCO chair on reorienting teacher education towards sustainability, in the Learning Teacher Network seminar on migration and quality education in Palermo, 2018).

These words are of course meant to be provocative. However, it would seem that the current educational system does not educate for sustainability action competent and empowered young people in regards to acting in a pro-sustainable way. As outlined in the background section, the educational system needs to be reoriented towards ESD to meet present and future challenges (e.g. Wals, 2011; Hopkins, 2012). The contribution of
this thesis to the ESD field confirms this need through generalizable, empirical results throughout Papers I-V. The results in Paper V show that ESD works, but also that ESD does not take place to a large extent in the Swedish school system. So, what kind of teaching is taking place in Swedish schools? Because of their design, the studies in this thesis cannot answer this question directly. It is, however, possible to discuss the findings in the light of other research in the field.

The impact of ESD certifications on students’ SC among Swedish and Taiwanese students is limited. In the first four papers this topic is hypothetically discussed and we argue that a normative teaching approach, rather than a pluralistic and transformative approach might be the explanation for these results. A normative teaching approach to sustainability implies that the aim of teaching is to transmit certain environmental values and behaviors to students based on scientific knowledge (Vare & Scott, 2007; Wals, 2011). A pluralistic and transformative approach in teaching deals with conflicting perspectives and interests, meaning that not only experts can provide the answers, and with complex problems without any simple solution (Mogensen & Schnack, 2010; Vare & Scott, 2007; Wals, 2011). This kind of complex problems are sometimes defined as wicked problems (Brown et al., 2010) and are characterized by the inherent relational conflicts between humans and between human and nature (Kramming, 2017).

According to the results for Swedish students in Paper V, the reorientation process towards ESD in terms of holism and pluralism has not fully taken place yet. There are also strong indications that teachers in ESD certified schools and non-certified schools generally teach environmental and sustainability issues in a normative manner (Boeve-de Pauw & Van Petegem, 2011; Borg et al., 2012; Stagell, Almers, Askerlund, & Apelqvist, 2014). Hence, there is a risk that teaching and learning in ESD certified schools will become too normative (Stagell et al., 2014) “turning education into a political tool to create a predetermined society” (Öhman, 2008, p. 20), which according to the results in Paper V would not lead to an increased willingness to act for sustainability among young people.
However, what is applicable in a Swedish and Western context may not necessarily be totally applicable elsewhere, for example in Taiwan. The results in Paper IV indicate that there is an effect of the GPPT on Taiwanese twelfth graders’ self-reported sustainability behavior (especially boys). Given the results in the Swedish context (Paper V, in which students’ experience of pluralism affects their sustainability behavior), pluralism could have been adopted in the Taiwanese twelfth grade context and might explain the results. However, behavioral approaches in western cultures, where decisions are often made on an individual level, may be inapplicable to non-western cultures (Fishbein & Ajzen, 2011). Fishbein and Ajzen (2011) argue that the decisions on actions are often group-based in non-western cultures and influenced by social factors that sometimes differ from individual preferences. Thus, the Taiwanese findings on sustainability behavior of twelfth grade boys warrant further investigation. Students experience in relation to the characteristics of ESD teaching and learning (i.e. in terms of holism and pluralism), should therefore be considered in future research.

**Whole school approaches to ESD**

Researchers emphasize the importance of whole school approaches as a way of reorienting education towards ESD (see Mogren, Gericke, & Scherp, 2018). A whole school approach is characterized by a shared vision of ESD that is implemented in the evaluation, planning and execution of teaching. Mogren and colleagues (2018) found that using implementation strategies which are integrated within the routines and structures in the school organization facilitates whole school approaches to ESD. Such strategies were less common in schools using ESD certifications to implement ESD in their organization (Mogren, Gericke, & Scherp, 2018).

Lysgaard, Larsen and Læssøe (2015) argue that the current eco-school certification system does not facilitate whole school approaches to ESD. They argue that an update of the certification system should focus on supporting schools to overcome obstacles (e.g. mono disciplinary structures, lack of ESD competences among teachers and lack of supporting structures in the school organization) that inhibit the possibility for students to
experience ESD. Lee, Wang and Yang (2013) found that not all people (i.e. not the whole school) were involved in the GPPT certified schools, similarly to the lack of whole school approaches to ESD, which was suggested by Lysgaard, Larsen and Læssøe (2015) to be the case among eco-schools. Moreover, the results in the fifth paper show that the positive effect of pluralism on sustainability behavior among Swedish students is there regardless of ESD-certification or not. Certifying initiatives aiming for a whole school approach would therefore benefit from developing emancipatory approaches in which students’ participation in activities for SD predicts the success of the program among students (Cincera et al., 2018).

Given the result discussion and the discussion on whole school approaches above, an ESD certification would not necessarily be of first priority when schools attempt to reorient education towards ESD. The next important step for ESD certifying organizations would be to collaborate with schools on reorienting education towards ESD, including emancipatory whole school approaches and the ESD teaching components of holism and pluralism.

**Method discussion and concluding remarks**

Given the aim of this thesis, the operationalization of the concept of SC into the SCQ has been a success factor. The quantitative approach using the SCQ and the nationwide samples has brought more generalizable findings of the effects of the Swedish ESD implementation at a student level to the ESD discourse. In this final section I highlight some key success factors and limitations related to the use of methods.

The use of methods in this thesis is by itself a contribution to a greater diversity of ESD research, at least in the Swedish context. The background section highlights that much of the ESD research in the Swedish context takes a small-scale qualitative approach (see GRESD, 2018). The thesis also contributes to the development of methods analyzing data in the Swedish ESD research context by using SEM. The advantages and disadvantages of the different analysis methods used in the papers are elaborated on in the method section.
To which degree the results can be considered to represent generalizable results depends on some issues considered to be a threat to generalizability (Robson, 2011, pp. 91-92). According to Kind and Barmby (2015) the generalizability of the results is defined by the degree of invariance across groups, contexts, issues and time, where invariance basically means that something does not change.

One issue of generalizability is related to the selection of participants and if the findings can only be related to the group studied. In the case of the studies in paper I-V, the selection was made to enable the comparisons between the ESD group of students (in certified schools) and the non-ESD group of students (in non-certified schools). The nationwide approach and the sample process including 51 schools and 2,413 students all over Sweden have been important for the standpoint that this thesis contributes findings that could be interpreted in a generalizable way. Another aspect to consider is if the findings are specific to or dependent on a particular context (Robson, 2011, pp. 91-92; Kind & Barmby, 2015). Such external validity, and the way the Taiwanese results have been used, strengthened the generalizability of the findings in this thesis. However, regarding the comparisons between different age groups, the cross-sectional design can be a limitation for the generalizability of the results (Robson, 2011). Future studies should therefore consider a longitudinal research design where the students are followed in research over a period of time. Construct validity is another issue that should be considered in terms of generalizability (Hair et al., 2010; Little, 2013). The SCQ is theoretically well-founded and the questionnaire is now validated in the Swedish context by our research team (Gericke et al., 2018). The questionnaire is also validated with good model fit in the Taiwanese context. The construct validity of the SCQ therefore contributes to the generalizability of the results in this thesis.

**The SCQ contribution**

As outlined in the introduction, there are many concepts and instruments in the field covering the environmental dimension. So, what has the introduction of the SC concept and the instrument of SCQ added to the field of
ESD? SC and its operationalizing questionnaire should be seen as an enlargement of other constructs in the field, e.g. environmental consciousness (Jiménez Sanchez & Lafuente, 2010; Sharma & Bansal, 2013), in that it also relates economic and social dimensions of SD to the knowingness, attitude and behavioral components. The three dimensions of SD are well anchored in the UNESCO policy framework, which has been an international benchmark and widely used framework in policy documents, educational curricula, organizational guidelines, etc. worldwide (e.g. UN 2015b; UNESCO, 2006; 2009; 2014a; 2014b; UNEP, 2015). By relating the concept of SC to the UNESCO framework, the concept is also automatically related to the more recent 17 sustainable development goals (SDGs). Moreover, in the SDGs education is represented as a standalone goal, (goal number four) in which ESD is stated as a means of quality education worldwide. The concept of SC can be expected to be long-lasting, given the efforts over the last twenty years, and the link to the present and future sustainability Agenda 2030 (UN, 2015b; UNEP, 2015).

A further strength of the SCQ is its foundation in environmental psychology and the connection to psychometric components considered as important for teaching and learning. However, there are of course a number of other closely related psychometric components which the SCQ does not cover. It is common, for example, to include measures of environmental values, interests, motivations, factual knowledge and beliefs in environmental and sustainability education investigations (e.g. Liefländer & Bogner, 2014; Goldman, Pe’er & Yavetz, 2017, Uitto, 2014). The risk that the multi-dimensional instrument of SCQ should have become an excessively heavy questionnaire was one reason for why the SCQ focuses on the cognitive, affective and behavioral components (e.g. see Kollmuss & Agyeman, 2002), as elaborated on in the background section.

The seven items of the ESD scale cover the core of holism and pluralism (e.g. Lijmbach et al., 2002; Rudsberg & Öhman, 2010; Sandell et al., 2005; Öhman, 2008). The scales showed good reliability and excellent construct validity. There are probably several other items that could have been included to further cover the concepts of holism and pluralism. However, there are benefits with keeping the scales as short as possible for students
to keep focused during the data collection, and moreover, despite the abstract nature of the items, the short scales work also for the students aged 12-13. From a statistical point of view there is no need to include more items to the holism and pluralism scales, since it would not improve the statistical model (Field, 2013; Hair, et al., 2010). Nevertheless, future research could consider if more topics related to the concepts of holism and pluralism could be covered by the ESD scale for theoretical reasons.

Using the SCQ in combination with the ESD items on holism and pluralism has been another success factor in terms of yielding generalizable findings of the effects of ESD implementation at the student level in Sweden. Holism was shown to have effect on student sustainability knowingness and pluralism on student self-reported sustainability behavior. This is an important finding, which shows that ESD works if students experience it. Moreover, it is an important result since self-reported behavior has been shown to be a strong mediator for real actions towards SD (Bamberg & Möser, 2007). However, using the SCQ will not make it possible to know why the students answer in a specific way, or to understand their reasoning on the self-reported behavior. The best way to capture that kind of questions would be to perform deep interviews with the students, which is why this thesis does not intend to answer that kind of question. Further research could therefore preferably use the SCQ and student answers to guide more qualitative approaches.

**Final words**

Agenda 2030 summarizes the global plan for a sustainable development through its highly interconnected 17 sustainable development goals (UN, 2015b). Education is highlighted in all the goals as a key success factor for achieving Agenda 2030 (Leicht, Heiss, & Byun, 2018). UNESCO has developed a programme to fulfill the intentions of global agreements on ESD. The global action programme on ESD has the overall goal to generate and scale up actions at all levels and areas of education and learning to accelerate progress towards sustainable development (UNESCO, 2014a).

This overall aim can be translated into two objectives. As mentioned earlier, one objective concerns the reorienting of education and learning so
that everyone can acquire the knowledge, attitudes and skills required to contribute to a sustainable development (Hopkins, 2012). The other objective concerns the whole institutional approach, which addresses all agendas, programmes and activities relevant to education promoting sustainable development (Leicht, Heiss, & Byun, 2018; UNESCO, 2014a). Around the world a great many local initiatives will be used to scale up actions on ESD, and evaluations of the effects at the student level are crucial. The SCQ and the ESD battery of items covering holism and pluralism approaches would be ideally suited for longitudinal studies as a way of monitoring long-term trends of whole school improvement of reorienting education towards ESD. The five papers in this thesis may be used to develop and to give further guidance to evaluation and implementation strategies on ESD that could have a positive impact on the education of young people for a sustainable future.
Notes

1. Web address to the questionnaire.
   Swedish version:
   http://urn.kb.se/resolve?urn=urn:nbn:se:kau:diva-67817
   English version:
   http://urn.kb.se/resolve?urn=urn:nbn:se:kau:diva-48133
   Chinese version:
   http://urn.kb.se/resolve?urn=urn:nbn:se:kau:diva-65197

2. Categorization of items:
   http://urn.kb.se/resolve?urn=urn:nbn:se:kau:diva-48136

3. SMEER is the abbreviation for the Centre of science, mathematics, and engineering education research at Karlstad university, Sweden.

4. SALSA, Skolverkets analysverktyg för lokala sambandsanalyser [The National Agency for Education’s analysis tool for context analysis]:
   https://www.skolverket.se/skolutveckling/statistik/om-skolverkets-statistik/salsa-statistisk-modell

5. SIRIS, Skolverkets internetbaserade resultat- och kvalitetsinformationssystem. [The National Agency for Education’s online information system on results and quality]:

6. Survey and report, Sunet:
   https://www.sunet.se/tjanster/survey/
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Swedish National Agency for Education. (2011a). *Curriculum for the compulsory school system, the pre-school class and school-age education.* Retrieved 12/10, 2018, from https://www.skolverket.se/publikationer?id=3984


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Appendix 1

Categorization of knowingness, attitude and behavior items into the environmental, social and economic dimensions according to UNESCO (2006) definition of SD dimensions in an educational perspective.

<table>
<thead>
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<th>Item number</th>
<th>Environmental</th>
<th>Social</th>
<th>Economic</th>
<th>Knowingness</th>
<th>Attitude</th>
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## Appendix 2

**Sustainability Consciousness Questionnaire**

**Part 1, grade 6**

For each statement below, mark the alternative which ties in best with your understanding. You can mark your response on a scale from **Strongly disagree** to **Strongly agree**. If you neither agree nor disagree then mark the **middle alternative**. If you don’t know how to respond to the question, then mark the alternative, **Don’t know**.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Economic development is necessary for sustainable development.</td>
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<tr>
<td>2. Improving people’s health and opportunities for a good life contribute to sustainable development.</td>
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<td>3. Reducing water consumption is necessary for sustainable development.</td>
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<tr>
<td>4. Preserving nature is not necessary for sustainable development.</td>
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<tr>
<td>5. A culture where conflicts are resolved peacefully through discussion is necessary for sustainable development.</td>
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<tr>
<td>6. Sustainable development demands that we humans reduce all sorts of waste.</td>
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<tr>
<td>7. People who exercise their democratic rights are necessary for sustainable development (for example, they vote in elections, involve themselves in social issues, express their opinions).</td>
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</tbody>
</table>
8 Reinforcing girls’ and women’s rights around the world is necessary for sustainable development.

9 Respecting human rights is necessary for sustainable development.

10 To achieve sustainable development, all the people in the world must have access to good education.

11 To achieve sustainable development, companies must treat their employees, customers and suppliers in a fair way.

12 Preserving many different natural species is necessary for sustainable development.

13 Having respect for other cultures is necessary for sustainable development.

14 Sustainable development demands a fair distribution of, for example, food and medical care among people in the world.

15 Wiping out poverty in the world is necessary for sustainable development.

16 Sustainable development demands that we switch to renewable resources (renewable resources include, for example, wind power, solar panels, ethanol, cardboard packaging.)
Sustainable development demands that people understand how the economy functions.

For sustainable development, big infectious diseases such as HIV/AIDS and malaria must be stopped.

For sustainable development, people need to be educated in how to protect themselves against natural disasters.

**Part 2, grade 6**

For every statement below, mark the alternative which corresponds best with your understanding. You can mark your response on a scale from **Strongly disagree** to **Strongly agree**. If you neither agree nor disagree then mark the **middle alternative**. If you don’t know how to respond to the question, then mark the alternative, **Don’t know**.

20 I think that everyone ought to be educated in how to live sustainably.

21 I think that we who are alive now should make sure that people in the future will be as well off as we are today.

22 I think that companies have a responsibility to reduce the use of packaging and disposable articles.

23 Using more of nature’s resources than we need does *not* threaten people’s health nor their chances for wellbeing in the future.
24 I think that we need stricter laws and regulations to protect the environment.

25 I think it is important to reduce poverty.

26 I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries.

27 I think that it is important to do something about problems which have to do with climate change.

28 I think that the government should provide financial aid to encourage more people to make the shift to green cars.

29 I think that the government should make all its decisions on the basis of sustainable development.

30 I think it is important that people in society vote in elections and express their views on important issues.

31 I think that people who pollute land, air or water should pay for the damage they cause to the environment.

32 I think that women and men throughout the world must be given the same opportunities for education and employment.
33 I think it is okay that each one of us uses as much water as we want.

Part 3, grade 6
For each statement below, mark the alternative which ties in best with your understanding.
You can mark your responses on a scale from **Strongly disagree** to **Strongly agree**. If you neither agree nor disagree then mark the middle alternative, **Don't know**.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
<th>Don’t know</th>
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<tbody>
<tr>
<td>34 Where possible, I choose to cycle or walk when I’m going somewhere, instead of travelling by motor vehicle.</td>
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<td>35 I never waste water.</td>
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<tr>
<td>36 I recycle as much as I can.</td>
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<tr>
<td>37 When I use a computer or mobile to chat, to text, to play games and so on, I always treat others as respectfully as I would in real life.</td>
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<td>38 I often do things which are <em>not</em> good for my health.</td>
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<tr>
<td>39 I do things which help poor people.</td>
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<td>40 I pick up rubbish when I see it out in the countryside or in public places.</td>
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<tr>
<td>41 I don’t think about whether things I do might harm the natural environment.</td>
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42 I often purchase second-hand goods over the internet or in a shop.

43 I always separate food waste before putting out the rubish when I have the chance.

44 I avoid buying goods from companies with a bad reputation for looking after their employees and the environment.

45 I do things to reduce waste (e.g., throwing away less food and not wasting paper).

46 I work on committees (e.g. the student council, my class committee, the cafeteria committee) at my school.

47 I treat everyone with the same respect, even if they have another cultural background than mine.

48 I support an aid organization or environmental group.

49 I watch news programs or read newspaper articles to do with the economy.

50 I show the same respect to men and women, boys and girls.
Part 1, grade 9 and 12
For each statement below, mark the alternative which ties in best with your understanding.
You can mark your response on a scale from Strongly disagree to Strongly agree. If you neither agree nor disagree then mark the middle alternative. If you don’t know how to respond to the question, then mark the alternative, Don’t know.

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<th></th>
<th>Strongly disagree</th>
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<td>1</td>
<td>Economic development is necessary for sustainable development.</td>
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<td>2</td>
<td>Improving people’s chances for a long and healthy life contributes to sustainable development.</td>
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<td>3</td>
<td>Reducing water consumption is necessary for sustainable development.</td>
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<td>4</td>
<td>Preserving nature is not necessary for sustainable development.</td>
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<tr>
<td>5</td>
<td>A culture where conflicts are resolved peacefully through discussion is necessary for sustainable development.</td>
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<tr>
<td>6</td>
<td>Sustainable development demands that we humans reduce all sorts of waste.</td>
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<tr>
<td>7</td>
<td>People who exercise their democratic rights are necessary for sustainable development (for example, they vote in elections, involve themselves in social issues, express their opinions).</td>
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</table>
8 Reinforcing girls’ and women’s rights and increasing equality around the world is necessary for sustainable development.

9 Respecting human rights is necessary for sustainable development.

10 To achieve sustainable development, all the people in the world must have access to good education.

11 Sustainable development requires that companies act responsibly towards their employees, customers and suppliers.

12 Preserving the variety of living creatures is necessary for sustainable development (preserving biological diversity).

13 Having respect for other cultures is necessary for sustainable development.

14 Sustainable development requires fair distribution of goods and services among people in the world.

15 Wiping out poverty in the world is necessary for sustainable development.

16 Sustainable development requires a shift to renewable natural resources.

17 Sustainable development demands that people understand how the economy functions.
18 For sustainable development, big infectious diseases such as HIV/AIDS and malaria must be stopped.

19 For sustainable development, people need to be educated in how to protect themselves against natural disasters.

**Part 2, grade 9 and 12**

For every statement below, mark the alternative which corresponds best with your understanding.

You can mark your response on a scale from **Strongly disagree** to **Strongly agree**. If you neither agree nor disagree then mark the **middle alternative**. If you don’t know how to respond to the question, then mark the alternative, **Don’t know**.

20 I think that everyone ought to be given the opportunity to acquire the knowledge, values and skills that are necessary to live sustainably.

21 I think that we who are living now should make sure that people in the future enjoy the same quality of life as we do today.

22 I think that companies have a responsibility to reduce the use of packaging and disposable articles.

23 Using more natural resources than we need does not threaten the health and well-being of people in the future.
24 I think that we need stricter laws and regulations to protect the environment.

25 I think it is important to reduce poverty.

26 I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries.

27 I think that it is important to take measures against problems which have to do with climate change.

28 I think that the government should provide financial aid to encourage more people to make the shift to green cars.

29 I think that the government should make all its decisions on the basis of sustainable development.

30 I think that it is important that people in society exercise their democratic rights and become involved in important issues.

31 I think that people who pollute land, air or water should pay for the damage they cause to the environment.

32 I think that women and men throughout the world must be given the same opportunities for education and employment.

33 I think it is okay that each one of us uses as much water as we want.
### Part 3, grade 9 and 12
For each statement below, mark the alternative which ties in best with your understanding.
You can mark your responses on a scale from **Strongly disagree** to **Strongly agree**. If you neither agree nor disagree then mark the **middle alternative**. If you don’t know how to respond to a question, then mark the alternative, **Don’t know**.

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<td>37</td>
<td>When I use a computer or mobile to chat, to text, to play games and so on, I always treat others as respectfully as I would in real life.</td>
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<td>38</td>
<td>I often make lifestyle choices which are not good for my health.</td>
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<td>I do things which help poor people.</td>
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<td>I don’t think about how my actions may damage the natural environment.</td>
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<td>I often purchase second-hand goods over the internet or in a shop.</td>
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<td>43</td>
<td>I always separate food waste before putting out the rubbish when I have the chance.</td>
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<tr>
<td>44</td>
<td>I avoid buying goods from companies with a bad reputation for looking after their employees and the environment.</td>
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<td>45</td>
<td>I have changed my personal lifestyle in order to reduce waste (e.g., throwing away less food or not wasting materials).</td>
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<td>46</td>
<td>I work on committees (e.g. the student council, my class committee, the cafeteria committee) at my school.</td>
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<td>47</td>
<td>I treat everyone with the same respect, even if they have another cultural background than mine.</td>
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<td>I support an aid organization or environmental group.</td>
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Student Sustainability Consciousness

Education for sustainable development (ESD) has been launched worldwide to empower young people by providing them with action competence for a sustainable future. ESD certifications are commonly used by schools as support in their ESD implementation efforts. To date, scholarly attention to and critical reflection on the effects of such certification on students’ perceptions of sustainability have been limited.

This doctoral thesis focuses on this gap in ESD research through five large-scale studies of which four were conducted in Sweden (N=2413) and one in Taiwan (N=1741). Questionnaire instruments measuring students’ sustainability consciousness (SC) and experiences of ESD were developed for the project. The findings reveal that the effect of ESD certifications on students’ SC is limited. The results also show positive effects of ESD on students’ SC in the form of the teaching approaches based on holism and pluralism, regardless whether schools were ESD certified or not. Moreover, results also reveal that in the certified schools the general adolescent dip and gender gap in students’ SC were reinforced. Given the findings, this thesis can give more generalizable empirical guidance for schools and certifying organizations to further reorient education towards ESD.

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